



Analysis of the social and cultural impacts of permafrost thaw in the coastal Russian Arctic: Case study of Tiksi and Bykovsky (Republic of Sakha, Russian Federation)

Brenda Natalia Doloisio

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Analysis of the social and cultural impacts of permafrost thaw in the coastal Russian Arctic: case study of Tiksi and Bykovsky (Republic of Sakha, Russian Federation)

Analyse des impacts sociaux et culturels de la fonte du pergélisol dans la cote de l'Arctique Russe : cas d'étude de Tiksi et Bykovsky (République de Sakha, Russie)

Thèse de doctorat de l'Université Paris-Saclay

École doctorale n° 629 : Sciences sociales et humanités (SSH)
Spécialité de doctorat : Architecture, Aménagement
Graduate School Sociologie et science politique
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Thèse préparée dans l'unité de recherche CEARC (Université Paris-Saclay, UVSQ) sous la direction de **Jean-Paul VANDERLINDEN**, Professeur à l'Université de Versailles Saint-Quentin-en-Yvelines et Directeur du Laboratoire de recherche CEARC.

Thèse soutenue à Paris-Saclay, le 10 mars 2022, par

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Titre : Analyse des impacts sociaux et culturels de la fonte du pergélisol dans la côte de l'Arctique Russe: cas d'étude de Tiksi et Bykovsky

Mots clés : changement climatique, fonte du pergélisol, communautés Arctique, culture, adaptation.

Résumé : L'Arctique est une région vaste et hétérogène connue par ses conditions climatiques et environnementales extrêmes. Des populations humaines ont habité ces territoires pendant des siècles. Récemment, les effets du changement climatique dans l'Arctique Russe ont gagné de la visibilité à cause du rôle que joue cette région dans la régulation du système climatique global, ainsi que dans divers processus géophysiques et biologiques. L'attention de la recherche scientifique est souvent focalisée sur la dimension matérielle du changement climatique et de la fonte du pergélisol, en négligeant l'importance de la dimension immatérielle de ces processus. Notre recherche doctorale propose une perspective élargie et analyse les impacts sur les acteurs, les éléments et les interactions qui constituent la base de la configuration sociale et des aspects culturels des communautés côtières de Tiksi et Bykovsky (District de Bulunsky, Fédération Russe). En adaptant l'approche constructiviste de la théorisation enracinée, il est ici proposé de plonger dans la perception des habitants de Yakutsk, Tiksi et Bykovsky (Yakoutie, Fédération Russe). Plus précisément, leurs récits de vie sont pour cette recherche, le point de départ qui permettra d'examiner leurs expériences, leurs interprétations et les implications des multiples modifications auxquelles leur système fait face comme résultat du changement climatique et de la fonte du pergélisol. Cela apportera de l'information utile concernant les spécificités terminologiques, ainsi que sur les liens de causalité entre chaque événement/processus, contribuant à la reconstruction des nouveaux schémas de risque – tels que vécus par les habitants locaux. Les récits de vie suggèrent que les changements biophysiques associés au changement climatique et à la fonte du pergélisol impactent également les dimensions culturelles et socio-économiques de ces villages côtiers.

Dans ce contexte, l'interconnexion entre les divers processus, éléments et acteurs s'est relevée évidente, de telle manière qu'essayer d'analyser les impacts de manière isolée pourrait entraîner une sous-représentation des aspects pertinents pour les locaux. Malgré leur proximité géographique, Tiksi et Bykovsky font face à des manifestations spécifiques du changement climatique et de la fonte du pergélisol, créant des enjeux différents pour leurs populations et leurs territoires. L'analyse qualitative démontre que ces processus ont déclenché la déstructuration du Monde du Nord tel que les habitants l'ont connu. Cela implique le changement du contexte relationnel et logique dans lequel les divers structures et éléments de ce système ont été conçus. Ces résultats sont particulièrement importants en raison des implications que les phénomènes observés ont sur la façon par laquelle les résidents locaux créent du sens, qu'ils interagissent entre eux ou avec le milieu dans lequel ils habitent. La recherche propose une vision holistique du changement climatique et de la fonte du pergélisol, proposant d'inclure à l'analyse tous ces aspects non-matériaux des existences locales qui sont fortement impactés, tels que le bien-être, les liens avec le territoire, la nourriture et les activités traditionnelles, la mobilité et leurs perspectives pour le futur. Enfin, le but de cette recherche est d'inclure, d'une façon la plus complète possible, le spectre des éléments significatifs pour les locaux, afin de pouvoir concevoir dans le futur des stratégies d'adaptation légitimes et respectueuses des personnes concernées ainsi que de leurs manières de vivre et de leurs visions du monde.

Title : Analysis of the social and cultural impacts of permafrost thaw in the coastal Russian Arctic: Case study of Tiksi and Bykovsky

Keywords : climate change, permafrost thaw, Arctic communities, culture, adaptation.

Abstract: The Arctic is a vast and heterogeneous region known for its extreme climatic and environmental conditions. Humans have inhabited these territories for centuries. Recently, the effects of climate change in the Russian Arctic have gained visibility worldwide because of the role it plays in the regulation of the global climate system, as well as in various geophysical and biological processes. Scientific research often focuses on the material dimension of climate change and permafrost thawing, neglecting the importance of the non-material dimension of these processes. This research proposes a broader perspective and analyzes the impacts on the stakeholders, elements and interactions that form the basis of the social configuration and cultural aspects of the coastal communities of Tiksi and Bykovsky (Bulunsky District, Russian Federation). By adapting the constructivist approach of grounded theory, it is here intended to delve into the perception of the inhabitants of Yakutsk, Tiksi and Bykovsky (Yakutia, Russian Federation). More specifically, their narratives are for this research, the starting point for examining their experiences, their interpretations and the implications of the multiple changes that their system is currently facing as a result of climate change and accelerated permafrost thaw. This provides fundamental information regarding terminological specificities, as well as information on the causal links between each event / process, actively contributing to the reconstruction of new risk patterns - as experienced by locals-. Life experiences suggest that the biophysical changes associated to climate change and thawing permafrost are also impacting the cultural and socio-economic

dimensions of life in these coastal settlements. In this context, the interconnectedness between the different processes, elements and stakeholders became evident. Therefore, trying to analyze the impacts isolatedly could lead to an under-representation of relevant aspects for local residents. Despite their geographic proximity, Tiksi and Bykovsky face specific manifestations of climate change and thawing permafrost, entailing different challenges for their populations and territories. The qualitative analysis shows that these processes triggered the de-structuration of the Northern World as the inhabitants knew it. This means that the relational and logical context in which the structures and elements of this system have been conceived has now changed. This is particularly relevant because of the implications that it may in the way locals create sense and meaning, how they interact with each other and with the environment in which they live. The research offers a holistic vision of climate change and permafrost thaw, proposing to include into the analysis all the non-material aspects of the northern residents' lives that are being strongly impacted, including their well-being, their ties with the territory, food and traditional activities, mobility and their future prospects. Finally, the aim of this research is to include a wide range of significant elements for local residents, in order to be able to formulate in the future legitimate adaptation strategies that respect the people concerned as well as their ways of living and their Worldviews.

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RESUME ETENDU EN FRANÇAIS

L'Arctique est une région vaste et hétérogène de la planète Terre. Elle est communément connue par ses conditions climatiques et environnementales extrêmes. Ces deux éléments ont influencé la manière dont ces territoires ont été occupés par des divers groupes humains ainsi que les moyens de subsistance particuliers qui y ont été développés. Il est communément accepté que les principaux premiers chasseurs de grands mammifères sont arrivés à la région il y a environ 4000 ans et ils se sont déplacés tout au long de la Sibérie et du Grand Nord Russe jusqu'à finalement traverser le détroit de Béring en arrivant sur la côte sud de la Beringie (Dixon, 2001). La technologie – comme la traction canine, l'équipement de chasse des baleines et l'élevage intensif de rennes – a joué un rôle fondamental dans l'adaptation humaine aux conditions environnementales de la région ainsi que dans la définition de la configuration sociale de ces groupes (Csonka & Schweitzer, 2004).

Actuellement, l'Arctique abrite à la fois des peuples autochtones et non autochtones. La proportion de chacun d'entre eux peut fortement varier d'une région à l'autre (Fondahl et al., 2015) en fonction de cinq caractéristiques principales : les spécificités culturelles, historiques et économiques, la manière dont être « l'autochtone » est définie et les niveaux de gouvernance dans chaque région. Certains groupes autochtones sont répartis spatialement dans plusieurs pays simultanément, comme par exemple, les Sami qui habitent dans certaines parties de la Norvège, de la Suède, de la Finlande et de la Russie. Comme résultat d'une série de processus historiques et de nombreuses interactions culturelles, les résidents de l'Arctique ont développé un fort sens de mobilité et de motilité. Ces populations sont désormais culturellement enracinées car l'appropriation et la circulation à travers le territoire est dans la plupart des cas, nécessaire pour aller travailler, étudier ou maintenir leurs activités traditionnelles. Certains habitants quittent leur lieu de naissance pour après revenir ; d'autres émigrent vers d'autres régions ou pays. Les modes et types de mobilité ont contribué à l'émergence d'une grande variété de moyens de subsistance, d'occupations et de formes d'interaction entre les populations et l'environnement dans l'Arctique russe (Dodds & Nuttall, 2019).

Récemment, le changement climatique et les impacts associés dans les régions polaires ont gagné une visibilité internationale, en particulier en raison du rôle qu'elles jouent dans la régulation du système climatique global, ainsi que dans d'autres processus géophysiques et biologiques importants. En effet, la rétroaction positive dans l'Arctique produit des réponses plus rapides et plus

sévères que dans d'autres régions du monde. La recherche scientifique (ACIA, 2004; IPCC 2007; Ford et Furgal, 2009) a démontré que le changement climatique a des effets multiples et simultanés sur la distribution de la végétation arctique, le paysage, les systèmes hydrologiques, les conditions du pergélisol, ainsi que sur la vie et les moyens de subsistance dans le Nord. Au cours des dernières décennies, la région a subi de profondes transformations environnementales, sociales et économiques (Larsen et al, 2014).

Les sciences naturelles ont une compréhension approfondie des implications biophysiques du changement climatique et de la fonte du pergélisol sur les divers éléments de l'écosystème Arctique et ses complexes interactions. Les changements majeurs sont étroitement associés à l'augmentation des températures due à l'augmentation des concentrations atmosphériques de gaz à effet de serre ou « GES » (Overland et al, 2018a). Les GES sont le principal contributeur au réchauffement de la région Arctique au cours du dernier tiers du siècle (AMAP, 2017). Les activités anthropiques sont principalement responsables de l'augmentation rapide des concentrations atmosphériques mondiales de dioxyde de carbone, de méthane et d'oxyde nitreux depuis 1750 (GIEC, 2007). Les températures Arctiques moyennes annuelles entre 2014 et 2019 ont dépassé tous les records précédents et depuis le milieu des années 1990, elles continuent à augmenter deux fois plus vite que la température moyenne mondiale (Overland et al., 2019).

L'augmentation des précipitations, comme dans la plupart des régions russes, impacte également les conditions du pergélisol : la neige empêche naturellement au pergélisol d'entrer en contact avec les températures de l'air plus basses en hiver (Douglas et al., 2020). En l'absence de neige, la pluie pénètre dans la couche supérieure du sol, augmentant la quantité totale de chaleur disponible. Comme résultat de ces deux processus, le pergélisol commence à se dégeler. La quantité totale d'eau contenue dans le sol déterminera les propriétés hydrologiques et thermiques, les échanges énergétiques et les processus biogéochimiques (Boike et al., 2019).

La température de l'air à la surface de l'Arctique a augmenté de plus du double de l'augmentation moyenne mondiale au cours des 50 dernières années (Notz et Stroeve, 2016; Richter-Menge et al., 2017). Ce phénomène connu sous le nom d'amplification Arctique réduit les gradients de température méridionaux et peut affecter la météo et le climat dans les latitudes moyennes (Overland et al, 2011 ; Cohen et al, 2014 ; Barnes & Screen, 2015 ; Luo et al, 2018). Pendant l'automne et l'été dans l'Arctique, la glace de mer saisonnière fond et ouvre une grande partie de l'océan

Arctique, permettant d'absorber grandes quantités de lumière du soleil pendant la saison chaude. L'énergie est donc libérée dans l'atmosphère sous forme de rayonnement à ondes longues et de flux de chaleur sensible pendant l'hiver. De cette façon, l'océan Arctique agit comme une source de chaleur pour l'atmosphère.

Ceci dit, il est également nécessaire d'approfondir les connaissances sur les implications sociales et culturelles du changement climatique et de la fonte du pergélisol. Dans ce contexte, cette thèse vise à contribuer à la compréhension des impacts sociaux et culturels spécifiques liés au changement climatique et à la fonte du pergélisol dans les villages côtiers de l'Arctique russe de Tiksi et Bykovsky (District de Bulunsky, Yakoutie). Plus précisément, le but de cette recherche est d'identifier et de mieux comprendre les dimensions tant matérielles qu'immatérielles qui sont actuellement menacées par les changements environnementaux auxquels ces villages font face. La Russie est le pays qui possède le plus grand territoire situé dans les hautes latitudes et au nord du cercle polaire Arctique (Heleniak, 2009). La zone Arctique de la Fédération de Russie est souvent appelée « Extrême Nord » (en russe : Крайний Север) ou « Grand Nord » (Дальний Север) et se situe au-delà du cercle polaire Arctique. La République de Sakha (ou Yakoutie) se situe dans une zone de pergélisol et se caractérise par un climat continental majoritairement rigoureux avec des hivers longs pouvant atteindre -60 °C, et des étés tempérés courts. Elle est la plus grande république de la Russie et plus du 40 % de son territoire se retrouve dans la région Arctique (Yakovleva et al., 2000). Elle est la patrie de cinq peuples numériquement peu nombreux du Nord, de la Sibérie et de l'Extrême-Orient de la Fédération de Russie (en russe « коренные малочисленные народы Севера, Сибири и Дальнего Востока »).

L'Arctique se caractérise par la présence d'eau à l'état solide qui constitue le volume nommé « cryosphère ». La cryosphère comprend la neige, le pergélisol terrestre et sous-marin, la glace de rivière et de lac, la glace de mer (sous toutes ses formes), les glaciers, les calottes glaciaires, les plateaux et les nappes (Solomon et al., 2007). Chaque composant est étroitement lié les uns aux autres et joue un rôle clé dans le maintien du fonctionnement du système. Le pergélisol est l'un des composants de la cryosphère et est défini comme le sol, les dépôts superficiels ou le substratum rocheux qui restent à 0 °C ou moins pendant au moins deux années consécutives (AMAP, 2017; French, 2018). Il s'étend tout au long de l'hémisphère Nord, et recouvre environ 15 millions de km² (Aalto et al., 2018). Son épaisseur peut considérablement varier ; il est possible de trouver certains endroits en Sibérie où il atteint jusqu'à 1200 m de profondeur (Tedrow, 2005). Une autre forme de

pergélisol est celui qui se situe sous les fonds marins des plateaux continentaux des régions polaires. Au-dessus du pergélisol, il y a la couche active, qui est traditionnellement identifiée comme la partie du sol qui subit le gel et le dégel saisonniers (Ping, 2005)

La Russie est le pays avec la plus grande étendue de pergélisol, en particulier dans sa région Arctique (French, 2018). L'ensemble du territoire de la Yakoutie contient du pergélisol. L'un des impacts actuels les plus visibles du réchauffement des températures dans l'Arctique est le dégel accéléré du pergélisol. Conformément à la tendance au réchauffement climatique, la température de la couche active a également augmenté depuis les années 1980 d'environ 3°C dans la région Arctique et, par conséquent, est devenue plus profonde dans la plupart des zones où le pergélisol est surveillé (AMAP, 2017). Le sol gelé saisonnier a diminué d'environ 7% dans l'hémisphère nord depuis 1900 (GIEC, 2007). Cependant, il est important de prendre en considération d'autres facteurs locaux qui peuvent également modifier les conditions du pergélisol, tels que la couverture neigeuse (Park et al., 2013), les variations de la végétation (Fedorov et al., 2019), la couche organique, l'humidité du sol, contenu de glace, les conditions de drainage et les activités humaines.

Les conditions susmentionnées impactent les conditions générales du pergélisol. Ceci a des impacts profonds sur plusieurs sphères dont l'écologie, les émissions de gaz à effet de serre, les infrastructures humaines, etc. Il existe une grande variété de manifestations, selon les conditions locales et l'emplacement. Il y a plusieurs modifications du paysage liées au dégel résultant du dégel du pergélisol, de l'affaissement et de l'enlèvement des matériaux du sol. Cependant, la plupart d'entre eux sont le résultat de l'interaction de plusieurs événements/processus en même temps (Jones et al., 2013). Par exemple : l'approfondissement de la couche active, l'accumulation d'eau à la surface du sol, la dégradation du pergélisol, les changements sur les rives des lacs et les falaises côtières, entre autres (Shur et Osterkamp, 2007). Cette thèse présente et développe une liste non exhaustive de six caractéristiques géomorphologiques qui caractérisent les terrains de pergélisol des hautes latitudes dans des conditions de dégel du pergélisol : 1) l'érosion côtière ; 2) les polygones en coin de glace, 3) le terrain thermokarstique, 4) les taliks ; 5) les pingos et 6) les sinkholes.

La capacité du terrain à supporter des bâtiments est connue sous le nom de « capacité portante ». Celle-ci est directement liée à la présence de pergélisol et diminue avec les températures plus chaudes (Anisimov & Reneva, 2006). Lorsque le pergélisol dégèle, la capacité portante du sol

diminue tandis que les forces de soulèvement sur les fondations augmentent (Andersland et Ladanyi, 2004). Cela cause de graves dommages aux bâtiments, aux installations industrielles, aux pipelines et à d'autres formes d'infrastructure dans le Nord.

Comprendre la configuration démographique et socio-économique actuelle ainsi que les potentielles implications du changement climatique dans l'Arctique méritent un examen plus approfondi des principaux processus historiques qui se sont déroulés dans la région. Plus particulièrement, ceux associés aux principales explorations, à la mobilité des populations, à l'établissement de nouveaux villages et aux interactions entre peuples autochtones et non-autochtones. L'évaluation de la composition et des changements démographiques est également essentielle pour comprendre le développement des infrastructures, la planification des économies régionales et, plus globalement, la logique des politiques appliquées dans l'Arctique.

Les humains ont occupé la région Arctique depuis au moins la dernière période glaciaire. Des vestiges archéologiques ont été trouvés dans le nord de la Finlande, de la Norvège, de la Suède, de la Russie et de l'Alaska datant de plus de 12.000 ans (Anderson, 1988; Dixon, 2001; Thommessen, 1996). Il est communément admis que les premiers chasseurs de mammifères sont arrivés il y a environ 4000 ans après le retrait de la calotte glaciaire en Europe. Ils se sont déplacés tout au long de la Sibérie et de l'Extrême-Nord Russe jusqu'à ce qu'ils aient finalement traversé le détroit de Béring et se soient déplacés le long de la côte sud de la Béringie (Dixon, 2001). L'arrivée des nombreuses vagues d'explorateurs - en particulier venant de l'Europe - depuis le début du XVI^e siècle ont conduit à une profonde transformation culturelle et organisationnelle parmi les communautés autochtones. Ces expéditions cherchaient souvent une route commerciale pour relier le Vieux Continent à l'Asie de l'Est (ex : La Grande expédition du Nord de 1733-1743). Elles étaient aussi perçues comme un moyen permettant aux marins d'annexer de nouveaux territoires à la juridiction de leurs pays d'origine (AHDR, 2004). Mais il y avait aussi des expéditions plus petites avec des intérêts commerciaux focalisées sur la chasse et la pêche à la baleine.

Les modes de vie autochtones comprennent des façons particulières d'interpréter et d'interagir avec l'environnement naturel (Freeman, 2000). Cela inclut les liens avec les territoires, qui sont souvent déterminant pour leurs identités (Fondahl et al., 2015). Dans la plupart des cas, les communautés autochtones du Nord dépendent d'activités comme la pêche, la chasse, l'élevage, et la cueillette. Cependant, il existe des différences historiques, culturelles et dialectiques entre les

groupes et il est donc important d'éviter de les traiter comme une unité homogène, notamment lorsqu'il s'agit d'aborder le changement climatique et ses impacts.

La population non autochtone est souvent plus nombreuse que l'autochtone. La proportion de chaque une a un impact significatif sur les dynamiques socio-économiques de chaque région (Bogoyavlenskiy et al., 2017). Les habitants non autochtones sont soit des colons récemment installés dans des villes/villages du Nord, soit des personnes nées dans le Nord après que leurs familles se soient installées pour travailler dans différents secteurs.

Depuis le XX^e siècle, les peuples autochtones ont été confrontés à des nouveaux facteurs de stress qui ont produit des fortes modifications dans leurs modes de vie et visions du monde : l'introduction de nouvelles formes de technologies, la dégradation des langues et cultures autochtones, la modification des paysages traditionnels, un développement industriel rapide et la perte de la biodiversité. Ils ont été également affectés par d'autres défis socioculturels tels que les taux élevés de suicide, l'alcoolisme et la toxicomanie, les grossesses parmi les adolescentes, la violence, le VIH/sida, entre autres. La composition démographique actuelle est le résultat de deux processus majeurs : l'émigration massive des peuples traditionnels et l'arrivée de nouveaux arrivants, surtout après la Seconde Guerre mondiale.

Cette thèse a été financée et menée au sein du projet européen « Nunataryuk ». Des chercheurs scientifiques de diverses disciplines ont été réunis afin d'évaluer les impacts de la fonte du pergélisol côtier et sous-marin dans les zones côtières de l'Arctique. Le projet se concentre sur dix sites répartis en trois zones géographiques différentes : la mer de Beaufort, la Sibérie orientale et les régions nordiques situées le long de la côte de pergélisol Arctique. Au sein de ce projet, le laboratoire de recherche CEARC (UVSQ), qui a accueilli les travaux réalisés pour cette thèse, fait partie du WP7. Il vise à créer un nouvel ensemble de données concernant la situation socio-économique de la zone côtière de l'Arctique et à développer un cadre pour la gestion des ressources naturelles qui sont actuellement affectées par la fonte accélérée du pergélisol. L'équipe française du Laboratoire CEARC se focalise sur les villages côtiers de Tiksi et Bykovsky (République de Sakha, Fédération de Russie).

Tiksi et Bykovsky ont été choisis en raison de ses caractéristiques intrinsèques. En fait, malgré leur proximité géographique et d'être isolés dans l'Arctique russe, leurs physiographies présentent des différences essentielles. La péninsule de Bykovsky est recouverte de dépôts riches en glace qui

sont soumis à la thermoabrasion sur la côte de la mer de Laptev, ainsi qu'à des processus de thermoérosion et de thermokarst (Meyer et al, 2002). En tant que la côte de Tiksi est naturellement protégée par cette péninsule. Il y a la chaîne cotière de montagnes de la crête de Kharaulakh à l'ouest et les vestiges d'une ancienne plaine d'accumulation, y compris la péninsule de Bykovsky, à l'est (Grosse et al, 2003).

Ils présentent également des différences en termes de composition ethno-démographique et des profils économiques qui pourraient influencer la perception des habitants locaux sur le changement climatique et la fonte du pergélisol. Les processus historiques et de sédentarisation de chacun de ces villages ont conditionné leurs organisations et leurs rôles à l'échelle locale (District de Boulunsky) et régionale (République de Sakha). Il s'agit des exemples typiques de villages de l'Arctique russe (Tiksi étant urbain et Bykovsky rural) qui ont gagné de l'importance pendant l'époque soviétique et par conséquent, ont également subi de profondes transformations socio-économiques et migratoires après son éclatement.

Obtenir une compréhension plus approfondie de l'impact du changement climatique et de la fonte du pergélisol sur la vie et les moyens de subsistance locaux dans ces deux villages, sert comme exemple des dynamiques locales au sein de l'Arctique russe : différentes sous-unités territoriales et socio-économiques peuvent coexister avec leurs propres systèmes de fonctionnement, préoccupations, priorités et stratégies d'adaptation. Il s'agit donc d'un point fondamental pour mener des études comparatives avec d'autres villages de la Yakoutie ou d'autres régions qui pourraient contribuer à obtenir une compréhension globale de la situation actuelle dans le Nord russe.

Cette recherche a été intégralement menée entre novembre 2017 et septembre 2021. Elle adopte une stratégie méthodologique qualitative. Elle se base sur une approche inductive et réflexive, car il était visé de développer un design de recherche flexible qui permette d'explorer des questions liées au « sens », mais aussi d'obtenir des informations supplémentaires sur les représentations sociales, les expériences, la perception et les attributions. Les représentations sociales sont ici conçues comme Moscovici (1984) : « elles doivent être vues comme une manière spécifique de comprendre et de communiquer ce que nous savons déjà ». Ce sont des phénomènes qui sont associés à la manière particulière de comprendre et de communiquer d'un groupe social en particulier qui créent à la fois une réalité et un sens partagé. Selon Urbina & Martínez (2006), la

perception est le premier processus cognitif de l'être humain : c'est la vision spécifique et personnelle du monde de chaque personne, mêlée avec la fantaisie que chaque sujet possède et le caractère égocentrique de l'expérience et la vision individuelle, ainsi qu'avec l'influence de la structure sociale, le contexte culturel et la langue de base pour la formation de certaines règles collectives.

Parmi les méthodes qualitatives, la théorie ancrée apparaît comme la meilleure option à intégrer car il s'agit d'une méthode systémique qui fournit des stratégies différentes et flexibles pour mener de la recherche qualitative (Chamaz et Bryant, 2016). Cette méthodologie permet de générer des concepts abstraits tout en identifiant les relations concrètes existant entre eux. Les créateurs de cette théorie visaient initialement à collecter et analyser des données qualitatives restant fidèles à la compréhension, aux interprétations, aux intentions et aux perspectives des personnes étudiées, telles qu'elles s'expriment dans leurs actions et leurs paroles (Clarke, 2007). Cela est essentiel pour fournir une compréhension plus globale des complexités associées à la fonte du pergélisol et aux impacts du changement climatique dans les communautés de Tiksi et Bykovsky.

Kathy Charmaz, une ancienne étudiante de Glaser et Strauss, a proposé une reformulation plus constructiviste de la théorie ancrée. Elle soutenait que les œuvres originales de Glaser et Strauss étaient intrinsèquement positivistes. Charmaz (2000, p. 531) a souligné qu'ils « supposent une réalité externe que les chercheurs peuvent découvrir et enregistrer : Glaser en découvrant des données, en les codant et en adoptant des méthodes comparatives étape par étape ; Strauss et Corbin à travers leurs questions analytiques, hypothèses et applications méthodologiques. Dans sa théorie enracinée constructiviste (CGT en anglais), elle a adopté les stratégies de la théorie enracinée comme un ensemble de pratiques et des principes directeurs au lieu de procédures stéréotypées à suivre (Charmaz, 2006). Les travaux initiaux de Glaser et Strauss affirmaient que de nouvelles théories émergent à partir de données distinctes de l'agent scientifique. Contrairement à cette idée, elle considère que les chercheurs font aussi partie des mondes qu'ils étudient et des données qu'ils collectent. Cela se produit dans le cadre de processus historiques, de structures sociales et d'interactions. La principale différence est que la CGT prend en compte les antécédents personnels et les expériences des chercheurs ainsi que celles des participants. Cette approche a été adoptée pour cette recherche car elle favorise également l'identification de la manière dont les actions et les significations sont interdépendantes avec des discours et des structures sociales plus larges (Charmaz et Bryant, 2016). De plus, les interprétations théoriques, selon elle, peuvent en

fournir une représentation interprétative, mais pas une image objective ni exacte (Charmaz, 1995, 2000). Une étape précédente a été ajoutée à mon projet de recherche avant de mettre en œuvre la stratégie constructiviste de Charmaz : la revue de bibliographique élaborée au cours du premier semestre de cette thèse. Celle-ci a façonné les questions de recherche initiales et a contribué à identifier des concepts clés liés à cette région particulière de la Russie et à ce sujet en particulier, ainsi qu'à reconnaître des informations importantes qui avaient été initialement ignorées. Cela a également amélioré les lacunes en matière d'informations pertinentes qui pourraient être potentiellement comblées au cours du processus de recherche. Contrairement aux approches positivistes, il n'était pas destiné à imposer une idée ou une théorie initiale dans les données, mais à laisser les données émergentes affiner les questions de recherche.

Avant de voyager à Yakoutsk (capitale de la République de Sakha) en juin 2018 et de passer à la récolte de données, une carte mentale avec les principaux acteurs a été élaborée afin d'identifier les potentiels secteurs de la société qui pourraient se voir affectés par la fonte du pergélisol et le changement climatique en Yakoutie. Cela a contribué à identifier les acteurs qui devaient – idéalement – être rencontrés lors de ce premier travail de terrain. Grâce à l'échantillonnage boule de neige, il a été possible de rencontrer de nouveaux participants. Aux fins particulières de cette recherche, les entretiens semi-directifs ont apparu comme l'outil le plus approprié pour interroger sur les perceptions et les expériences des communautés côtières de l'Arctique russe concernant les changements climatiques et le pergélisol. De plus, il s'agit d'une méthode ouverte, qui s'intègre parfaitement à l'approche constructiviste de la théorie ancrée utilisée pour cette recherche. Deux voyages de terrain ont été effectués : un en juin 2018 à Yakoutsk, et un deuxième en juillet 2019 à Tiksi et Bykovsky.

Pendant l'étape suivante - le codage – les divers processus (physiques et culturels) qui sont déchaînés par la fonte du pergélisol et le changement climatique ont été identifiés, ainsi que les significations que les habitants leur sont attribués et quelles actions sont jugées comme légitimes. La première étape du codage consistait à créer des codes permettant d'organiser thématiquement l'information récoltée. Cela m'a permis d'avancer vers une interprétation analytique de l'information recueillie. La première étape comprenait un codage ligne par ligne. L'unité herméneutique de Yakoutsk contenait 46 codes au total. Celles-ci ont ensuite été réorganisées sous la forme de 6 « familles de codes » thématiques plus larges et intégratives. Les différentes relations existant entre les codes et les familles thématiques ont été visuellement représentées sous la forme d'une carte mentale.

L'information recueillie à Tiksi et Bykovsky a été analysée comme une seule unité herméneutique car nous n'avons utilisé qu'un seul cadre d'entretien pour les habitants de ces deux villages. Cette unité herméneutique contenait 110 codes au total mais les familles de codes n'ont pas été créées.

La deuxième étape comprenait la mise en relation et la comparaison des données des deux unités herméneutiques et l'introduction, en conséquence, de nouveaux codes ciblés. La comparaison des récits des participants au sein d'un même travail de terrain et puis entre les deux terrains, a permis de saisir des subtilités et de contraster les différentes expériences liées au pergélisol et au climat. Les notions, idées et processus les plus fréquemment mentionnés contenus dans les codes ont émergés. Simultanément, j'ai commencé à sélectionner manuellement les codes les plus importants après avoir traité et comparé ceux déjà émergés en Yakoutsk et ceux de Tiksi et Bykovsky. De nouvelles catégories ont été créées et ont été regroupées en essayant de les relier à mes questions de recherche initiales.

Pour terminer, en échantillonnant mes catégories théoriques, il a été possible de saisir et d'englober une grande diversité d'expériences et d'associations locales liées à la fonte du pergélisol en Yakoutie. Cela a contribué à construire de nouvelles hypothèses provisoires qui ont été étudiées et renforcées par des recherches supplémentaires jusqu'à l'obtention d'une théorie plus solide qui conviendrait à mes récits. L'échantillonnage théorique a facilité l'identification de variations qui ne correspondaient pas à l'autre gamme d'expériences. Bien qu'obtenir un diagnostic précis des causes de ces différences émergentes nécessiterait de poser plus de questions à ces mêmes personnes interrogées, après avoir analysé et comparé à nouveau les données, j'ai pu obtenir une meilleure compréhension des implications subtiles et, par conséquent, j'ai constitué une théorie analytique plus solide.

Lors du premier terrain, il a été exploré comment, en racontant leurs expériences, les habitants de la République de Sakha décrivent avec précision leur compréhension de la fonte du pergélisol et du changement climatique. Pendant ce processus, il a été possible d'identifier les principales différences en termes de perception entre les divers acteurs régionaux. Cela a permis aussi de reconstituer les mécanismes spécifiques par lesquels ces processus physiques affectent leur environnement naturel, leur relation avec celui-ci et les dimensions non matérielles de leur vie et de leurs moyens de subsistance. Des éléments clés ont été découverts, tels qu'un niveau élevé de

sensibilisation parmi la population concernant la fonte du pergélisol et ses impacts : c'est un problème saillant en Yakoutie. Il existe aussi une compréhension explicite des réseaux complexes de causalité entraînés par la fonte du pergélisol. Le besoin de stratégies d'atténuation exprimé lors des entretiens, semble refléter un déficit de l'agentivité et une dépendance des habitants par rapport aux autorités externes.

L'analyse des récits a également démontré que la vie et les préoccupations quotidiennes, à la fois pratiques et symboliques, allant du niveau personnel au niveau local, régional et national, sont interconnectées et, selon les répondants, devraient rester de cette manière. Les dimensions matérielles et culturelles de la fonte du pergélisol sont les deux faces d'une même pièce et sont fortement interdépendantes. L'analyse des récits a démontré que pour les habitants, les processus géophysiques activés par les changements du climat et du pergélisol transforment le paysage et modifient les modèles écologiques. Mais ces transformations dépassent les dimensions purement physiques et matérielles, et exercent une pression supplémentaire sur les cultures du Nord. Les aspects matériels et non-matériels sont constamment superposés. Par exemple, la dégradation physique (se manifestant sous différentes formes : comme la fonte des cimetières, l'augmentation des défenses de mammoth apparaissant dans le pergélisol ou les déplacements forcés, entre autres) menace les représentations symboliques, les pratiques matérielles et les liens affectifs qu'ils ont développés au sein de ces territoires. Pour les habitants du Nord, leurs territoires sont remplis de souvenirs, d'expériences de vie et ont contribué à développer une manière particulière d'interpréter et de valoriser les événements. La restructuration forcée de leurs caractéristiques culturelles déclenchée par le changement climatique et la fonte du pergélisol pourrait, selon eux, conduire à une fragmentation socioculturelle irréversible.

Les résultats du premier travail de terrain démontrent que la science est perçue par les habitants comme une source centrale de solutions pour la fonte du pergélisol et les impacts associés. Les solutions fondées sur la science semblent légitimes aux répondants. Maintenir cette association étroite entre les dimensions matérielles et culturelles en conduisant de la recherche peut contribuer à augmenter la légitimité de la même. Traduire ces résultats en stratégies publiques concrètes se relève comme une nécessité face aux changements rapides.

Les résultats cartographient avec succès la fonte du pergélisol et ses impacts à l'échelle régionale, en utilisant les récits de personnes de différents endroits de la Yakoutie

comme point d'entrée. L'extension de cette analyse en dehors de la capitale, pourrait contribuer à l'obtention d'une analyse plus détaillée des implications de la fonte du pergélisol et du changement climatique dans d'autres villages de l'Arctique Russe. En ce sens, le travail de terrain mené en 2019 à Tiksi et Bykovsky pour cette thèse, représente un exemple concret de ce type d'analyse au niveau du District de Bulunsky.

Les entretiens menés à Tiksi et Bykovsky ont apporté des informations très précises sur les manifestations et interprétations locales du changement climatique et de la fonte du pergélisol. Cela était particulièrement pertinent pour analyser l'influence d'être villages côtiers et d'être situés dans l'Arctique russe sur la perception des habitants. Il a été également exposé que malgré leur proximité géographique, l'étendue et les implications de ces phénomènes étaient vécues et racontées différemment entre les populations de ces villages.

Les modifications liées au changement climatique et à la fonte du pergélisol ont déclenché la « déstructuration » du monde nordique tel que les habitants le connaissaient. Cela n'implique pas que le Monde précédent a entièrement disparu. Il est ici suggéré que plusieurs structures ou éléments constitutifs de l'ancienne configuration ont survécu, mais que le contexte logique et relationnel dans lequel elles ont été conçues est en train de changer (Wachtel, 1976). Cela peut aussi modifier le sens que les locaux attribuent à chaque élément de leur Monde. Il y a donc une reconfiguration des mécanismes d'interaction entre les habitants locaux, le climat, leur milieu naturel et chacune de ses composantes, tant en termes économique-productifs que socioculturels. Malgré les efforts déployés pour délimiter conceptuellement le type de sphère ou de domaine, l'analyse des récits démontre que dans la pratique, une telle déstructuration se produit dans différentes sphères simultanément et, par conséquent, les résultats doivent être étudiés en respectant cette interconnexion. La grande variété d'exemples recueillis à travers des récits démontre que les habitants sont confrontés au défi de redéfinir ses manières d'interagir avec chaque composante de leur environnement. Mais ils sont aussi obligés de créer de nouveaux outils et de mécanismes qui leur permettent d'absorber et de lutter contre les impacts négatifs du changement climatique et de la fonte du pergélisol dans leurs vies et leurs moyens de subsistance.

Les dimensions socio-économiques, culturelles et naturelles sont constamment superposées lorsque on aborde les impacts de la fonte du pergélisol et du changement climatique. Ils interagissent les uns avec les autres dans une boucle de rétroaction synergique. Ce n'est qu'en

comprenant les interactions spécifiques qu'il est possible de reconstituer la réalité des habitants du Nord telle qu'ils la conçoivent. De même, pour déterminer l'étendue et les implications de la « déstructuration » du Monde nordique, il est nécessaire d'identifier les multiples interactions entre chacun des éléments du système dans lequel ils habitent. Ces récits démontrent que la variété des éléments que ces communautés adoptent et intègrent dans leurs systèmes comme « précieux » n'est ni homogène ni prévisible. Une compréhension exhaustive de ce qui est vital pour les résidents et pourquoi, fournira une base plus solide pour formuler des stratégies d'adaptation légitimes, efficaces et spécifiques aux sites. Le chevauchement constant entre les dimensions émergentes des récits des habitants apparaît également lorsque l'on essaie de comprendre les impacts. Il est donc proposé que les impacts associés au changement climatique et à la fonte du pergélisol sont difficiles à insérer dans des limites bien précis, à définir en termes quantitatifs ou avec des critères externes. Les communautés de Tiksi et Bykovsky sont actuellement confrontées aux premières étapes d'une nouvelle période de restructuration sociale, culturelle et écologique. Dans ce contexte, l'évaluation de l'habitabilité dans les villages nordiques nécessite désormais d'inclure également ces facteurs de stress non biophysiques qui ont également un impact sur la vie et les moyens de subsistance des résidents du Nord. Les récits révèlent que l'analyse de la complexité de la situation actuelle dans ces villages nécessite de placer chaque impact dans un réseau plus large d'interrelations.

Lorsqu'ils évaluent l'habitabilité dans ces villages, les habitants l'ont associée discursivement à deux principaux types de mouvements migratoires: soit y rester, soit partir. Cependant, cette décision est une tâche complexe et non linéaire qui nécessite d'évaluer plusieurs aspects simultanément. Plus précisément, il est nécessaire d'approfondir les aspects qui contrebalancent les conditions de vie difficiles et qui influencent activement la réticence de certains habitants à quitter ces villages. Ceux-ci sont particulièrement pertinents car ils peuvent être considérés comme nécessaires pour que les habitants mènent une vie avec des moyens de subsistance significatifs à Tiksi et Bykovsky.

Déménager à d'autres régions peut être perçu à la fois comme un mécanisme qui renforce la liberté de mouvement des habitants du Nord, mais aussi comme une mesure adaptative pour quitter ceux endroits qui ne réunissent plus les conditions nécessaires pour développer leurs vies selon leurs visions du monde et besoins. Dans certains cas, l'émigration est considérée par les habitants comme une option pour poursuivre leurs rêves et leurs projets de vie là où les conditions sont favorables. La nostalgie soviétique apparaît dans les récits de Tiksi et Bykovsky comme un concept à double signification: d'un côté, comme point de référence avec lequel ils comparent leurs conditions de vie actuelles. D'un autre côté, comme un sentiment d'ancrage local vécu par les membres de la communauté qui habitaient dans le Nord pendant l'époque soviétique et qui y vivent encore. La nostalgie apparaît souvent traduite comme un fort désir de « reconstruire » le village pour le rendre aussi prospère qu'il l'était à l'époque soviétique et pour retrouver le niveau de vie qu'il y avait.

Une autre sphère pertinente de la vie dans le Nord qui nécessite particulière attention à la lumière des changements sont les activités traditionnelles (notamment la chasse, la pêche et l'élevage de rennes). Elles jouent un rôle clé dans les décisions des habitants, car elles sont un élément essentiel qui nourrit - à la fois matériellement et symboliquement - le réseau de partage et de soutien régional et local qui est culturellement enraciné en Yakoutie. Ils contribuent à lutter contre les effets négatifs des prix élevés et des bas salaires dans les villages nordiques. Ces réseaux permettent aux populations rurales et urbaines d'accéder à la nourriture traditionnelle. Ainsi, certains habitants du Nord les perçoivent comme des éléments qui augmentent le sentiment d'habitabilité dans leurs villages. Autrement dit, les réseaux de partage et de soutien renforcent l'esprit de solidarité entre villageois mais aussi entre ruraux et urbains.

Essayer de réfléchir à des stratégies d'adaptation face à ces changements multidimensionnels implique accepter que l'adaptation n'est pas un concept inexploré ni récemment introduit chez les résidents du Nord. Actuellement, les formes locales d'adaptation sont associées à la mobilité ; au réseau de partage et de soutien ; aux ressources naturelles et activités traditionnelles ; et aux fonds et investissements gouvernementaux.

Pour conclure, les informations recueillies lors des deux travaux de terrain ont permis d'identifier des éléments clés qui sont associés à des formes d'adaptation quotidiennes, locales et parfois implicites entre les habitants du Nord. Les réseaux de soutien et les activités traditionnelles se sont

avérés être indirectement et fortement impactés par le changement climatique et la fonte du pergélisol. Les habitants perçoivent les activités traditionnelles et les réseaux de soutien comme des éléments qui contribuent également à continuer de s'adapter aux conditions de vie nordiques fluctuantes - et donc à augmenter l'habitabilité générale de leurs lieux-. À l'inverse, la dégradation de ces éléments pourrait représenter une diminution de la capacité d'adaptation des habitants du Nord et affecter la sphère culturelle. Par exemple, avoir la certitude de pouvoir se procurer du poisson et de la viande à un prix accessible (ou gratuitement) est essentiel pour le budget des habitants du Nord. Finalement, ne plus avoir les conditions biophysiques requises pour garantir le fonctionnement normal de ce système, pourrait augmenter la pression sur la stabilité financière déjà fragile des ménages nordiques.

INTRODUCTION

The Arctic is a vast and heterogeneous region, well known for its harsh climate and specific environmental conditions. These have had an enormous influence on the way these territories have been occupied by human groups and the particular livelihoods that have developed there. It is commonly accepted that the first large-mammal hunters arrived in the area around 4000 years ago and moved along Siberia and the Russian Far North until they finally crossed the Bering land strait and arrived at the southern coast of Beringia (Dixon, 2001). Technology – such as dog traction, whale-hunting equipment, and intensive reindeer herding – played a key role in human adaptation to the environmental conditions of the area and defined the social configuration of these groups (Csonka & Schweitzer, 2004).

Nowadays, the Arctic is home to both Indigenous and non-Indigenous peoples. The proportion of each can strongly vary a lot depending on the region (Fondahl et al., 2015). Regions are distinguished according to five main characteristics: the specific cultural, historical and economic backgrounds, the way in which “indigeneness” is defined, and the levels of self-governance. Indigenous groups can be spatially distributed over several countries, such as the Sami who live in some parts of Norway, Sweden, Finland and Russia. As a result of a series of historical processes and cultural interactions, Arctic residents have developed a strong sense of mobility and motility. These have now become rooted in the culture and circulating throughout the territory is necessary to go to work, study or practice traditional activities. Some people decided to leave their places of birth for a period of time and then come back; others emigrated to other regions or countries. This was particularly important for the emergence of a wide variety of livelihoods, occupations and ways of interacting with their environment in the Russian Arctic (Dodds & Nuttall, 2019).

Recently, climate change and its impacts on Polar regions have gained visibility worldwide, given the crucial role of these regions in the regulation of the global climate system and geophysical and biological processes. More rapid and severe responses to climate change are seen in the Arctic than in any other region on Earth. Scientific research (ACIA, 2004; IPCC 2007; Ford & Furgal, 2009) has demonstrated that climate change affects Arctic vegetation distribution, the landscape, the hydrological patterns, permafrost conditions, as well as northern lives and livelihoods. Thus, over

recent decades, the region has undergone deep environmental, social and economic transformations (Larsen et al, 2014). In this context, this dissertation aims to contribute to the general understanding of the specific social and cultural impacts of climate change and permafrost thaw on the coastal Russian Arctic settlements of Tiksi and Bykovsky (Bulunsky District) and, more precisely, to understand both the material and non-material dimensions endangered by the complex series of environmental changes that these settlements are currently experiencing.

There is a deep understanding of the bio-physical processes associated with climate change. High concentrations of atmospheric greenhouse gases (GHG) produce an increase of overall temperatures (AMAP, 2017; Overland et al, 2018a) and therefore play a key role in climate change. Carbon dioxide, methane and nitrous oxide concentrations have been increasing since 1750 due to anthropogenic activities (IPCC, 2007). Similarly, annual mean temperatures have been increasing since mid-1990s. The Russian Arctic has also been experiencing an unprecedented increase in the mean air temperature. According to Kattcov & Semenov (2014), this average rate was $+0.43^{\circ}\text{C}$ per decade over the last 40 years. Warmer temperatures in spring and fall have produced earlier snowmelt, longer and warmer snow-free periods and deeper seasonal thawing of permafrost (Anisimov, 2017). At a regional scale, the main concern about climate change in the Arctic is that the temperature here is increasing at twice the global mean temperature increase, at least (Overland et al., 2019). The Arctic seasonal sea-ice melts between autumn and summer, leading to the opening of a large portion of the Arctic Ocean. When this occurs, the ocean absorbs large amounts of sunlight and energy is subsequently released into the atmosphere as longwave radiation, and as sensible heat fluxes during the winter. Consequently, the Arctic Ocean acts as a heat source of the atmosphere and, over the past 50 years, the Arctic surface air temperature has increased to more than double the global average (Notz & Stroeve, 2016; Richter-Menge et al., 2017). However, the effects of this process known as "Arctic amplification" can also be felt in mid-latitude weather and climate (Overland et al, 2011; Cohen et al, 2014; Barnes & Screen, 2015; Luo et al, 2018).

Arctic sea ice also plays an important role in the region as it creates thermal insulation between the ocean and atmosphere, influences thermohaline circulation and provides habitat to a wide variety of Arctic species. Recent measurements have demonstrated that most of the sea ice is now "first year ice", meaning it is thinner and more vulnerable to changes in the atmosphere and ocean (Perovich et al., 2015). Older and thicker forms of ice have been shrinking since 1980s (Meier et al., 2014; Perovich et al., 2015). Between 1979 and 2018, there was a sharp reduction in sea ice of at

least 5 years old: it went from 30% to 2% only (Stroeve & Notz, 2018). As a consequence of increasing proportions of first-year ice, the summer ice-albedo feedback is accentuated due to earlier open water areas (Stroeve et al., 2012). Two other major changes are observed in the Arctic sea ice: a reduction in the total amount of days with sea ice cover (AMAP, 2017) and a sharp decline in the overall sea ice extent (Barber et al., 2017; Comiso et al., 2017; Stroeve & Notz, 2018, Overland et al., 2018). As a result of warmer temperatures, the sea ice extent is decreasing while the increase in temperature due to stronger heat transfers from the ocean to the atmosphere is accentuated. The irregular fluctuation of the atmospheric pressure in the North Atlantic Ocean, known as "North Atlantic Oscillation" is therefore altered (Screen & Simmonds, 2010). The combination of these two processes impact strongly the Greenland Ice Sheet mass balance (Meredith et al., 2019).

Polar oceans are also undergoing deep changes: their temperatures continue to increase because of an increased absorption of solar radiation and accelerated sea ice loss (Perovich, 2016). Moreover, these increases are now affecting deeper ocean levels (IPCC, 2007). The temperature is estimated to have increased at a rate of 0.5°C per decade over ice-free zones in the Arctic basin during the summer (Timmermans et al., 2017). Warmer temperatures accelerate sea ice retreat, contributing to sea-level rise due to seawater expansion (AMAP, 2017). Changes in primary production in the high-latitude seas have also been triggered (Ardyna et al., 2014). Finally, more freshwater is discharged into the oceans as a result of the melting of glaciers and ice caps in the Arctic.

Climate change in the Arctic also affects snow, an important element that contributes to the overall mass balance of Arctic sea ice cover (Blazey et al., 2013; Webster et al., 2014; Lecomte et al., 2015). It also influences the ground thermal regime; the freshwater budget; and processes associated with both vegetation and biogeochemical activity (Meredith et al., 2019). The accumulation of snow on sea ice can increase the albedo effect, reflecting up to 85% of the incoming solar radiation between spring and summer (Perovich & Polashenski, 2012). Additionally, it can increase the thermal insulation and inhibit sea ice melt. Such process also affects the development of ice algae as it inhibits the arrival of light to the bottom of the ice layer (Mundy et al., 2007). Shrubs can capture bigger amounts of snow, leading to an increase of the thermal insulation and as a consequence, an increase in the ground temperature (Stieglitz et al., 2003). The active layer thaws and becomes deeper, creating a sharp reduction in the albedo effect, while simultaneously releasing additional carbon to the atmosphere (Chapin et al., 2005). This chain of bio-physical

processes is particularly relevant for permafrost thaw.

As previously mentioned, warmer temperatures in the Arctic reduce the thickness of seasonal sea ice (Olsen et al., 2017; Granskog et al., 2018) and the snow cover extent. Projections estimate that by mid-century, the duration of snow cover is expected to shrink by an additional 10-20% from current levels under a high emissions scenario. Arctic precipitations, mainly in the form of rain, are also expected to increase in the near future (AMAP, 2017).

The interplay between atmospheric circulation and warmer temperatures in the Arctic should not be overlooked as, in association with modifications in sea ice, snow cover and surface temperatures (Overland et al., 2012; Screen et al., 2013; Petrie et al., 2015), this can alter wind patterns and the jet streams (Overland et al., 2018). In this sense, Wegmann et al. (2015) demonstrated that anomalies in the planetary wave pattern were associated with the sharp reduction of sea ice in the Barents and Kara Seas. As a result, moisture transport was enhanced and snow depth in western Siberia increased.

Higher global greenhouse gas emissions (GHG) are closely associated with warmer temperatures (Fyfe et al., 2013) and an acceleration of permafrost thawing which causes the release of GHG stored in the frozen soil. This creates a positive feedback of the Arctic and global temperatures and increases the total amount of GHG concentrations in the atmosphere (Sloan, 2003; Maslin, 2004). Significant amounts of methane hydrates are contained in sediments, especially on Arctic continental shelves (IPCC, 2007) which are released to the atmosphere when permafrost thaws. Another important GHG is water vapor which creates warmer temperatures across the globe (AMAP, 2017) as it increases the phenomenon of Arctic amplification. Water vapor forms clouds and fog but also plays a key role in processes such as evapotranspiration, condensation and radiative transfer. GHG also alter the atmospheric and oceanic circulation and in turn, affect weather patterns by accelerating the melting of ice sheets and glaciers. It is estimated that half of the summer sea ice loss in the Arctic is produced by GHG (Kay et al., 2011; Notz & Marotzke, 2012). In addition, the global sea level raises, and alters the release and the uptake of carbon dioxide and methane (Sommerkorn & Hassol, 2009).

Arctic biodiversity is not exempted from negative effects caused by a rapidly changing environment and climate. For example, recently, more episodes of algal bloom have been observed and mammals have undergone serious changes in their diets. In some cases, shifts in predator-prey

relationships, habitat uses, and migration patterns have been observed (AMAP, 2017). Ice crust provoked by more frequent rain-on-snow and winter thaw/refreezing events reduces grazing possibilities of lichens and mosses for animals like caribou, reindeer, and muskox (AMAP, 2017). Changes in marine mammal and seabird populations can also be seen: some are modifying the migration timing or pathways while others changed their prey (Post et al., 2013; Hamilton et al., 2019). Because the black-legged kittiwake (*Rissa tridactyla*), experiences difficulties to adapt to warmer sea-surface temperatures, the size of their colonies are now in sharp decline. Foraging sites for predators and places where Arctic sea birds and marine mammals concentrate are also being transformed (deHart & Picco, 2015; Hamilton et al., 2017; Hunt et al., 2018). For example, the retraction of the southern ice shelf into the Arctic Ocean is hindering female walruses (*Odobenus rosmarus*) from hauling themselves onto the ice shelf in summer (Kovacs et al., 2015) and as a result, an increasing number of calves are dying. Reductions in the temporal and spatial distribution of the sea ice where hooded and harp seals (*Cystophora cristata* and *Pagophilus groenlandicus* respectively) breed is changing too (Øigård et al., 2013; Bajzak et al., 2011). This results in greater levels of stranding and pup mortality (Johnston et al., 2012; Soulen et al., 2013; Stenson & Hammill, 2014). Moreover, changes in ice conditions and temperatures have forced some marine predators, like the ringed seals (*Phoca hispida*), to switch their diet: they now opportunistically consume Atlantic water-based prey (Lowther et al., 2017).

Other species groups, such as bivalves, cephalopods, echinoderms, crustaceans, corals and fish are particularly affected by ocean acidification. According to Shiozaki et al. (2019), this is occurring at a faster pace in the Arctic Ocean than in any other region of the world and is triggered by two main processes: the increased inflow of fresh water from melting sea and land ice, and higher concentrations of atmospheric carbon dioxide (Qi et al., 2017; Steinacher et al., 2009; Yamamoto-Kawai et al., 2009). Ocean acidification reduces calcification and increases dissolution of the calcium carbonate structure of calcifying organisms (Comeau et al., 2009; Hofmann et al., 2010). It can also affect noncalcifying organisms: more specifically, their growth, survival rate, and elemental composition (Sugie et al., 2013, 2018).

Additionally, fish species can also be affected by fluctuations in environmental conditions such as higher ocean temperatures. This can translate into an expansion of the suitable feeding areas for boreal/subarctic species. Such is the case of the Atlantic cod (*Gadus morhua*) in the northern Barents Sea (Kjesbu et al., 2014).

Arctic primary producers (algae and phytoplankton) are also impacted. In fact, the net primary production (NPP) has increased by 30% since 1998 due to a sharp reduction in the extent of ice cover (Arrigo & van Dijken, 2011, 2015; Kahru et al., 2016). Phytoplankton blooms have also become more frequent (Kahru et al., 2011), especially in autumn due to longer open-water seasons (Ardyna et al., 2017).

Arctic vegetation is also experiencing radical changes too: to begin with, the tundra environment is being replaced by increasing amounts of biomass. This process, commonly known as “the greening of the Arctic”, has been gaining in importance in the region in recent decades, although at different paces (Park et al. 2016; Bhatt et al., 2017; National Academies of Sciences, Engineering, and Medicine, 2019). This process is predominantly triggered by warmer summer air temperatures (Myers-Smith & Hik 2018; Pastick et al., 2019) in the presence of sufficient moisture. Consequently, shrubs are becoming increasingly present throughout the tundra (Myers-Smith et al. 2015; Salmon et al. 2019). This phenomenon is particularly visible on Alaska’s North Slope, mainland Canada and the Russian Far East (Frost et al., 2019). On the contrary, other parts of the boreal forest are showing a browning trend (AMAP, 2017). This occurred after extreme winter thaw events which were then followed by an abrupt cooling and desiccation, or rain-on-snow events. However, a long list of alternative conditions may also contribute to this process: drier conditions during the growing season, fires, animal and insect activity, industrial pollution (Xu et al., 2013), anomalies in snow depth (Bieniek et al., 2015), or reductions in plant moisture availability due to changing hydrology (Kim et al., 2014).

Natural sciences have a deep understanding of the bio-physical implications of both climate change and permafrost thaw in the Arctic ecosystem and the complex interactions between them. However, more knowledge about the social and cultural implications of these processes is still needed. Characterizing the impacts and new risks of climate change and permafrost thaw for the Russian coastal Arctic requires analysis and integration of information on geomorphology, governance, historical processes, population mobility, demographic composition, the particular ties between settlements and between indigenous and non-Indigenous peoples, among others. Understanding is also essential on how changes in permafrost and climate can trigger broader modifications that lead to the redefinition of the particular ways in which Arctic human populations interact with their surrounding natural environment. This is particularly relevant as it is often associated with their particular worldviews, identity and how they give meaning to their lives. Considering that climate

and permafrost shape every aspect of life in northern settlements, designing suitable adaptive strategies requires delving into the interplay in natural environments of other often ignored processes like those associated with well-being, identity and mobility. Despite the theoretical knowledge obtained in diverse scientific fields, it is still unclear what the concrete psychological and emotional consequences of climate change and permafrost thaw are for northern residents living in settlements like Tiksi and Bykovsky, and how these could shape the future of traditional activities, the demographic configuration and migration patterns. This information should be integrated into policy-making processes associated with environmental issues and socio-economic development, especially at a regional and district level. One of the main challenges associated with conducting this type of multidisciplinary research in the Russian Arctic is the need to take a holistic, rigorous yet flexible approach that analyzes, integrates and captures the interconnectedness of a wide range of elements, processes and stakeholders simultaneously.

Russia is the country with the largest expanse of permafrost in the world (Zhao et al., 2013). The Republic of Sakha (also known as "Yakutia", a name given during the Soviet period which stands for Yakut ASSR) is the territorial and administrative division that has the most permafrost in the Russian territory. Although climate change affects many spheres of the Arctic ecosystem, the purpose of this dissertation is to focus on one component of the cryosphere: permafrost. More specifically, the aim is to understand how changes in permafrost and climate alter the social and cultural dimensions of the settlements of Tiksi and Bykovsky in the Bulunsky District. These are often associated with non-material elements that are equally important to lead meaningful lives. It intends to capture and analyze the elements, processes and interactions involved in the construction of meaning: those that each stakeholder attributes to the past and current configuration of their lives and livelihoods in the Republic of Sakha and the Bulunsky District, as well as the meaning attributed to the numerous ongoing changes. Thus, the detailed qualitative analysis of local narratives will contribute to the identification of the patterns of new risks that are emerging in the area as a result of climate change and permafrost thaw. The specific spatial configuration and historical processes of these settlements will also be integrated into this analysis as they sway local inhabitants' perception of these bio-physical processes.

This dissertation also aims to identify the specific ways in which current environmental and climatic changes in this area can lead to the redefinition of the interplay between human populations and each of the dimensions (cultural, natural and socio-economic) of the reality they live in. Unveiling the particular interactions between the material and non-material spheres will also play a key role

in improving the overall understanding of the extent of the impacts of climate change and permafrost thaw. The intention is also to analyze the implications of the changes that Tiksi and Bykovsky are currently undergoing for their relationships with other northern settlements in the Bulunsky District. The focus is on aspects associated with the role of each settlement, traditional activities, food production and redistribution, mobility and migrations. This was also integrated into the regional dynamics in order to capture how these local district changes affect the population and dynamics of other zones of the Republic of Sakha. Finally, this dissertation will delve into the future perspectives of these two northern settlements: more specifically, in order to understand how historical events, current undergoing changes and new risks influence the way local residents perceive their future and the future of their settlements. Within this context, rich information will be obtained on the meaningful, and often non-material, aspects of their lives and livelihoods, such as for example, the ties with territory, the role of traditional activities in local economies and social configuration, local forms of attachment and identity, among others. It will also be helpful to identify the aspects essential for the formulation of adaptive strategies accepted by local residents as legitimate, locally-relevant and respectful of their system of shared values. The results of this dissertation will represent an important contribution to the policy-making and decision-making processes, especially because it aims to bring together information that is often treated independently. It will provide specific input into how the cultural, natural and socio-economic spheres of these settlements interact and are being redefined in the context of accelerated climate change and permafrost thaw.

A qualitative methodological strategy appeared to be the best option as it facilitates the capturing of the perception and interpretation of a reality constructed within a particular social, political and historical context and is therefore, conceived from a subjective perspective (Pérez Serrano, 2001). A flexible research design was adopted in order to explore issues related to “meaning”, but also to delve into social representations, experiences, perception and attributions. These meanings should be analyzed within a broader spatial scale: in fact, they are closely related to the relationships between the representations of the inhabitants from Yakutsk, Tiksi and Bykovsky. These participants analyzed and described the processes triggered by climate change and permafrost thaw in connection with their daily experiences. This approach enabled the capture, through locals’ narratives, of the “plurality of other people’s voices that inhabit in one’s own voice, that is, how the others are present in one’s own statements” (Arfuch, 2002). The interest of using individual narratives as an entry point was to reconstruct the diverse experiences around permafrost thaw and

climate change as well as their implications for the Republic of Sakha and more specifically, for Tiksi and Bykovsky. Moreover, using an inductive logic provided flexibility and openness throughout this research. It identifies the complexities and interrelationships relevant to the contexts under study (Gallart, 1992). Although the main type of information is qualitative, it was also decided to use quantitative data to complement the understanding of demographic composition and migration patterns in the region. Some of the data collection techniques used were observation, interviews, and document analysis. Trying to obtain a general understanding of climate change and permafrost thaw in these two settlements is strongly associated with local specificities as they shape the way impacts are perceived and valued by local residents. However, understanding the influence and extent of these processes in these two coastal Russian Arctic settlements makes an important contribution to the understanding of the situation in the Bulunsky District where there is little information on the social impacts of these processes. More specifically, they could provide an entry point for future research in neighboring settlements and therefore, provide more details about the implications at a district scale.

During the first semester of this PhD research, a non-exhaustive bibliographic review was undertaken to give an overview of the current state of scientific knowledge on the impacts of permafrost thaw on Arctic regions, and when possible, in the Russian Arctic. Initially, I focused on social and economic impacts as they served as guiding concepts for my research questions. This review included information obtained from books, reports and articles which were enriched by multiple disciplinary perspectives including economics, geography, history, psychology, anthropology, sociology, etc. For each document, it was intended to identify innovative scientific elements (topics, notions or theoretical approaches) that could enrich both the Nunataryuk Project and my dissertation. Moreover, analyzing study cases from other Arctic regions also helped to delineate the current general state of knowledge in my domain of interest. Filtering was also required when the content was not relevant to my research or because of personal disagreement with the theoretical approaches proposed. This exercise actively contributed to the detection of relevant scientific information gaps as well as to the adjustment and reformulation of my research questions throughout the process. It allowed me to recognize aspects that I had previously overlooked and to integrate new key concepts related to this particular region into my research. The intention was not to force any initial idea or theory onto the data, but instead, to let emerging data refine my research questions.

This thesis was conceived and funded within the European project “Nunataryuk.” This project aims to identify and characterize the manifold impacts of permafrost thaw on coastal areas in the Arctic. It focuses on deepening the current understanding of organic matter release, the impacts on infrastructure, pollution, health and lifestyles, as well as the consequences for the global climate and economy. One of the distinctive elements of this project is that research is accompanied by representatives from Arctic coastal communities and indigenous people. Nunataryuk is based in ten different Arctic sites distributed in The Beaufort Sea, the East Siberia and the Nordic areas. One of the pillars of the project – which is equally important for this dissertation – consists of targeting community-specific issues associated with thawing permafrost, especially in ice-rich coastal permafrost areas. The interest of including as many communities as possible is to increase the reliability of projections and interpretations of the impacts and therefore, contribute to the implementation of better and more suitable adaptive strategies.

The research laboratory CEARC (UVSQ) in France hosted the work for this thesis, integrates the WP7 of Nunataryuk and covers the East Siberia region, more specifically, the coastal settlements of Tiksi and Bykovsky (Bulunsky District) situated in the Republic of Sakha (Russian Federation). This dissertation was conducted in collaboration with Russian partners from the North Eastern Federal University of Yakutsk (NEFU) and the Institute for Humanitarian Research and Indigenous Issues (Siberian branch RAS). The Russian Arctic Zone is predominantly characterized by a harsh continental climate, the presence of permafrost, low population density, dependence on natural resources as well as on the delivery of goods and an important industrial-economic development (Stepanko, 2019). Two fieldworks in different locations inside the Republic of Sakha were conducted:

the first in the regional capital city of Yakutsk (June-July 2018)

the second in Yakutsk, Tiksi and Bykovsky (July-August 2019)

Both fieldworks were led on the Russian side by Inga Nikulkina (Professor of Economics at NEFU) and Vyacheslav Shadrin (Researcher in Indigenous Studies, RAS). Local translators were hired to facilitate the work to the French teams. During the second fieldwork, the French team spent one week in the city of Yakutsk before travelling to Tiksi and Bykovsky, where the core of the research was conducted.

The aim of the first fieldwork was to capture the reality of permafrost thaw and climate change in

the capital city of Yakutsk, while the second focused on the local situation of Tiksi, the administrative center of the Bulunsky District, and the rural settlement of Bykovsky (situated in the same district). These two are examples of northern settlements in the Russian Arctic that have experienced a moment of splendor during the Soviet times and faced deep socio-economic and migration modifications after the Soviet Union collapsed. Despite their relative proximity to each other and the fact that they share the "remoteness" of the Russian Arctic, their physiography differs strongly. The Bykovsky Peninsula is covered by polygonal ice wedges within ice-rich sediments (known as Ice Complex), which are subject to numerous thermoerosion and thermokarst processes. Steep cliffs and shallow terraces containing thermokarst mounds are situated on the coast of the peninsula (Meyer et al, 2002). On the other hand, Tiksi is naturally protected by the Peninsula of Bykovsky. In the West is the coastal mountain range of the Kharaulakh Ridge and some remains of a former accumulation plain (Grosse et al, 2003). These two settlements also differ in terms of ethnical-demographic composition and economic activities. The largest ethnic group in the area is Sakha, and there are over 2000 Evenki (small-numbered indigenous people). The economy of the district still relies on activities such as fishing, hunting and animal breeding (reindeer, horses, cattle principally), activities which were introduced by the first inhabitants of the area. The Bulunsky districts catches about 21% of total fish caught in the Republic of Sakha, becoming one of the leading fish producers of the Republic. Omul, nelma, chir, muksun, vendace, and sturgeon are the main varieties. Fishing collective enterprises from the area played an important role in the regional economy and represented an important source of employment for local residents. Most of these inhabitants returned to their regions of origin after fisheries closed. Berry gathering is another important activity in the region, and these are considered by locals to be one of the main traditional food products (together with meat and fish). Wild herb gathering is done at a household scale but a few are gathered by local food-processing companies. Agriculture is poorly developed in these northern territories due to the harsh climatic conditions and is limited to areas situated far from economic centers, which increases the costs of production and transportation. As a result, agricultural products are in low demand.

Scoping the impacts of climate change and permafrost thawing in these coastal settlements of the Bulunsky District will serve as a record of local dynamics within the Russian Arctic. It will provide useful information on the environmental and socio-economic particularities of each of these settlements and identify the main concerns and priorities of local inhabitants as well as the main adaptive strategies perceived as "acceptable". Reproducing this type of research in other

settlements/villages in the area could increase the overall understanding of the situation in the Russian Far North concerning climate change and permafrost thaw.

The main research question that guided the course of this research during the first fieldwork was: "How do people living in the Republic of Sakha experience permafrost thaw and climate change?". The scoping fieldwork conducted in Yakutsk (June, 2018), provided me with new information on the main stakeholders at a regional scale. It also helped to identify and understand how different, yet complementary, points of view on permafrost thaw and climate change co-exist among the population in the capital city of the Republic of Sakha.

The selection of cases and stakeholders, and the final number of interviewees was defined during the field sessions. However, before travelling to Yakutsk for the first time in 2018, I decided to elaborate a draft mental map (see Figure 55) of the stakeholders. This helped me to visually identify the sectors of society that could potentially be affected by permafrost thaw and climate change in the Republic of Sakha. These then became broader families of stakeholders that I met and interviewed during the fieldwork. Collaboration with our Russian colleagues was essential at this stage as the draft version was fleshed out. Through snowball sampling, we met a first series of informants which led to meeting new types of interviewees. On many occasions, after the interview came to an end, interviewees would suggest other participants. Applying snowball sampling in both fieldworks facilitated collecting information at both the regional and local levels.

It was decided not to establish an exact number of cases for this research. Instead, achieving the theoretical saturation was set as an objective as this would provide a greater replication and overall reliability. Finding different categories of stakeholders made it possible to delve into shared points of view and similarities between them. By doing so repeatedly, theoretical saturation was attained. Representative stakeholders were sought out to interview in order to analyze the core topics of this dissertation, i.e. permafrost thaw and climate change. Thus, samples were chosen for theoretical purposes. New patterns were identified after analysis of the answers of each group of stakeholders, and preliminary conclusions were formulated. When experiences or patterns emerged from several narratives, this provide more solid and convincing evidence for my research, and therefore, reinforced the preliminary conclusions. From my samples, new theories emerged and were finally generalized (Yin, 2018). In other words, the purpose was to fit emerging theory with the data gathered during the fieldworks.

Rich data concerning the physical and cultural implications of permafrost thaw and climate change in the Republic of Sakha emerged from the coding of the interviews. This also provided information about the meaning and relevance of these changes, as well as the actions accepted as legitimate by the interviewees.

Obtaining detailed information about the context in which such processes, interpretations and actions occur is essential to understand the reasons for local perceptions. However, this also required delving into assumptions by participants. Inquiring about certain taken-for-granted aspects during the interviews gave me more visibility on:

- The logical order of processes and events;
- The causal relationships between them;
- The feedback loops between processes and events as a result of permafrost thaw and climate change
- Which adaptive measures are considered legitimate and positive by the local population

Semi-structured interviews were helpful as they allowed space for the participants to reflect on their daily life events and to describe them within their local frame. Reconstructing and interpreting this type of information was essential to apprehend the reality as experienced and understood by them. Each fieldwork enriched my research from different perspectives: the first in Yakutsk (2018), gave me an overview of the general situation concerning permafrost thaw at a regional scale. This was mainly because interviewees, although living in this city, were born in different parts of the Republic of Sakha. This introduced new concepts and specificities into my research.

During the fieldwork in Tiksi and Bykovsky (2019), more site-specific and detailed information was gathered. This time, the aim was to understand how the specific geographical conditions and relative emplacement of each of these Arctic and coastal settlements shaped local perceptions of changes in permafrost and climate. Gathering information at a regional and local scale facilitated the identification of similarities and differences between the predominant emerging trends. For my research, this represented an opportunity to fulfill key conceptual gaps but also reconstructed the existing implicit relationships between the regional and the local framework.

Sample questions were used in both fieldworks. They framed and guided conversations towards the topics of interest for this research. In the formulation of these sample questions, particular

attention was paid to topics that could be considered locally as “sensitive” (politics, military, etc.). Sample questions give the possibility of obtaining complementary information on a particular topic. Therefore, each can be slightly modified to adapt to the context of each interviewee. Although the dynamic implementation of the interview frameworks slightly differed between the interviewees, attention was given to avoid forcing participants’ responses. A commonly shared guideline for all the members of the teams was adopted in both fieldworks.

One of the major benefits of conducting face-to-face interviews was the possibility of capturing how each participant addressed topics differently. For example, during the fieldwork in Yakutsk, a law student insisted on the fact that permafrost is an unimportant topic for the inhabitants of the city, and didn’t understand why this research focused on this topic. On this occasion, I decided to communicate the interest that this particular topic had for both the scientific and local community. This was one pertinent example of a situation where it was important not to force the participant’s point of view or understanding. Moreover, I paid particular attention to avoid introducing my personal thoughts or terminologies into narratives.

The transcriptions from each of the two fieldworks were treated, coded and analyzed as independent hermeneutic units in Atlas.ti 8. Codes organize the information thematically and facilitate the global analysis. Coding has the potential to obtain a higher level of familiarity with the studied phenomena and the possible experiences associated to them, not as experienced or preconceived by the researcher, but from the participants’ points of view (Charmaz, 2006). This step allowed me moving forward to an analytic interpretation of the gathered information. Codes are useful in qualitative research because they show action while introducing concrete examples and dilemmas associated to each studied process. Finding the most appropriate words to englobe ideas according to locals’ perspectives was one of the biggest challenges. It was necessary to dismiss or reduce the influence of my own preconceptions about the experiences and processes captured during the fieldworks.

Coding participants’ narratives revealed some – until now - invisible relationships between concepts, ideas and processes. Some codes were not directly linked to climate change nor accelerated permafrost thawing but still provided valuable information about the general context in which these processes occur and how they are mentally constructed. Such was the example of the nostalgia feeling associated to the Soviet era, or the future perspectives for northern

settlements, among others.

Coding allowed me to understand what is happening as well as to understand my interviewees' standpoints. Doing this after the fieldwork to Yakuts in June 2018 was particularly relevant because as it promoted the theoretical integration of my data, coding introduced new and more precise questions which were extremely helpful for addressing the research questions of my second fieldwork.

Coding required paying particular attention to the transcriptions and translations of the narratives. Russian transcriptions were useful to pull the exact words that interviewees used during the interviews, and therefore, to find the most precise translation in English. This aimed at staying as close as possible to the original sense, meaning and purpose of their ideas. Locals' specific concepts and words reflected in some cases, assumptions, connotations and framed actions. Such was the case, for example, of "traditional knowledge threatened" or "buildings/houses detrimental". Both codes contain information about particular processes that frame inhabitants' action.

When coding, I decided to include gerunds (which reflect action taking place) and static words/concepts. These allowed me to start rebuilding connections and interactions between codes. At a broader scale, this would also facilitate the theorizing process by clearing the diverse existing relationships between individuals, events and experiences that were described in locals' narratives.

Each phrase could contain multiple codes simultaneously, which also revealed since an early stage, the complexity and interrelationships of the processes associated to permafrost and climate in the Republic of Sakha.

This research required moving forth and forward: rewording some codes was necessary to improve the fit and relevance of each of them as it was desired to capture and communicate the local reality in the most reliable way. The theoretical analysis of these codes revealed the main processes and stakeholders involved, and rendered their interconnectedness explicit. At this stage of the research, the interconnectedness between the material and physical dimensions of permafrost thaw and climate change in the Republic of Sakha became evident.

As the two main processes were addressed in both fieldworks, some codes were repeated. However, in some cases, the codes from the second fieldwork were more precise. For example, in Yakutsk,

there was only one global code called "permafrost" which included a wide diversity of feelings, experiences and indirect associations with this word. In Tiksi and Bykovsky, two clearly different codes associated with permafrost emerged: "permafrost definitions" and "permafrost thaw". The former dealt with the various forms of understanding of permafrost in local narratives, while the latter focused on particular experiences and derived processes associated with the thawing of permafrost. These differences were also linked to the way the questions were formulated in each case to address the topic.

To conclude, this research also includes reports and census data which contains statistical and legal information and results obtained from local researchers on migration and economy, among others. The analysis of some of the main problems identified by respondents (for example, mammoth tusk gathering, fishing activities) were complemented with legal information. These supplementary sources of information were useful as during the interviews the researcher did not always have enough time to expand on all the questions to fully cover a particular topic. In this sense, existing texts fill the information gaps in each interview. Contrasting narratives and existing documents revealed the overall coherence and complementarity between them.

Comparing statements from participants' narratives within the same fieldwork and between fieldworks allowed me to capture subtleties in the different ways changes related to permafrost and climate are experienced. The qualitative coding revealed the most frequently mentioned notions, ideas and processes and therefore, it was possible to integrate more detailed data. New broader categories emerged from the overall codification and analysis of narratives. They included:

- Interactions between climate change and permafrost thaw
- Permafrost thaw impacts on the material dimension
- Permafrost thaw impacts on the cultural and symbolic dimensions
- Defining agency as perceived locally
- Identifying adaptive strategies
- Determining future perspectives

This dissertation demonstrates that climate and permafrost shape every aspect of lives in Tiksi and Bykovsky. Climate change and permafrost thaw are now two salient topics among local residents in these settlements in the Bulunsky District. Despite their geomorphological and socio-economic differences, both settlements are experiencing rapid environmental modifications, although at a

different pace and extent. Interpreting their impacts requires understanding the local frame of reference (associated with climatic conditions, historical, political and demographical processes, among others) in which they are inserted as this influences how residents attribute meaning and value to them. Narratives reflect their deep understanding of the complex causal webs associated with climate change and permafrost thaw, as well as the main impacts. This reveals an intermeshing of the material and non-material spheres. In this context, characterizing each impact requires inserting them into a broader network of interrelationships and impacts. Accelerated climatic and environmental changes are now leading to the deconstructing of the Northern world as residents know it. As a result, residents are now forced to find new forms of interaction with the diverse elements of their surrounding environment. Similarly, residents now need new tools and mechanisms to mitigate the negative impacts, tools that are often perceived as dependent on external intervention or approval (for example, federal or regional government funding, programs or legal modifications). Science-based solutions are seen as legitimate by local residents. This could be an entry point to create concrete spaces of dialogue between both local and scientific forms of knowledge. This could be particularly relevant for future policy-making and decision-making.

Residents also pointed out that living in northern settlements like Tiksi and Bykovsky is challenging because of the delicate socio-economic reality they live in and perceive it as an urgent topic. Narratives demonstrate that residents perceive these challenges as a legacy of the Soviet dissolution. In this sense, they emphasize the need to tackle several problems and risks simultaneously, and not focus solely on permafrost thaw or climate change. Another major finding is the central role of the support-and-share network in the Republic of Sakha's lifestyle and culture. This not only acts as a buffer absorbing some of the negative impacts of low salaries and high prices in northern settlements, but also sustains the spirit of "reciprocity" that rules the social life of this population. This network is essentially sustained by the products produced by traditional activities: fish and meat principally. Faced with climate change, these activities are increasingly affected. This is why it is possible to affirm that this is endangering the complex material (food production and redistribution) and non-material (solidarity and reciprocity) relationships involved in this network.

Another relevant finding of this research is that northern residents evaluate liveability by considering a wide range of new stressors (especially those associated with environmental changes) as well as non-material elements that are perceived as important for them (for example, access to the share-and-support network, Soviet nostalgia, their attachment to cold weather, etc.). This is

why, even though mobility is strongly rooted in Northern culture as an alternative that provides freedom of movement, some others express their reluctance to leave their settlements, despite the challenging living conditions. In this sense, exploring these topics, allowed me to identify new elements closely associated with the traditional concept of "place attachment".

To conclude, this dissertation demonstrates that trying to insert the impacts of climate change and permafrost thaw within strict conceptual boundaries does not fit the reality as local residents experience it. To conclude, it is clear that there is a need to create a new configuration that integrates new channels of interaction in both economic-productive and socio-cultural terms.

Tiksi and Bykovsky are two study cases that, although they are both coastal communities and are in the same district, present different geomorphological and socio-economic characteristics. Focusing on these settlements enlarged the overall understanding of the different elements that are under threat from climate change and permafrost thaw in remote settlements like these. However, during the fieldworks and the analysis process, several limitations emerged. First of all, because of the limited resources and limited duration of each fieldwork, it was not possible to further explore how local residents from neighboring settlements could be impacted if Tiksi undergoes dramatic changes. For example, if, as many respondents mentioned, Tiksi was redeveloped like in the "old times", would this accentuate the "centrality" of Tiksi within the district? Would this reinforce the lack of interest of younger people in neighboring rural settlements in maintaining traditional activities? Would they move to Tiksi looking for new job opportunities and lifestyles? This question is also valid for the hypothetical case in which the population of Bykovsky is forcibly displaced in the near future: where would the majority of the population resettle? If Tiksi, how could that impact on the socio-economic reality of the settlement? Would this also affect the requirements in the area for adaptation to climate change? What would the effects of this forced displacement be on mobility and migration trends within the district and within the Republic of Sakha? What are the psychological and emotional impacts on displaced families from Bykovsky (who until then, have been entirely dependent on fishing)?

Given the local expressions of attachment to place, it has been observed that some people are unwilling to leave their settlements. In this context, it is necessary to explore the alternatives they consider as legitimate if the effects of climate change and permafrost thaw continue to diminish quality of life in Tiksi/Bykovsky.

In the future, more qualitative research is recommended to capture the subtleties in terms of the impacts of climate change and permafrost thaw for the different indigenous groups living in both settlements. The information collected during the 2019 fieldwork for this dissertation provided a general overview but needs to be compared with different groups to confirm its general validity.

Additionally, information on alternative ways of obtaining traditional food (meat and fish) if hunting and fishing activities in northern settlements continue to be negatively affected is quite limited. Similarly, it is unclear what new alternatives to current traditional activities could emerge if settlements continue undergoing rapid bio-physical changes as a result of climate change and permafrost thaw in the near future.

It was not possible to dive into the details how these processes can negatively affect local spirituality and worldviews. Although some narratives provided input on this, these affirmations cannot be accepted as a truth valid for all Indigenous peoples living in these settlements. This is partially explained by the fact that only a few respondents addressed these topics during interviews and therefore, it was not possible to capture the full spectrum of experiences of different indigenous groups.

Similarly, despite having gathered information that gave me an overview of the local forms of agency, it was not possible to investigate its relationship with place attachment in those residents who are unwilling to leave, and those who, despite their emotional ties and desire to see prosperous development of these settlements in the future, plan to leave for other districts.

For the specific purpose of this dissertation, analysis of recent documents and programs adopted at both federal and regional levels to promote the socio-economic development of the Russian Arctic has been limited. Considering the extent of each, a deeper analysis is suggested to connect legal information with the potential impacts on the quality of life of Tiksi and Bykovsky in the near future, and how could this be related to adaptive strategies and formal action.

Despite the flexibility and overall benefits of the methodology proposed in this dissertation, there were also some limitations: first of all, because of the language barriers, it must be acknowledged that live translations may diminish the specificity of the interviewees' ideas. This is also applicable to those cases where, because of time, interviews were directly transcribed and translated into English without the Russian transcript.

In order to make sure that interviewees felt safe and comfortable during the interviews, there were no specific questions on gender and sex. They were asked to introduce themselves, but the information provided by each respondent differed. This is why the analysis and conclusions of this research did not focus in those aspects which could enrich the desegregation of information and provide a broader understanding of the different impacts of climate change and permafrost thaw according to the characteristics of the respondent. Similarly, during the second fieldwork, the French-Russian teams split up to interview local residents and the dynamic and depth of each interview varied quite a bit. These differences were strengthened by the particular way the interview of each person was conducted, but also by other elements like age, gender and nationality (for example, if only one member of the Russian team conducted the interview). In addition, much information obtained during the interviews was new for the interviewers and this made it difficult to delve into more detail on the spur of the moment. This dissertation is divided into three main sections:

- the first, including chapters 1, 2 and 3, contains rich information on scientific knowledge that sustains this research.
- The second, including chapters 4, 5 and 6, provides the reader with methodological information.
- The last, including chapters 7, 8 and 9, presents the main findings and results of this research.

This research is essentially qualitative, but relies on both instrumental observational data and quantitative information collected during and after each fieldwork. These provide a wider understanding of the extent and implications of climate change and permafrost thaw for this particular region of the Russian Arctic.

In order to help the reader to contextualize the final results of this dissertation, it was decided to begin with an overview of the available scientific information on climate change (chapter 1) and permafrost thaw (chapter 2) in the Arctic. These chapters contain mainly observational data and indicators. They gather the main findings from the natural sciences on: the bio-physical processes activated by climate change and permafrost thaw, and how these create new interaction mechanisms that are inserted within a broader feedback loop in the Arctic system. Chapter 1 begins with a global introduction to the main generalities of the polar regions. It then narrows in on the Arctic, and finally concentrates on the Russian Arctic. However, the bio-physical

processes are presented here at the scale of the Arctic region. Chapter 2 includes a brief introduction to the elements of the cryosphere, and then focuses on the definition of permafrost and how it is impacted by climate change. Even if permafrost thaw can be triggered by different processes (for example, anthropogenic action), this dissertation focuses on those associated with climate change (more specifically, with warmer air leading to higher soil temperatures). The fourth section describes the main landscape modifications associated with permafrost thaw, including coastal erosion, ice wedge polygons, thermokarst, taliks, pingos and sinkholes. Finally, it discusses the effects that permafrost thaw can have on soil's bearing capacity.

Chapter 3 provides the reader with historical and geographical information on Arctic communities. This includes both indigenous and non-indigenous people. It enumerates and describes the main historical Arctic expeditions that shaped the current territorial organization of the region. It addresses the different indigenous groups living in the Arctic as well as their geographical distribution and the different notions of "indigenusness". This chapter describes the main processes (related to the economic development of the area and its geopolitical interests) that contributed to the arrival of new non-Indigenous peoples in the Arctic and how this impacted the original residents. It concludes with a global analysis of the main challenges that Indigenous peoples are now experiencing as a result of a complex series of environmental, political, and social changes in these communities which threaten their linguistic diversity, spiritual practices and worldviews, traditional activities, ties with the environment and identity.

Chapter 4 briefly describes the general guidelines and targets of the European Nunataryuk Project which funded this PhD. It also explains the role of the CEARC Laboratory within this project, its main responsibilities and the contribution this dissertation is expected to make to this broad multidisciplinary project. It then outlines the general context of the Republic of Sakha, including the administrative, political and historical processes. For this purpose, it was key to access sources of information in Russian, especially for site-specific detailed information. A similar approach is taken for the Bulunsky District and the chapter concludes with the outstanding characteristics of the settlements of Tiksi and Bykovsky which are both located in this district. Because of the relevance of traditional activities (agriculture, animal breeding, hunting, fishing and picking berries, mushrooms and wild herbs) for the local economies, this topic was presented in a separate section of this chapter.

Chapter 5 overviews the specificities of the methodological approach used in this dissertation. It focuses on the qualitative grounded theory and the main variations proposed by Charmaz and Paillé. It also presents the main strategies that were applied in order to overcome the main challenges faced during this research, for example, the language barriers. It finishes with a brief section that expounds on some key terminological specificities for this dissertation.

Chapter 6 chapter provides the reader with the theoretical baselines that justify each of the different stages of this research. It particularly addresses the theories behind collecting, gathering, coding, analyzing data and sampling. It finishes with a short section that outlines how the information on interviewed stakeholders was treated methodologically.

Chapters 7, 8 and 9 are the last chapters of this dissertation and are based on qualitative perception indicators. Chapter 7 focuses in the outcomes of the first fieldwork conducted in the regional capital city of Yakutsk in 2018. The results mainly concern the regional perception of permafrost thaw and climate change. It contains a mental map based on the coding of local narratives which identifies the main stakeholders, processes and dimensions impacted by both bio-physical processes.

Chapter 8 and Chapter 9 bring together the findings of the fieldwork conducted in Tiksi and Bykovsky in 2019. The former begins with an overview of local perceptions of climate change and permafrost thaw. More specifically, the spheres of northern lives that are perceived to be at risk from these processes are identified. It also includes other social and economic challenges pointed out by residents as equally important in shaping their living conditions in these settlements. Chapter 9 presents the current and future perspectives of Tiksi and Bykovsky in the light of climate change and permafrost thaw. The main mobility trends are analyzed, as well as the major concerns and future prospects of the inhabitants of these settlements. Finally, there is a section that enumerates and describes the main elements that were mentioned by local residents as they analyzed liveability and future projects.

The general conclusions of this dissertation are the result of extensive cross-linking analysis of both types of indicator and are presented after chapter 9.

CHAPTER I: CLIMATE CHANGE IN THE ARCTIC

This chapter presents the main characteristics of the Polar regions in general, as well as those of the Russian Arctic in particular. It also describes the main challenges associated to climate change that these regions are currently facing. Particular attention is given to the dynamics taking place in the Russian Arctic. This chapter also enumerates the key findings (based in observations and measurements) in terms of components and interacting processes of the Arctic environment that contribute to the understanding of the local and regional impacts of climate change. They are fundamental to the understanding of my fieldwork sessions in Russia, and the associated results.

I.A) POLAR REGIONS

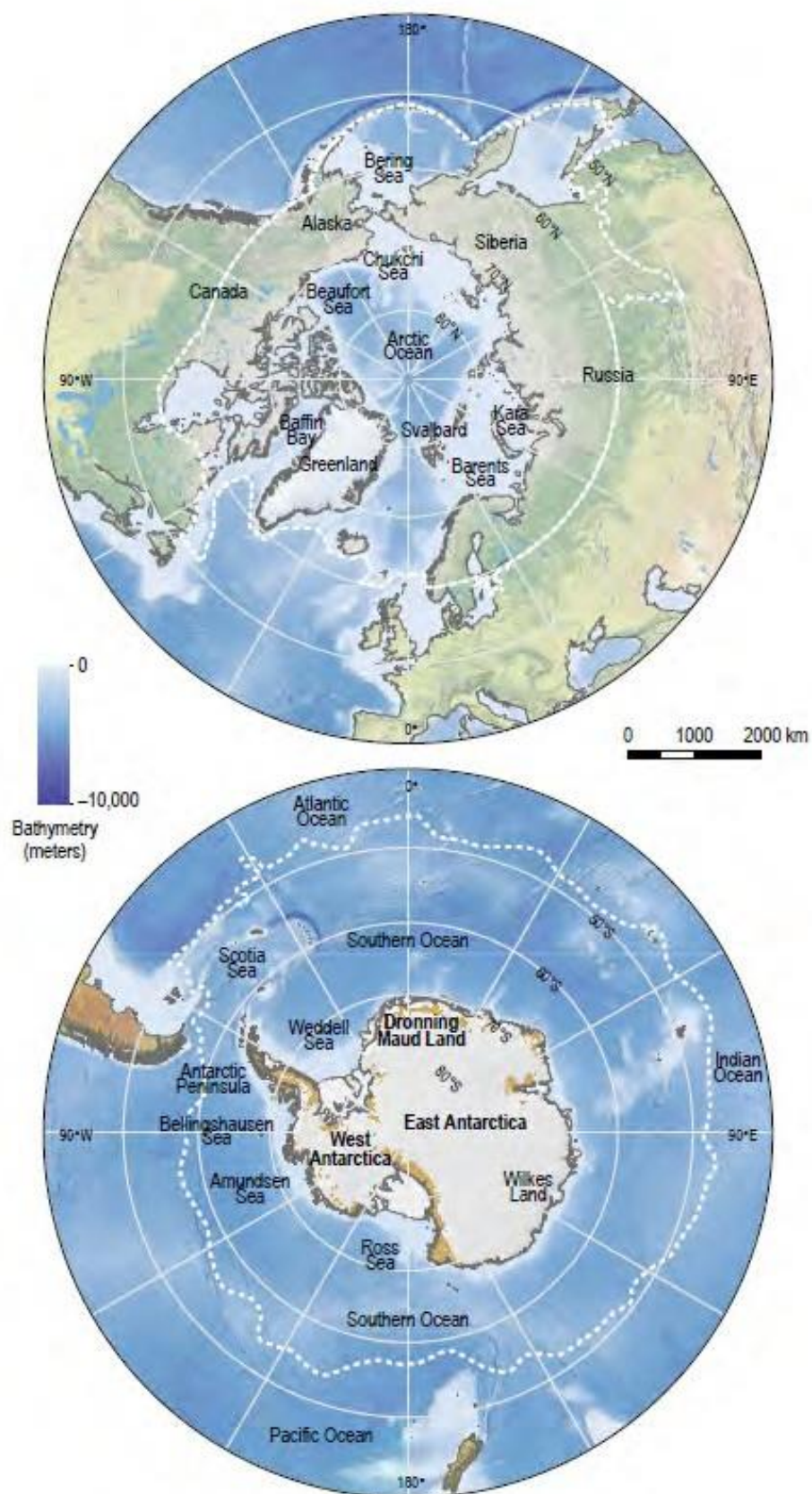
The Arctic and Antarctic are the two Earth's Polar regions. Both are characterized by cold weather and the presence of water in different states: ice, snow and water. They play a key role in the regulation of the global climate system and are at the core of important geophysical and biological processes. One of the most relevant features of Polar regions is the large seasonal variation in terms of incoming solar radiation (Anisimov et al, 2001), which leads to the phenomena of polar nights in winter and polar days in summer.

Their main difference lies in their geographical situation: Antarctica is an entirely frozen continent which is surrounded by oceans, while the Arctic is an ocean covered with a layer of sea ice surrounded by landmasses and open oceans (Anisimov et al, 2001). Moreover, in the Arctic millions of people live. They have adapted to harsh climatic conditions. In the Antarctic there are only scientific research stations and no permanent human settlements.

Due to their close interactions with the climate system, both regions are considered to be highly sensitive to climate change. The complex positive feedback mechanisms produce more rapid and severe responses in the Arctic than in any other region on Earth. This has undeniable effects on the cryosphere, vegetation and human communities. The Arctic also has been experiencing other consequences related to environmental pollution, oil and gas industries, and overfishing (Kruk et al., 2018; Morgana et al., 2018).

The extensively studied warming, sea ice retreat, melting of glaciers and other changes in the cryosphere in northern high latitudes represent today a symbol of global climate change (Walsh,

2009).



*Figure 1: Geographical situation of polar regions.
Source: Meredith et al. (2019)*



Figure 2: Relative position of the Arctic Ocean.
Source: The Arctic Institute

I.B) THE ARCTIC

Polaris, the North Star lies above the North Pole. It is surrounded by the Ursa Major constellation, the Great Bear. The word "Arctic" derives from the ancient Greek word "Arktikós" (ἄρκτος, or kktos), which means the country of the Great Bear (ACIA, 2004).

The Arctic Ocean covers about 14.2 million km² and includes the Canada and Eurasian Basins, the Siberian Seas (Kara, Laptev and East Siberian seas), the Chukchi Sea, the Beaufort Sea, the Barents Sea, the Greenland Sea, the Baffin Bay and the Hudson Bay.

The Arctic region is not homogeneous and exceeds the formal countries boundaries. Arctic Nations include:

- **United States: Alaska**

- **Canada: Yukon, Northwest Territory and Nunavut**
- **Denmark: Greenland and Faroe Islands**
- **Iceland**
- **Norway: Finnmark, Troms and Nordland**
- **Sweden: Norrbotten, Västerbotten**
- **Finland: Lapland, Oulu, Kainuu**
- **Russia: Murmansk, Karelia, Arkhangelsk, Komi, Yamal-Nenets, Khanty-Mansi, Taimyr and Evenk, Sakha, Magadan, Koryak, Chukotka.**

Canada, United States/Alaska, Greenland/Denmark, Norway, and the Russian Federation are Arctic countries with coasts in the Arctic Ocean. While Iceland, Finland and Sweden are Arctic countries but do not have coasts on the Arctic Ocean. Over 4 million people live in this area, of whom 10% are Indigenous peoples (AHDR, 2014).

Since 1996, issues related to this Region are treated by the Arctic Council, which is an intergovernmental forum formed by the eight Arctic States. It works as an international forum operating on the basis of consensus. It aims at echoing the peaceful and cooperative spirit in these territories. Military security issues have been explicitly excluded from its tasks. Arctic states have sovereignty over territories within this region and constitute members of the Arctic Council. The landmasses surrounding the Arctic Ocean and its waters are governed by national jurisdictions and international law. Since 2020, there are 6 permanent participants and 38 observers in the Arctic Council, the latter also participate in meetings and events. Additionally, subsidiary bodies such as Working Groups and Task Forces also work in the implementation of specific objectives of the Council.

In geographic terms; the Arctic is situated around the North Pole. Yet, there is no universal definition. In some occasions, the multiple perspectives and definitions overlap. Definitions have been proposed in order to delimitate it according to different criteria. For example: one of the most frequently used delimitations is the one of the Arctic Circle (66° 33' 44" N) which delimits the region according to the solar radiation. This imaginary line marks the latitude above which, in theory, the sun never sets on the summer solstice (June 21st) and never rises on the winter solstice (December 21st). Using the Arctic Circle as a reference, the Arctic (mainland and sea area) cover a total of 20.946

BOX 1: INTERNATIONAL COOPERATION IN THE ARCTIC

The "Murmansk Speech" by Secretary General Mikhail Gorbachev of the Soviet Union is often identified as an important historical event that led to the current regional cooperation in the Arctic. In 1987, during a visit to the Kola Peninsula, the then Secretary-General of the Soviet Communist Party, Mikhail Gorbachev, launched a series of policy initiatives which ultimately came to mark the beginning of the end of the Cold War era in the Arctic. His six proposals were aimed at transforming the northern part of the globe from being a sensitive military theatre to becoming an international 'zone of peace' (Atland, 2008). More specifically, they were about:

- 1) establishing a nuclear-weapon-free zone in northern Europe and reducing military activities,
- 2) debating strategies about confidence-building measures in northern seas,
- 3) achieving civilian cooperation in developing natural resources,
- 4) coordinating international scientific research,
- 5) gathering efforts to protect the environment,
- 6) opening the Northern Sea Route to foreign ships.

The speech is currently considered to be a turning point for the geopolitics of the Arctic region. Consequently, the end of the Cold War was accompanied by the reestablishment of connections between northern regions, and the dawning of a new era of international cooperation.

Another definition focuses on the temperature (10°C July isotherm), considering as Arctic territories those where the monthly average temperature in July (the warmest month in the Northern Hemisphere) remains below 10°C or 50°F.

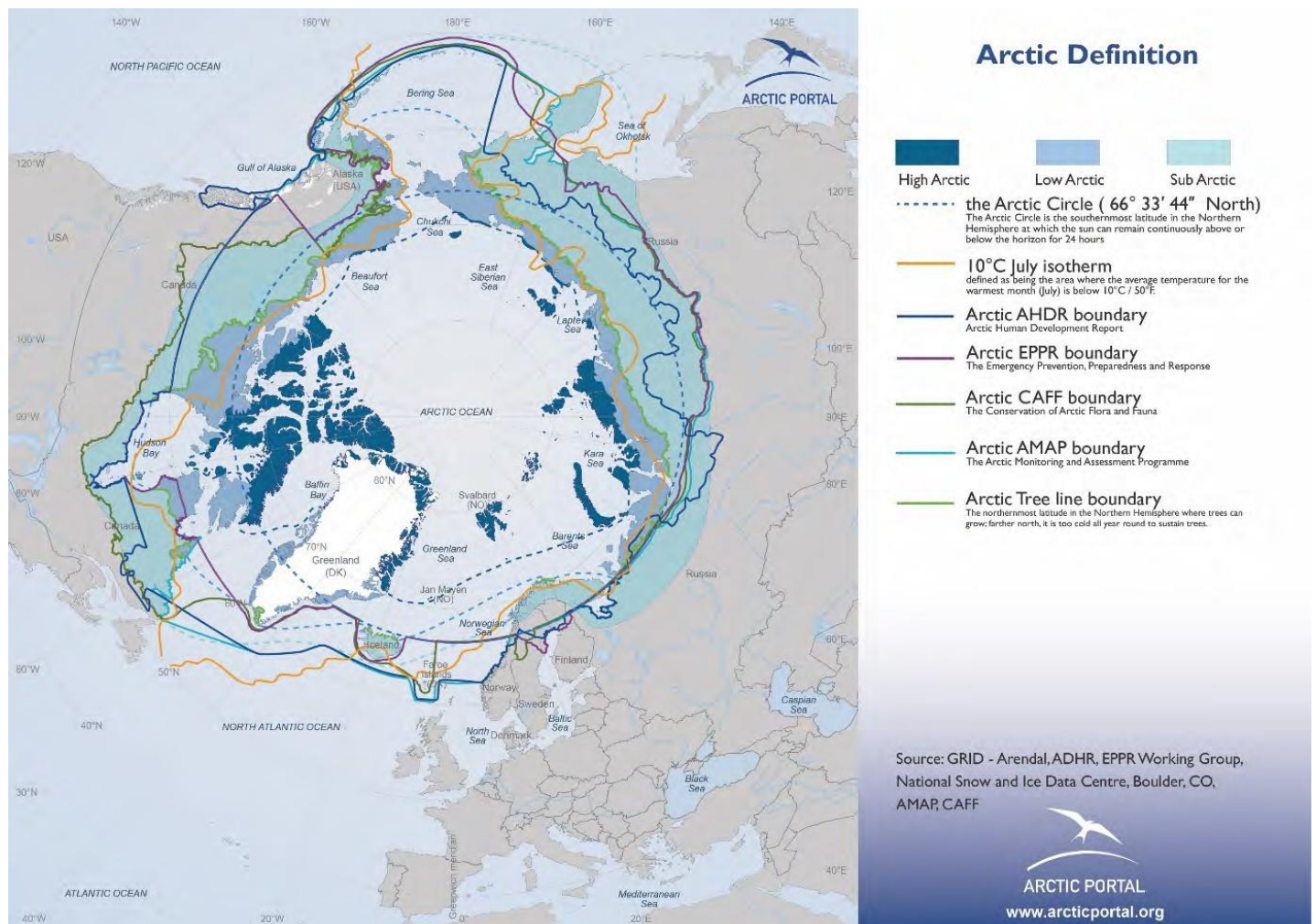
Yet another biophysical definition delimits the Arctic region according to the forest line which depends on the temperature. In this case, the Arctic region is considered to be predominantly characterized by wooded tundra and glaciers.

If we take into consideration the permafrost distribution, then the Russian Arctic area includes a wider amount of land compared to other delimitations. Permafrost is defined as soil that stays frozen for at least two consecutive years.

The cultural definition considers that the Arctic includes the homelands of northern Indigenous peoples. Political boundaries can also vary according to the interest of each country.

The Arctic Monitoring and Assessment Programme (AMAP)'s definition incorporates elements of the Arctic Circle, political boundaries, vegetation boundaries, permafrost limits, and other oceanographic features. The region covered by AMAP integrates the terrestrial and marine areas north of the Arctic Circle (66°32'N), and north of 62°N in Asia and 60°N in North America, modified to include the marine areas north of the Aleutian chain, Hudson Bay, and parts of the North Atlantic Ocean including the Labrador Sea. Other Arctic Council working groups such as the Emergency, Prevention, Preparedness and Response (EPPR) developed their own boundaries or adapted the AMAP definition.

The Arctic Human Development Reports (AHDR) considers Arctic as an area of 40 million km² characterized by a homogenous cultural, social and economic region. It includes all of Alaska, Canada North of 60°N together with northern Quebec and Labrador, all of Greenland, the Faroe Islands, and Iceland, and the northernmost counties of Norway, Sweden and Finland. In Russia, this definition englobes the Murmansk Oblast, the Nenets, Yamal-Nenets, Taimyr, and Chukotka autonomous okrugs, Vorkuta City in the Komi Republic, Norilsk and Igarka in Krasnoyarsky Kray, and those parts of the Sakha Republic whose boundaries lie closest to the Arctic Circle.



The Conservation of Arctic Flora and Fauna (CAFF, 2013), defines the Arctic taking into consideration political, climatic and biological features. It largely follows the tree line in order to include the ecosystems that are the focus of its activities.

"The North" is also used interchangeably with "the circumpolar North" and is frequently understood as a synonym of the "Arctic" (Dodds & Nutall, 2019). The Arctic is also frequently used as a synonym of the "North" and the "circumpolar North". In some occasions, many high latitude places are defined as "northern" but are not necessarily "Arctic."

I.B.I) The Russian Arctic

Russia is the country that has the largest territory lying in high latitudes and north of the Arctic Circle (Heleniak, 2009). The Arctic zone of the Russian Federation is often referred to as the "Extreme North" (in Russian: Крайний Север) or the "Far North" (Дальний Север). It is considered to be the

region located beyond the Arctic Circle and covers a large portion of land, water area and continental shelf of the seas of the Arctic Ocean. The Russian Arctic covers over 5.000.000 km² of the Russian Federation and represents almost one fifth of the federal budget revenues. It includes:

- **9 regions, including 4 entire Russian federal subjects: Chukotka Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Nenets Autonomous Okrug, Murmansk Region.**
- **Municipal entities of 5 Russian federal subjects: Republic of Karelia, Komi Republic, Arkhangelsk Region, Krasnoyarsk Territory, Republic of Sakha (Yakutia). The Decree of 13 May 2019 No. 2201" integrated new territories from Yakutia to the Arctic Zone of Russia, including the Abyysky, Eveno-Bytantaysky National, Momsky, Srednekolymsky, Verkhnekolymsky, Verkhoyansky, and the Zhigansky National Evenkiysky districts¹.**

The Russian Arctic is highly urbanized and has the most populous cities in the Arctic (Heleniak, 2020). This region is characterized by natural resources extraction, their processing and transportation. The mining sector prevails and constitutes one third of the Gross Regional Product (GRP) of the macro-region (Simakova & Stepus, 2017).

¹ Указ Президента РФ от 13 мая 2019 г. N 220 "О внесении изменений в Указ Президента Российской Федерации от 2 мая 2014 г. N 296 "О сухопутных территориях Арктической зоны Российской Федерации".



Figure 4: Map of the continental territory of the Arctic Zone of the Russian Federation in accordance with the Decrees No. 296 of 2014 and No. 287 of 2017. 1. Murmask Oblast; 2. Republic of Karelia (Belomorsky, Loukhsky, Kemsy municipal districts); 3. Arkhangelsk Oblast (Mezensky, Onezhsky, Primorsky municipal districts, territories of Arkhangelsk city, Novodvinsk city, Severodvinsk, Novaya Zemlya); 4. Nenets Autonomous Okrug; 5. Yamal-Nenets Autonomous Okrug; 6. Republic of Komi (territory of Vorkuta city); 7. Krasnoyarsk Krai (Taimyrsky Dolgan-Nenets, Turukhansky municipal districts, territory of Norilsk city); 8. Republic of Sakha (Yakutia) (Allaikhovsky, Anabarsky Dolgan- Evenki, Bulunsky, Nizhnekolymsky, Ust-Yansky municipal districts); 9. Chukotka Autonomous Okrug; 10.

Lands and islands located in the Arctic Ocean, listed in the Decree of the Presidium of the USSR Central Executive Committee dated 15 April 1926 "on declaration of lands and islands located in the Arctic Ocean as the USSR territory" and in other laws and regulations of the USSR. Source: Ministry of Natural Resources and Environment of the Russian Federation².

Russia's coastline accounts for 53 percent of the Arctic Ocean coastline and englobes the Barents Sea, Kara Sea, Laptev Sea, and East Siberian Sea. A number of archipelagos can be found, from which the most prominent are the Novaya Zemlya in the Kara Sea, the Severnaya Zemlya in the Laptev Sea, and the New Siberian Islands in the East Siberian Sea. the East Siberian Sea. The three

² Министерство природных ресурсов и экологии Российской Федерации

major river systems of this region are:

- 1) the Yenisey River (in the west, and discharges in the Kara Sea);**
- 2) the Lena River (discharges in the Laptev Sea);**
- 3) the Kolyma River (ends in the East Siberian Sea).**

These rivers play a key role for northern settlements as they work as transportation routes during the winter and autumn. Shallow-draft ice breakers ensure the access and delivery of goods to communities living along these rivers.

BOX 2: RUSSIAN POLICIES IN THE ARCTIC

"The Fundamentals of State Policy of the Russian Federation in the Arctic in the Period up to 2020 and Beyond" (in Russian "Основы государственной политики Российской Федерации в Арктике на период до 2020 года и дальнейшую перспективу") has been adopted by the Russian President D. Medvedev in September 2008. This document defines the main objectives, strategic priorities and mechanisms of realization of the state policy of the Russian Federation in the Arctic. Additionally, it develops the socio-economic and national safety strategies to implement in the Russian Arctic zone.

The main strategy priorities are:

- to maintain an active interaction with sub-Arctic states in regards to delimitation of maritime areas on the basis of international law and mutual arrangements;
- to create a homogenous Arctic search and rescue regime;
- to strengthen bilateral relationships within regional organizations;
- to assist the effective use of cross-polar air routes and the NSR for international navigation;
- to contribute within international Arctic forums;
- to delimitate the maritime spaces in the Arctic Ocean;
- to improve the management of the social and economic development in the region;

- to improve Indigenous peoples' quality of life;
- to develop an Arctic resource base through improved technology;
- and to modernize and continue developing Russia's Arctic infrastructure.

I.B.II) The Arctic Zone and the Republic of Sakha

The Republic of Sakha (Yakutia) lies in a zone of permafrost and is characterized by a predominantly harsh continental climate. As a result, there are long winters with temperatures that can reach -60°C, and short temperate summers. The lowest temperatures have been recorded in the Siberian arctic were recorded in the village of Oymyakon (located in the Yakutsk region), in 1924: -71.2°C ("Russia", 2020).

It is the largest republic of Russia and more than 40% of its territory is in the Arctic region (Yakovleva et al, 2000). Its Arctic coastline along the Laptev Sea and the East Siberian Sea covers about 2000 km (Skryabin, 1996). The Arctic zone of the Russian Federation includes the territories of five Arctic districts: Anabarsky, Bulunsky, Ust-Yansky, Allaikhovsky, and Nizhnekolymsky and Subarctic territories of the following northern districts: Oleneksky, Zhigansky, Verkhoyansky, Momsky, Abysky, Srednekolymsky, and Verkhnekolymsky. More than 68 thousand people live in the Russian Arctic Zone³.

The Republic of Sakha is the homeland of five small-numbered Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation (in Russian "коренные малочисленные народы Севера, Сибири и Дальнего Востока"): Evens, Evenks, Yukagirs, Dolgans and Chukchi. They have been living in northern territories since ancient times, before any other nation arrived to these lands (Sleptsov & Petrova, 2019).

³ Statistical Yearbook of the Republic of Sakha (Yakutia): Stat. Collection. / Territorial body of the Federal State Statistics Service for the Republic of Sakha (Yakutia). - Yakutsk, 2019 – 654 p. (Статистический ежегодник Республики Саха (Якутия): Стат. Сборник. / Территориальный орган Федеральной службы государственной статистики по Республике Саха (Якутия). – Якутск, 2019. – 654 с.).



*Figure 5: Arctic districts of the Republic of Sakha.
Source: Popova, N.V., Abramov, A.F., & Markova, L.N. (2020)*

I.C) CLIMATE CHANGE IN THE ARCTIC

Climate shapes every aspect of northern environments, lives and livelihoods. The impacts of climate change are particularly profound in Arctic regions (ACIA, 2004; IPCC 2007; Ford & Furgal, 2009) and affect multiple complex systems simultaneously: the cryosphere, the hydrology and freshwater ecosystems, the oceanography and marine ecosystems, the terrestrial ecosystems, as well as the health, economy and lifestyle of northern communities. For the purpose of this research, two types of climate change indicators will be considered and intersected: those based on instrumental observational data (usually included in different scientific reports and articles) and those which are a reflection of the real changes in climate in northern residents' perception. In most cases, the latter start being manifested when climate changes exceed certain threshold values and therefore became more "noticeable" for residents (Anisimov et al., 2020). Chapters 1 and 2 focus on the first type of indicators, while chapters 7, 8 and 9 are based on perception indicators. The final conclusions of this research will be elaborated after analyzing both types of indicators, as they are considered equally necessary to characterize the situation concerning climate

change and permafrost thaw in the Republic of Sakha, and more specifically, in Tiksi and Bykovsky.

During the past recent decades, the Arctic region has experienced rapid environmental, social, and economic transformations (Larsen et al, 2014). Major changes are closely associated to increasing temperatures due to increases in atmospheric greenhouse gas (GHC) concentrations (Overland et al, 2018a). However, the temperature variability along the region is large. The main contributor to warming in the Arctic region in the last third of the century is GHG (AMAP, 2017). Anthropogenic activities are principle responsible for the rapid increase of global atmospheric concentrations of carbon dioxide, methane and nitrous oxide since 1750 (IPCC, 2007). The annual mean Arctic temperatures between 2014-2019 all exceed previous records and since mid-1990s, it keeps warming at more than twice the magnitude of global mean temperature increases (see Figure 6 below) (Overland et al., 2019). Climate change unchained several modifications in the contemporary landscapes, including changes in hydrological patterns, vegetation distribution and thermal state of permafrost.

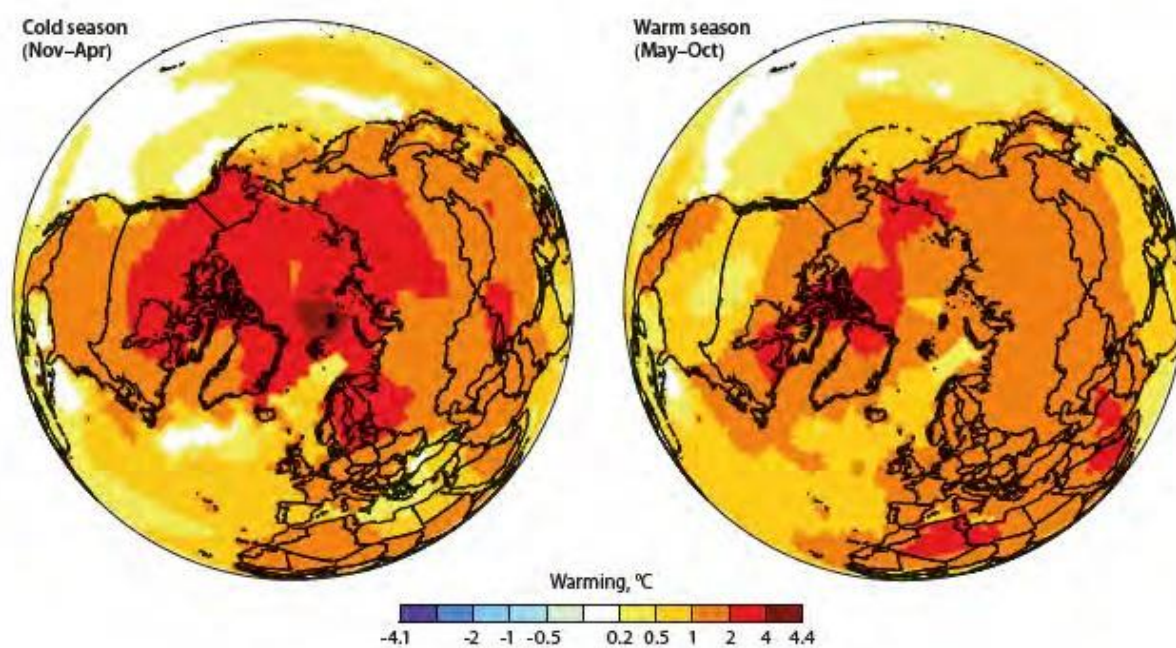
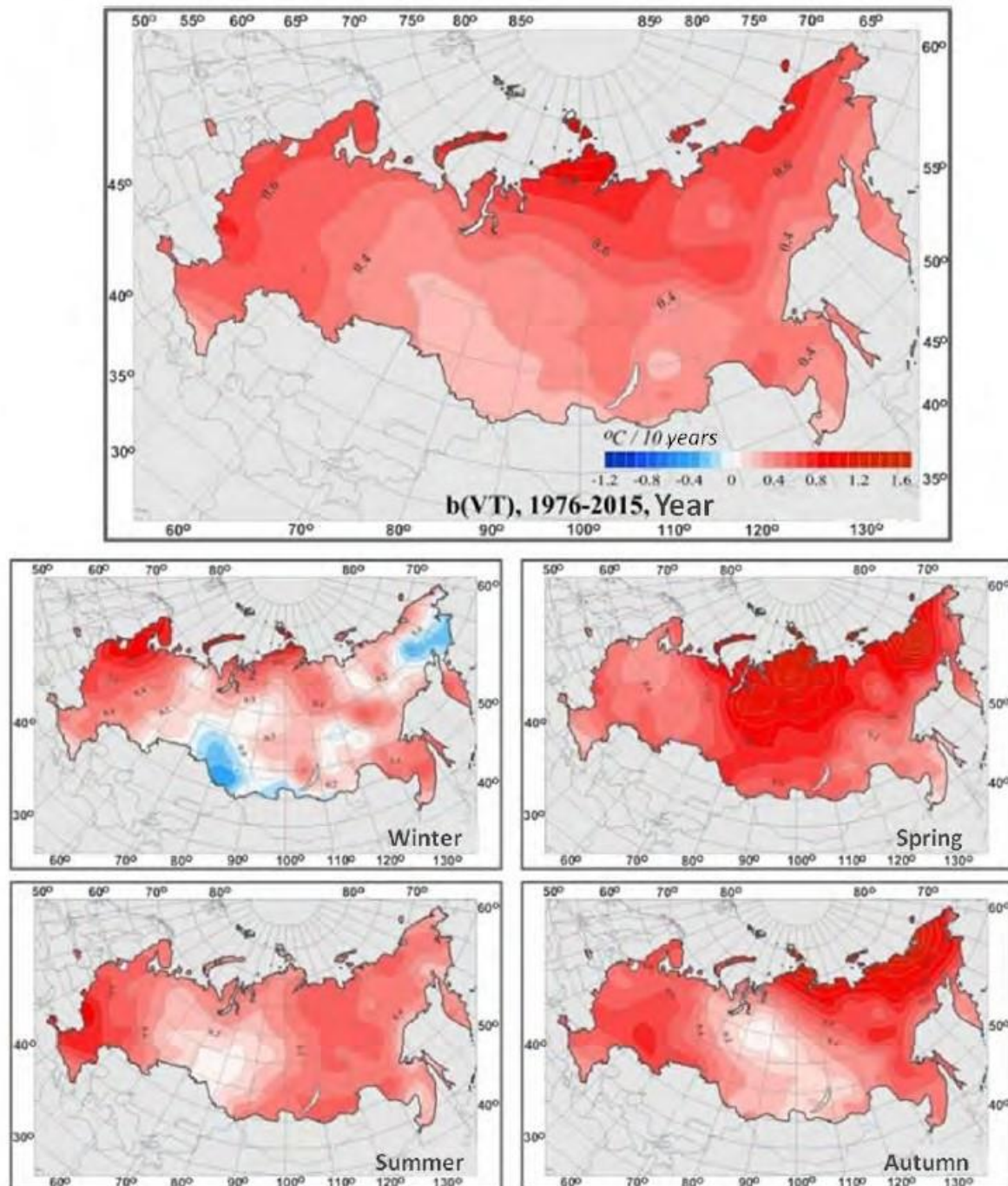


Figure 6: Arctic warming for the period 1961–2014 in the cold season (Nov–Apr) and warm season (May– Oct)
(NASA GISTEMP <http://data.giss.nasa.gov/gistemp/maps/>).
Source: AMAP, 2017

In the past 40 years, the annual mean air temperature over the Russian territory has been rising at an average rate of 0.43°C per decade (see Figure 7 below) (Kattcov & Semenov, 2014). Observations indicate that the Arctic and subarctic regions have experienced sharper warming with a mean annual temperature raise of 0.5-0.9°C per decade. More specifically, winter temperature increased

by 0.4-0.8°C in Central and Northern Siberia, the Republic of Sakha and the Russian Far East. Warmer temperatures in spring and fall leads to earlier snowmelt, longer and warmer snow-free periods and deeper seasonal thawing of permafrost (Anisimov, 2017).



*Figure 7: Air temperature trends between 1976-2015 (°C/10 years).
Source: Anisimov, 2017.*

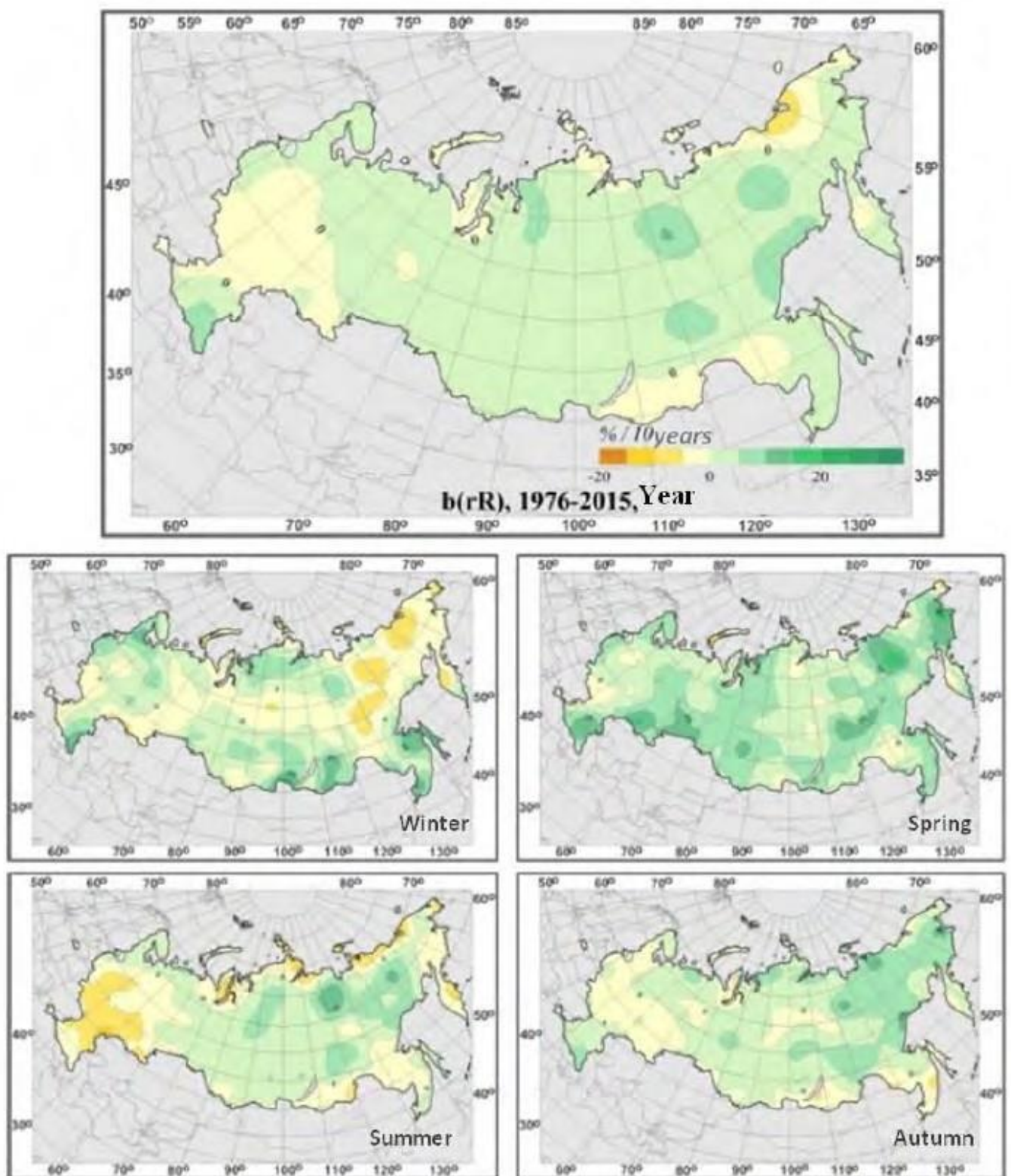
Increasing precipitations, as experienced in most Russian regions, also impact frozen ground conditions (see Figure 8 below). Snow naturally insulates permafrost from getting in contact with lower air temperatures in winter (Douglas et al., 2020). In absence of snow, rain penetrates the upper layer of the soil, increasing the total amount of heat. As a result of both processes, permafrost thaws. The total amount of water content in the soil determines the hydrological and thermal properties, the energy exchange and biogeochemical processes (Boike et al., 2019).

The Arctic surface air temperature has increased to more than double the global average increase over the last 50 years (Notz & Stroeve, 2016; Richter-Menge et al., 2017). This phenomenon known as Arctic amplification reduces meridional temperature gradients and can affect mid-latitude weather and climate (Overland et al, 2011; Cohen et al, 2014; Barnes & Screen, 2015; Luo et al, 2018). During the autumn and summer in the Arctic, the seasonal sea-ice melts and opens a large portion of the Arctic Ocean, allowing it to absorb large amounts of sunlight during the warm season. Energy is therefore released to the atmosphere as longwave radiation, and as sensible heat fluxes during the winter. This way, the Arctic Ocean acts as a heat source to the atmosphere.

According to Meredith et al (2019), the Arctic climate system has registered new extremes:

- **The frequency of some extreme events is also changing: for example, periods of extreme cold during both summer and winter are in decline. While extreme warm days are increasing in some areas, for example, in northeastern Russia (AMAP, 2017).**
- **Annual Arctic surface temperature for each of the past five years between 2014–2018 (relative to a 1980–2010 base line) exceeded that of any year since 1900 (Overland et al., 2018);**
- **Near-surface temperature anomalies of +6°C (relative to 1981–2010) were recorded in the Arctic in winter (January to March) between 2016 and 2018 (see Figure 9 below) (Overland and Wang, 2018);**
- **Warm air and moisture from the Pacific and Atlantic Oceans arrived to the central Arctic and increased downward longwave radiation, delaying the sea ice freeze-up, and increasing the absence of sea ice;**
- **Delayed freeze-up of sea ice in subarctic seas (Chukchi, Barents and Kara) creates a positive feedback allowing warmer temperatures to progress further toward the North Pole (Kim et al., 2017);**
- **Summer sea ice loss has dramatically increased over the past 15 years;**

- **Winter sea ice maxima of the last 4 years were at record low levels in comparison with the 1979–2014 period (Overland, 2018);**
- **Freshwater storage in the Arctic Ocean has increased by more than 11% in comparison with the 1980–2000 average (AMAP, 2017).**



*Figure 8: Precipitation trends between 1976 and 2015 (%/10 years).
Source: Anisimov, 2017*

The Arctic became an important source of global sea-level rise: between 2011 and 2014, Greenland contributed with an average loss of 375 gigatons of ice per year, which represents almost the double of the rate corresponding to the period 2003-2008 (AMAP, 2017).

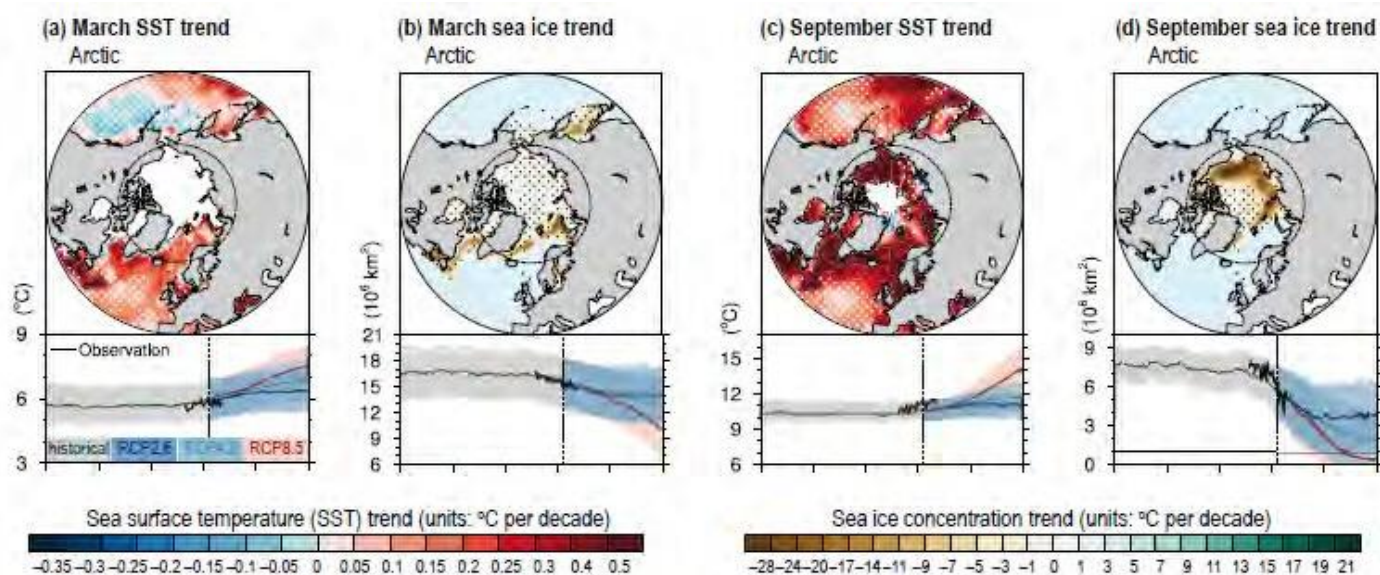


Figure 9: Maps indicating linear trends (in °C per decade) of the Arctic sea surface temperature (SST) for 1982–2017 in March and September and the linear trends of sea ice concentration (in % per decade).

Source: Meredith et al., 2019.

Even under the scenario of “limiting global temperature rise to well below 2°C by the end of the century” (IPCC, 2018; UNFCCC, 2015; Boucher et al., 2016; Hulme, 2016; Sigmond et al., 2018), the annual Arctic temperature is expected to increase by ~4°C by mid-century.

I.C.I) Sea ice

The sea ice plays a key role in the Arctic environment and more specifically, it is a key feature of polar oceans. Its loss is currently considered to be one of the most prominent indicators of global climate change. The Arctic sea ice reflects a high proportion of the incoming solar radiation back to space, reducing the total amount of energy absorbed by the surface. But it also creates thermal insulation between the ocean and atmosphere, it influences thermohaline circulation and provides habitat to a wide variety of Arctic species, especially birds and mammals. The winter sea ice that survives the melting season, forms new multi- year ice (Meredith et al., 2019).

However, current trends indicate that most of the sea ice in the Arctic now is only “first year” ice, which is thinner and less resilient to changes in atmospheric and oceanic conditions (see Figure 10 below) (Perovich et al., 2015). This is essentially ice formed during the autumn and winter that melts the following spring/summer. Older and thicker ice has been rapidly disappearing since 1980s (Meier et al., 2014; Perovich et al., 2015). In fact, between 1979 and 2018, there was a dramatic

reduction in sea ice of at least 5 years old: it went from 30% to 2% (Stroeve & Notz, 2018). Thinner ice in spring also increases summer ice-albedo feedback through earlier formation of open water areas (Stroeve et al., 2012). Days with sea ice cover also declined (up to 10-20 days per decade between 1979-2013). (AMAP, 2017). Since 1989, it has been observed a sharp decline in the overall sea ice extent (Barber et al., 2017; Comiso et al., 2017; Stroeve & Notz, 2018, Overland et al., 2018) (See figure 9 above). The decline of summer Arctic sea ice is unprecedented since 1979 (Walsh et al., 2017).

It has been demonstrated that the Arctic sea ice is now thinner through volume reductions in satellite altimeter retrievals (Laxon et al., 2013; Kwok, 2018), ocean-sea ice reanalyses (Chevallier et al., 2017) and in situ measurements (Renner et al., 2014; Haas et al., 2017).

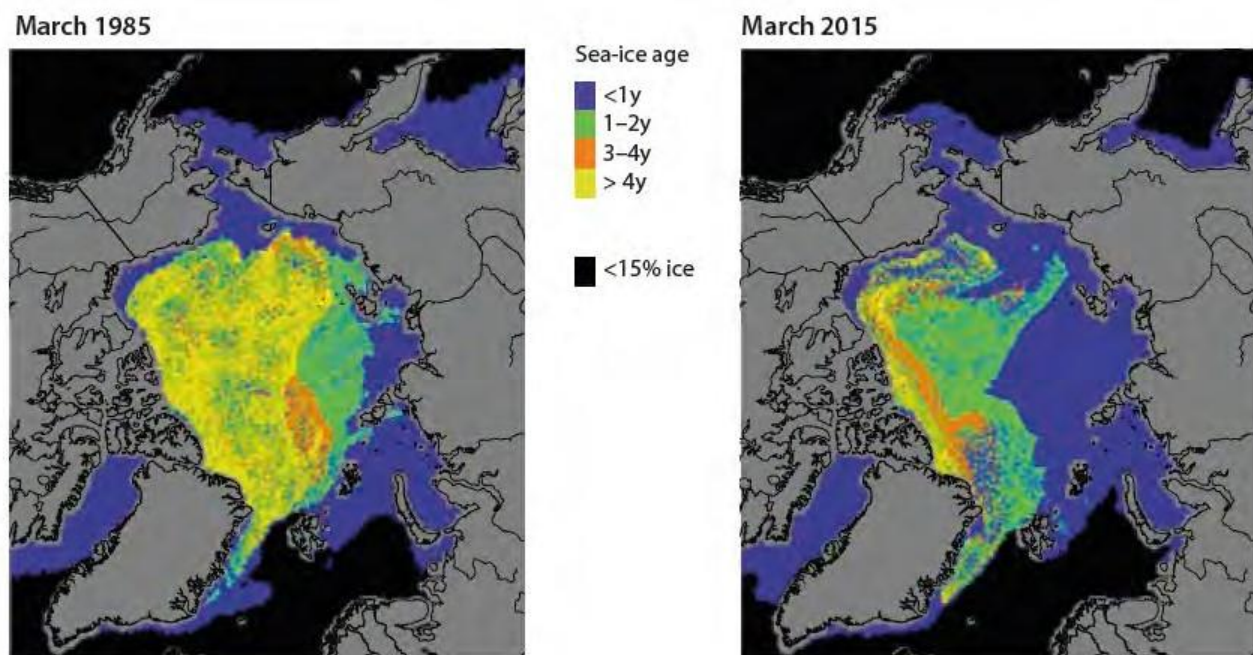


Figure 10: Map contrasting the sea ice age in March 1985 and March 2015.
Source: Perovich et al., 2015.

One of the characteristics of changes in the Arctic is their interconnectedness: Arctic ice freeze-up is now occurring later, which as a result, also delays the snowfall accumulation on sea ice. This produces a thinner and less insulating snowpack (Sturm and Massom, 2016). The melting season also became longer due to both earlier melt onset and later freeze-up (Stroeve & Notz, 2018). Earlier melt onset produces earlier water open (Stroeve et al., 2012a; Serreze et al., 2016) and increases melt pond development (Perovich & Polashenski, 2012). As a result, summer ice albedo

feedback is also stronger (Stroeve et al., 2014; Liu et al., 2015).

Another form of ice, "landfast", is also important for the Arctic coastal sea ice system. It is immobile sea ice that is anchored to the land or to ice shelves and acts as a floating extension of the land (Meredith et al., 2019). It is predominantly a seasonal phenomenon: ice is formed each fall and breaks up during the following spring. About 660,000 km² of landfast ice is found in the Kara, Laptev, and East Siberian seas (Yu et al., 2014). It reduces the erosive action of waves over the Arctic coasts (Lantuit & Pollard, 2008) and influences sediment dynamics (Eicken et al., 2005). Additionally, it redirects the river inflow when it enters the marine environment (Kasper, 2010). Local communities use landfast to travel, to hunt and to access some remote offshore regions. It is also used to build ice roads, runways, pipelines and related facilities (Masterson, 2009). But it is also an essential element for different animal species such as birds and mammals (Lovvorn et al., 2018). As a result of climate change, the Arctic landfast ice is currently facing thinning trends in springtime maximum sea ice. The winter season landfast sea ice extent has also experienced a dramatic decrease in some regions (up to 7% per decade) (Meredith et al., 2019). It is now occupying the coastline for shorter periods of time and is no longer as thick as it was before.

Estimations indicate that the Arctic sea ice will continue decreasing at a fast pace, especially in face of greenhouse gas (GHG)-induced warming. As a result, the amount of sunlight absorbed and released will increase. This will also extend the ice-free periods in the Arctic Ocean and amplify the overall Arctic warming during the coldest periods of the year (Dai et al., 2019). Moreover, these changes will also impact marine ecosystems: more light will boost the growth of phytoplankton, causing potential disruptions in the Arctic food webs. It works as a source of food and protection for krill, while birds and big mammals (seals, walrus and polar bears) use it as haul-outs during foraging trips. Other animals give birth and nurse their pups (see Figure 11 below) (IPCC, 2014). It is projected that climate change will impact species composition, production and ecosystem structures and functions (Frainer et al., 2017; Kaartvedt & Titelman, 2018; Moore et al., 2018).

Sea level rise is another indicator of changes in the Arctic and it is associated to the discharge of glaciers and ice sheets. The global average sea level has risen by more than 20 cm since 1900. However, other non-Arctic elements are also involved in the contribution to global trends, such as thermal expansion of the oceans and mass loss from the Antarctic Ice Sheet. Moreover, changes in sea level rise are not homogenous and vary according to the region (AMAP, 2017).

Despite the potential benefits, the stipulated increase in temperature in the future decades will increase the challenges that northern communities will face (Reisser, 2017). For example, coastal erosion will increase as a result of a reduction in the ice extent which enhances the erosive effect of waves. This also impacts infrastructure and settlements built on the coastline.

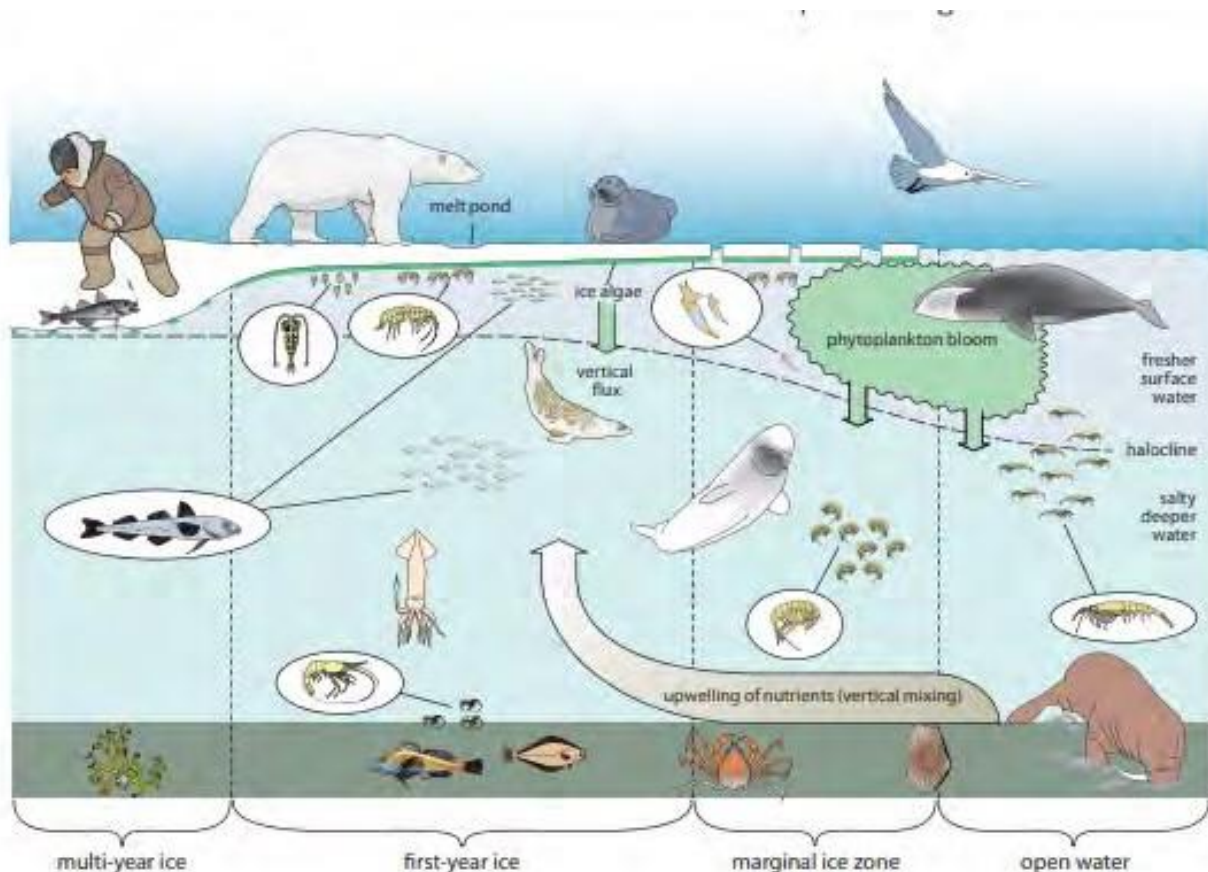


Figure 11: Changes in the Arctic cryosphere and their potential effects in the marine ecosystem structures and functions. Source: AMAP, 2011

I.C.II) Oceans

Warming of the climate system is unequivocal and as a result, Polar Oceans are also changing: it has been registered an increase in the global average air and ocean temperatures, the melting of snow and different forms of ice, and rising global average sea level. Higher average temperatures of the global oceans have been registered as a result of increased absorption of solar radiation and sea ice loss (Perovich, 2016). Increases in temperature reached depths of up to 3000 m (IPCC, 2007). Timmermans et al (2017) estimated that temperature has been increasing at a rate of 0.5°C per decade over ice-free zones in the Arctic basin during the summer. Between 1979 and 2011, the decrease in Arctic Ocean albedo represented more solar energy input to the ocean (Meredith et al,

2019). Sea ice retreat caused, according to estimations, $6.4 \pm 0.9 \text{ W/m}^2$ of radiative heating since 1979 (Pistone et al, 2014) This contributes to sea level rise due to seawater expansion (AMAP, 2017). Simultaneously, upper-ocean temperatures of the Arctic unchanged changes in primary production in the high-latitude seas (Ardyna et al., 2014). Additionally, the atmospheric water vapor content has also increased over the land and the ocean (IPCC, 2007).

Another important process to take into consideration is the increase of freshwater discharge into the oceans due to the melting of glaciers and ice caps. According to Box et al (2018), the Arctic land ice sea-level rise contribution for the 1992–2017 period has been estimated to be equivalent to 31% of the global sea-level rise. As a result, the total organic material discharged is also altered. For example, Hawkings et al. (2016) estimated that the Greenland ice sheet contributes about 15% of total bioavailable phosphorus input to the Arctic oceans ($\sim 11 \text{ Gg/y}$).

The aforementioned processes have global-scale implications for the storage and cycling of heat, carbon and other important components. The Arctic Ocean is expected to continue warming significantly during this century both at the surface and its deeper layers (Meredith et al., 2019). It is expected that the amount of sea ice loss, freshwater discharge and nutrient fluxes will accelerate in the face of warmer climate (AMAP, 2017).

I.C.III) Snow cover

Snow plays a major role in the Arctic environment. Not only does it contribute to mass balance of the Arctic sea ice cover (Blazey et al., 2013; Webster et al., 2014; Lecomte et al., 2015) but also influences the energy budget, the ground thermal regime; the freshwater budget; and processes associated to vegetation and biogeochemical activity as well as and different species (Meredith et al., 2019). The amount and duration of snow that falls in the Arctic depends on multiple processes and feedback interactions: they are strongly influenced by moisture, latitude, and the elevation of the ground. In winter, for example, spatial variability of snow is determined by the terrain, the vegetation (Assini & Young, 2012; Rees et al., 2014; Homan & Kane, 2015) and wind redistribution (Déry & Yau, 2002; Essery & Pomeroy, 2004; Sturm & Stuefer, 2013). It is also influenced by other broader processes, such as atmospheric and oceanic circulation (AMAP, 2017).

Snow accumulated on sea ice increases albedo effect and between spring and summer it can reflect up to 85% of the incoming solar radiation (Perovich & Polashenski, 2012). Its insulating effect can

also inhibit sea ice melt. However, this property also prevents light from reaching the bottom of the ice, where some forms of ice biota develop (Mundy et al, 2007). Snow deposits can depress and flood sea ice, creating new snow ice.

An increase of shrubs growth in the tundra traps more snow, increasing the insulating effect and therefore, increases the temperature of the ground (Stieglitz et al., 2003). As a result, the active layer also becomes deeper and the resulting albedo decreases, while releasing additional carbon to the atmosphere (Chapin et al., 2005). This is particularly relevant for permafrost thawing.

Climate change in the Arctic keeps reducing the seasonal sea ice thickness (Olsen et al., 2017; Granskog et al., 2018) as well as the snow cover extent. For example, "in recent years, June snow area in the North American and Eurasian Arctic has typically been about 50% below values observed before 2000" (AMAP, 2017). By mid-century, the duration of snow cover is expected to shrink by an additional 10-20% from current levels under a high emissions scenario. Arctic precipitations will likely increase in the future, with a major proportion of it falling as rain instead of snow (AMAP, 2017).

Changes in snow cover will continue impacting traditional activities of northern communities which are strongly dependent on snow conditions. Such is the case of hunting, fishing and herding but also access to country food. These cases may have implications for both locals' health and incomes (AMAP, 2017).

I.C.IV) Atmospheric circulation

Higher temperatures of the lower atmosphere associated to changes in sea ice, snow cover and higher surface temperatures (Overland et al., 2012; Screen et al., 2013; Petrie et al., 2015), influence wind patterns and the jet stream (Overland et al., 2018). In this sense, for example, Wegmann et al. (2015) demonstrated that declining sea ice in the Barents and Kara Seas resulted in anomalies in the planetary wave pattern that enhanced moisture transport and increased snow depth over western Siberia.

Moreover, changes in atmospheric circulation create more persistent weather patterns such as the prolonged blocking patterns that were observed over the eastern Canadian Arctic and Greenland (Overland et al., 2012). These were responsible for accelerating summer melt of snow and ice in the region (Bezeau et al., 2015).

Atmospheric circulation is also affected by Arctic amplification (Francis and Vavrus, 2015; Mann et al., 2017). As a result, the sea ice extent decreases and accentuates the increasing temperatures due to the strong heat transfers from the ocean to the atmosphere. Consequently, the North Atlantic Oscillation - an irregular fluctuation of the atmospheric pressure that occurs in the North Atlantic Ocean - changes (Screen & Simmonds, 2010). Both processes impact the Greenland Ice Sheet mass balance (IPCC, 2019).

Atmospheric circulation change is also linked with variance in surface mass balance (Chen et al., 2015). The recent strong increase in surface melting in Greenland produced negative surface mass balance along its southwestern ice sheet (van As et al., 2014).

Some authors estimate that in the future, there will be changes on the North Atlantic Ocean circulation due to an increase in the accumulation of Arctic freshwater (Prowse et al., 2015; Carmack et al., 2016; Marnela et al., 2016; Yang et al., 2016). However, it is still uncertain what the exact future response of atmospheric circulation over the Arctic will be to even higher temperatures and accelerated declining sea ice due to the multiplicity of simultaneous interactions involved (Barnes & Screen, 2015).

I.C.V) Greenhouse gases

Greenhouse gas (GHG) emissions influence conditions in the Arctic region and in the rest of the world as a whole (Corel, 2006). At a global scale, GHG modify atmospheric and oceanic circulation that affect weather patterns, by increasing melting of ice sheets and glaciers that raise global sea level, and altering the release and the uptake of carbon dioxide and methane (Sommerkorn & Hassol, 2009). On the other hand, the increasing temperatures in the Arctic are closely associated to anthropogenic greenhouse gases (Fyfe et al., 2013).

Increasing concentrations of atmospheric greenhouse gases are responsible for almost half of the summer sea ice loss in the region (Kay et al., 2011; Notz and Marotzke, 2012). The other half is attributed to natural variability (IPCC, 2007). Atmospheric warming in the area accelerates permafrost thawing, releasing GHG which were packed in the frozen soil, creating a positive feedback of the Arctic and global temperature while increasing global GHG concentrations in the atmosphere (Sloan, 2003; Maslin, 2004). Methane is thought to be up to 25 times more potent a greenhouse gas than carbon dioxide. Significant amounts of methane hydrates are contained in

sediments, especially on Arctic continental shelves (IPCC, 2007). When permafrost thaws, its methane is released and often reaches the atmosphere un-oxidized.

Water vapor is the strongest GHG, and its presence fosters warming across the globe (AMAP, 2017). In the Arctic, it increases Arctic amplification of climate warming as a result of clouds, albedo and air temperature (Langen et al., 2012). Water vapor forms clouds and fog, but also play a key role in processes such as evapotranspiration, condensation and radiative transfer (especially of longwave radiation under clear skies). In fact, humidity inversions are essential to form clouds (Nygård et al., 2014).

Permafrost region soils store about 60% of the world's soil carbon in 15% of the global soil area. It is estimated that in the upper active layer and permafrost soils, there are $1,000 \pm 150 \text{ PgC}$, while in deeper yedoma and deltaic deposits there are an additional 500 PgC (Turetsky et al., 2020). However, this storage rate is currently experiencing a decline (Schuur et al., 2013, 2015; Commane et al., 2017, Jeong et al. 2018) due to abrupt thawing permafrost. This carbon becomes available for decomposition and remobilization and therefore triggers GHG emissions of carbon dioxide (CO_2) and methane (CH_4) (Voigt et al., 2017).

Permafrost soils also stock big amounts of nitrogen. It is estimated that in the upper 3 meters of permafrost, there are about 67 billion tons of total nitrogen. These stocks are more than 500 times larger than the annual amount of N added to the soils under the form of fertilizers in the world (Voigt et al., 2017). As a result of thawing permafrost, two main processes can take place: on the one hand, big amounts of nitrous oxide (N_2O) emissions can be released as a result of the nitrification and denitrification processes (Voigt et al., 2017; Yang et al., 2018; Mao et al., 2020). Patches of bare peat in permafrost peatlands have been identified to be hot spots for N_2O emissions in subarctic tundra (Voigt et al., 2017). On the other hand, larger amounts of N in the soil can facilitate plant N uptake and therefore enhance ecosystem production (Keuper et al., 2017; Salmon et al., 2016). Shifts in plant species composition are particularly relevant because they can have different effects on climate: some can reduce the surface albedo and amplify the regional greenhouse warming by increased evapotranspiration (Foley, 2005; Swann et al., 2010; Lorant et al., 2011). Shrubs can also reduce permafrost thaw due to greater shading in summer (Blok et al., 2010).

The future emissions of GHG in the Arctic is still unclear and each possible scenario represents different challenges for life and livelihoods in the Arctic, including natural resources management,

local and regional economies, northern cultures and traditional activities. According to Meredith et al., (2019), for example, in the case of achieving a stabilized global warming of 1.5°C, sea ice-free Arctic in September is projected to occur significantly less frequently than at 2°C (1% c.f. 10–35%).

I.C.VI) Biodiversity

Multiple and simultaneous changes associated to physical, chemical and biological processes (Frederiksen, 2017) in the Arctic impact marine ecosystems and biodiversity (see Figure 12). This includes changes in the ranges of species, increasing the occurrence of algal blooms; changes in marine mammals' diets; creating shifts in predator-prey relationships, habitat uses, and migration patterns (AMAP, 2017).

Grazing animals - such as caribou, reindeer, and muskox – experience difficulties to access lichens and mosses due to the ice crust provoked by rain-on-snow and winter thaw/refreezing events (AMAP, 2017).

Arctic marine mammal and seabird populations react differently when ecological interactions are altered or their habitat is threatened: some of them change their range (modifying the timing or pathways for migration), others shift their preys (Post et al., 2013; Hamilton et al., 2019) when this is possible. However, some species experience hardship in face of warmer temperatures: for example, the population of black-legged kittiwake (*Rissa tridactyla*) colonies sharply declined in the 1990s due to an abrupt warming of sea-surface temperature. Other species such as Arctic endemic marine mammals have little scope to move northward in response to increasing temperatures (Kovacs et al., 2012; Hamilton et al., 2015). Moreover, foraging sites for top predators and concentrate places for sea birds and marine mammals in the Arctic are also being impacted (deHart & Picco, 2015; Hamilton et al., 2017; Hunt et al., 2018). Walrus (*Odobenus rosmarus*) calves have experienced higher rates of mortality. This is explained by the retraction of the southern ice edge into the Arctic Ocean which hinders female walruses from hauling out on ice over the shelf in summer (Kovacs et al., 2015). The sea ice where seals breed is also undergoing dramatic changes in terms of temporal and spatial distribution (Bajzak et al., 2011; Øigård et al., 2013), leading to increases in stranding and pup mortality when the ice extent shrinks (Johnston et al., 2012; Soulen et al., 2013; Stenson & Hammill, 2014).

As a result of the aforementioned examples, the availability of prey resources is also affected

(Asselin et al., 2011; Øigård et al., 2014; Choy et al., 2017). For example, ringed seals shifted their diets due to sea ice changes (Lowther et al., 2017).

Other species groups - such as bivalves, cephalopods, echinoderms, crustaceans, corals and fishes- are impacted by ocean acidification – process which is currently occurring at a faster pace in the Arctic Ocean than in any other region of the world – (Shiozaki et al., 2019). This is caused by the increased fresh water input of melting sea and land ice, as well as the enrichment of atmospheric carbon dioxide (Qi et al., 2017; Steinacher et al., 2009; Yamamoto- Kawai et al., 2009). Such process particularly affects calcifying organisms as it reduces the rates of calcification and dissolution of their calcium carbonate structure (Comeau et al., 2009; Hofmann et al., 2010). However, ocean acidification can also alter the growth, survival rate, and elemental composition of other noncalcifying organisms (Sugie et al., 2013, 2018). The wide variety of reactions unchained will also have a different energetic cost to adapt to changes in the ocean (Luckman et al., 2014; Howes et al., 2015; Falkenberg et al., 2018).

Arctic primary producers are also being affected (Moore et al., 2018). Since 1998, a reduction in ice cover increased by 30% the net primary production (NPP) in ice-free Arctic waters (Arrigo & van Dijken, 2011; Arrigo & van Dijken, 2015; Kahru et al., 2016). It also leads to earlier phytoplankton blooms (Kahru et al., 2011). As a result of longer open water season, autumn blooms also became more frequent in the Arctic (Ardyna et al., 2017).

The distribution and production of fish are also affected by changes in climate. Higher temperature and changes in the quality and distribution of prey is already affecting marine fish (Wassmann et al., 2015; Dalpadado et al., 2016; Hunt et al., 2016). Two major trends can be identified: on the one hand, higher temperatures can expand suitable feeding areas for boreal/subarctic species. This is the case of the Atlantic cod (*Gadus morhua*) in the northern Barents Sea, Atlantic Sector (Kjesbu et al., 2014).

On the other hand, shorter ice covered season and reduced sea ice can negatively impact other species, such as the polar cod (*Boreogadus saida*) through loss of spawning habitat and shelter, increased predatory pressure, reduced prey availability (Christiansen, 2017), and impaired growth and reproductive success (Nahrgang et al., 2014). All these simultaneous and interconnected changes may have irreversible consequences for the Arctic food webs.

I.C.VII) Vegetation

The process known as “the greening of the Arctic”, which consists of replacing the treeless tundra environment by increasing amounts of biomass (see Figure 12 below), has been expanding along the Arctic territory during the last decades, although not homogeneously (Park et al. 2016; Bhatt et al. 2017; National Academies of Sciences, Engineering, and Medicine, 2019). It is influenced by several climatic and environmental factors, but warmer summer air temperatures are considered to be the main driver of long-term greening (Myers-Smith & Hik 2018; Pastick et al. 2019). As a result, it is observed an increase of Arctic shrub extent in the tundra (Myers-Smith et al. 2015; Salmon et al. 2019). Such trend was particularly observed in Alaska’s North Slope, mainland Canada and the Russian Far East (Frost et al., 2019).

Research indicates that increased long-term photosynthetic activity should be expected in Arctic terrestrial regions (e.g. Bhatt et al., 2013; Urban et al., 2014), especially in the tundra biome, where the combination of higher temperatures and sufficient moisture availability facilitates greener vegetation.

Although some tundra regions became greener during the past decades, the last decade showed a browning trend of some parts of the boreal forest (AMAP, 2017), especially after experiencing extreme winter thaw events (followed by abrupt cooling and dissection), or rain-on-snow events. This could also be associated to other factors such as drier conditions during the growing season, fires, animal and insect activity, and/or industrial pollution (Xu et al., 2013), anomalies in snow depth (Bieniek et al., 2015), or reductions in plant moisture availability from changing hydrology linked to permafrost degradation (Frost & Epstein, 2014; Kim et al., 2014). For example, permafrost thaw and herbivory can lead to the greening and browning of certain areas (Lara et al. 2018; Pastick et al. 2019).

Increased plant mass has the potential to trap more snow (Whittington et al., 2012), to reduce blowing snow sublimation losses, reduce albedo (Lorantý et al., 2014), affect snow thermal properties (Domine et al., 2015) and melt season energy budget (Marsh et al., 2010). As a result, this produces predominantly positive feedbacks to soil warming and plant growth (Gouttevin et al., 2012; Johansson et al., 2013).

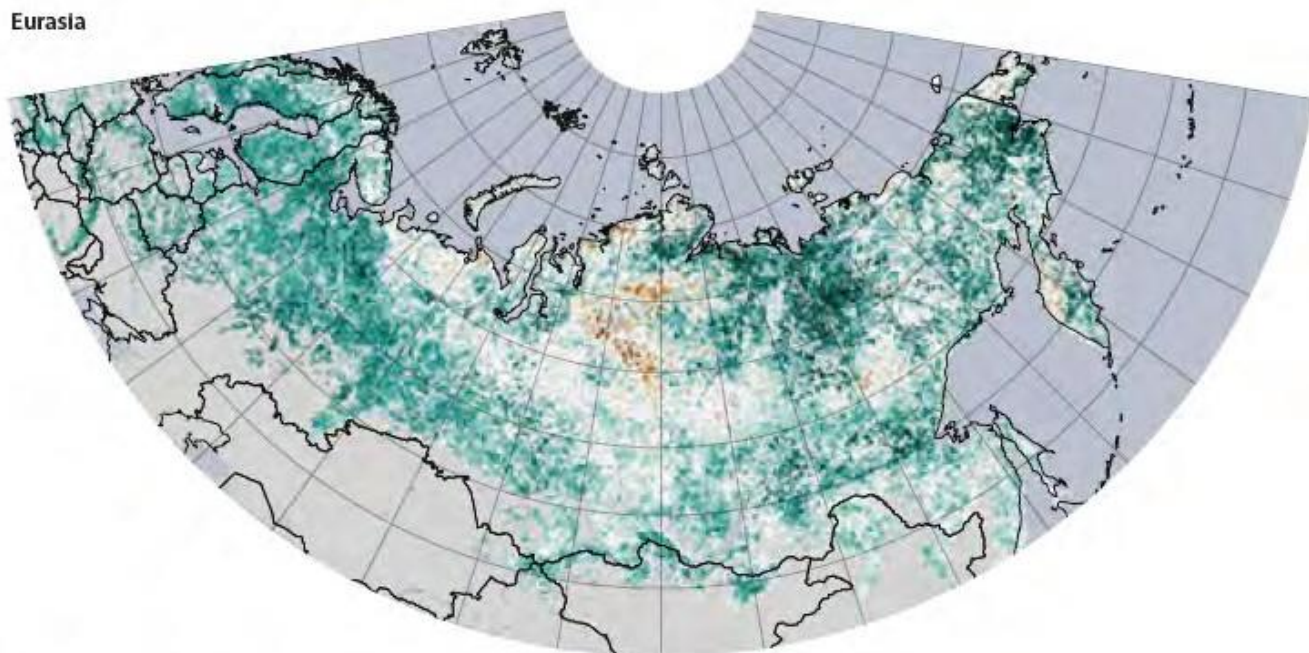
The analysis of data demonstrates that vegetation responses to temperature and precipitation will

differ according to the latitude (Miles et al. 2019), elevation (Verbyla & Kurkowski 2019), soil moisture (Rocha et al. 2018), and human land-use (Chen et al. 2019; Tømmervik et al. 2019).

Changes in Arctic vegetation (see Figure 12 below) can also lead to the potential reduction of water and food security. Major changes in the abundance and distribution of certain animal species (such as reindeer and salmon) have already been registered (AMAP, 2017). These changes represent concrete threats for northern communities, which in some cases strongly or completely rely on activities such as herding, hunting, fishing, breeding and gathering.

The content of this chapter evinces the multiple and diverse effects of climate change from a strictly bio-physical point of view. The complexity of these processes does not only rely on the wide variety of elements concerned and their resulting interconnections, but also on the necessity to analyze them within broader scales: impacts often exceed the local sphere and can equally extend to a regional scale. However, more information is still required to better understand the connectedness between climate change and permafrost thaw. For this purpose, chapter 2 will delve into the details of the specificities associated to the cryosphere, and more specifically, those from the frozen ground or “permafrost”. It will address the different landscape modifications that can be observed in the Arctic as a result of the influence of climate change on permafrost thaw.

Eurasia



North America

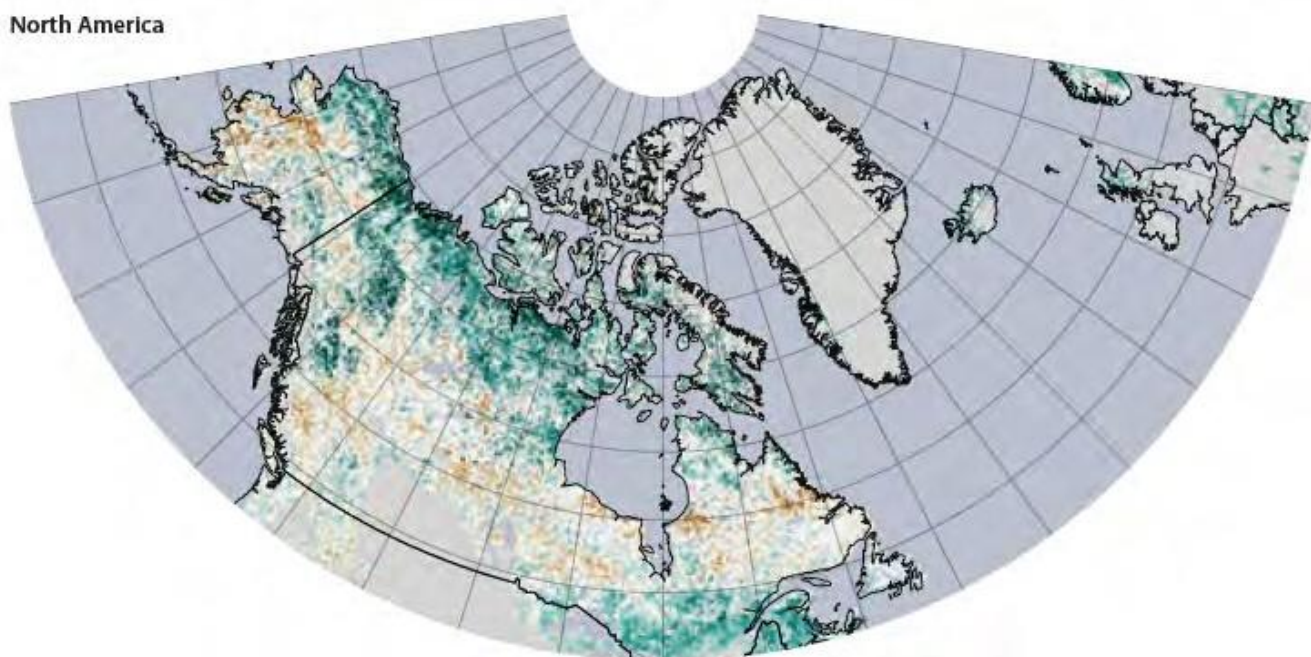


Figure 12: Vegetation greenness (normalized difference vegetation index) trend derived from satellite data for the period 1982–2011 for Eurasia and North America.

Source: Xu et al., 2013; NASA Earth Observatory in AMAP, 2017.

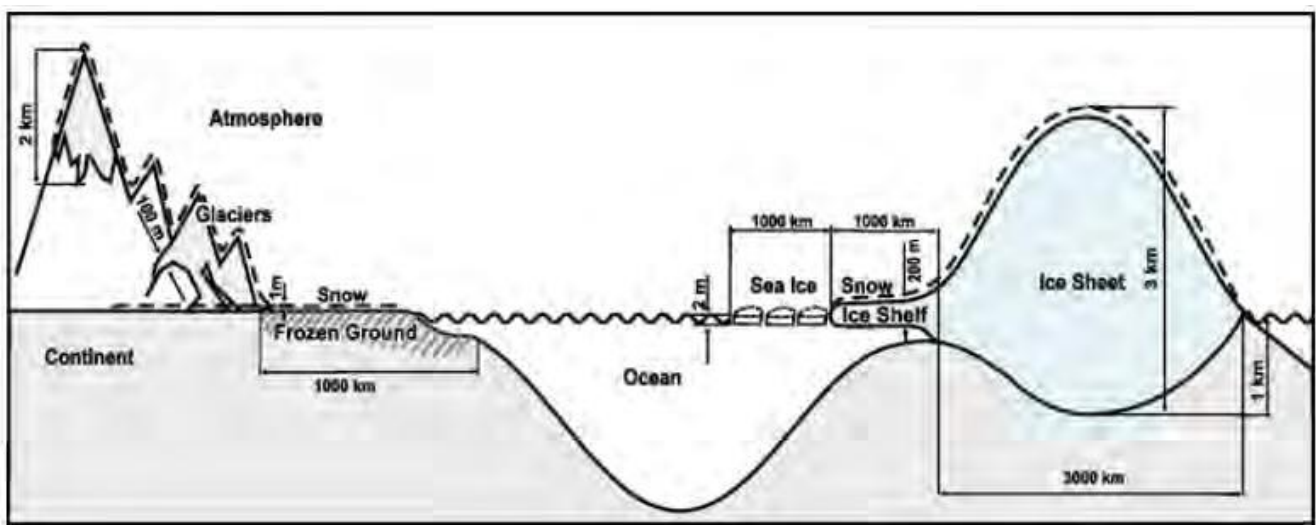
CHAPTER II: ARCTIC PERMAFROST THAW

This chapter presents a brief overview of the current understanding of permafrost, its thaw under climate change, and the associated impacts. It presents the diverse manifestations of permafrost thaw that have been observed and registered in the Russian Arctic during the recent past decades. The main bio-physical processes associated to frozen soil deterioration are described: coastal erosion, landslides, thermokarst and a reduction in bearing capacity.

II.A) THE CRYOSPHERE

The Arctic is characterized by the presence of water in its frozen state which constitutes the surface known as "cryosphere". It includes snow, terrestrial and sub-sea permafrost, river and lake ice, sea ice in all its forms, glaciers, ice caps, shelves and sheets (Solomon et al, 2007) (see figure 13 below). Each component is strongly interrelated to each other and plays a key role in maintaining the system functioning.

The presence of the cryosphere in the North shapes the development of human infrastructure: it is the surface where buildings, pipelines, and transport facilities are built, but also where meaningful places for northern residents are situated as well. It is essential for transportation and for the delivery of goods to remote communities during winter (West and Hovelsrud, 2010; Forbes, 2011).



*Figure 13: Different components of the cryosphere.
Source: IPCC AR4.*

The Arctic has been experiencing unprecedented changes and the effects have been registered. Between the last 20-30 years, the Russian Arctic permafrost temperatures have increased between 1-2°C (Romanovsky et al. 2010) and the depth of the active layer has also increased in many areas (ACIA, 2004). The overall proportion of frozen water has also decreased (AMAP, 2017). Sea ice extent has been shrinking and thinning (e.g: see Figure 14 below), mountain glaciers and ice caps keep retreating and the Greenland ice sheet is undergoing accelerated summer melt (Barry, 2017). Changes in terms of frequency and characteristics of precipitations have also been registered: it is now more frequent to see precipitations arrive as rain, especially in winter (which accelerates snowmelt). The phenomenon known as « rain-on-snow » became more frequent (AMAP, 2017). A warmer weather implies an increasingly positive permafrost feedback, while the albedo feedback decreases when both the ice and snow melt (Yumashev et al., 2019).

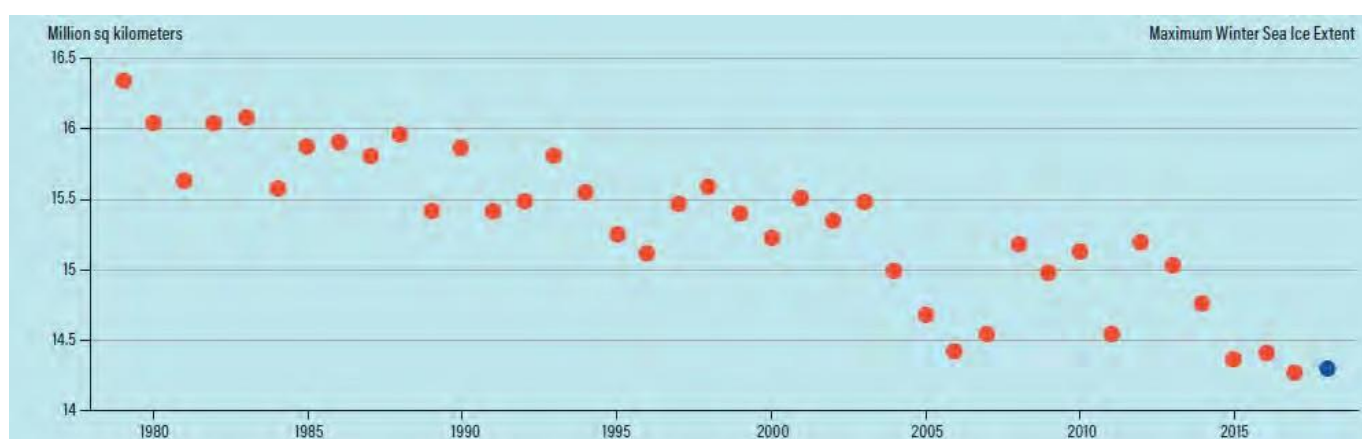


Figure 14: Maximum winter Arctic sea ice extent between 1979-2018.
Source: Overland et al., 2018.

The largest component of the cryosphere is the frozen ground, which is often considered to be the near-surface soil affected by freeze-thaw cycles, seasonally frozen ground and permafrost. The processes of thawing and freezing regulate the energy and moisture levels in the surface, and therefore interplay with climate and hydrologic systems (c et al., 2007).

II.B) PERMAFROST

Permafrost - also known as perennially frozen ground - is one of the components of the cryosphere and is defined as the soil, superficial deposits or bedrock that remains at 0°C or below for at least two consecutive years (AMAP, 2017; French, 2018). It extends along the Northern Hemisphere, amounting to about 15 million km² (Aalto et al., 2018). Its thickness can vary greatly, making it

possible to find some locations in Siberia where it reaches up to 1200 m deep (Tedrow, 2005). Another form of permafrost is the one situated beneath the seabed in the continental shelves of polar regions, known as subsea permafrost. However, this type of permafrost is formed under different circumstances (Lemke et al., 2007). Subsea permafrost was originally formed on the continental shelves when the shelves were exposed during periods of low sea level. Such was the situation during times of major glacial activity (Osterkamp & Gosink, 1991). The sea level would rise as glaciers melt (Are et al., 2002).

The importance of permafrost – usually containing ice - in the Arctic resides in the fact that it shapes the biogeophysical conditions of the surrounding environment and therefore, the human activities as well. This characteristic will also determine the strength and stability of the frozen ground (Callaghan et al., 2011).

Permafrost can be classified as continuous (90%), discontinuous (50–90%), sporadic (10–50%) zones, or isolated patches (10%) according to the areal continuity of its coverage (see Figure 15 below) (Anisimov & Zimov, 2020). The amount of ice - contained in permafrost, also known as “ground ice”, also plays a key role in the type of reactions to climate change. According to the Canadian Permafrost Association (n.d), ground ice can be found under different forms: as segregated ice (either as lenses or layers), ice wedges (which can grow beneath tundra polygons), or massive ice (as layers or bodies of ice).

Permafrost rich in ice-content exceeding that of soil pores is usually known as “rich-ice permafrost” (ACIA, 2004; French, 2007). Eastern Siberia contains rich-ice permafrost which contains more than 40% volume of ground ice in the form of segregated ice and massive ice- wedges (Harris, 1988; French & Shur, 2010). Its degradation can lead to the formation of thermokarst lakes (Kaufman et al., 2004; Wanner et al., 2008). Another particular form of permafrost is known as “Yedoma Ice Complex deposits” which are permafrost deposits of silt and sand-rich organic sediments that can reach up to tens of meters thick and contain large amounts of ground ice. They contain between 2% and 5% of organic carbon (Strauss et al., 2017). These characteristics made them particularly sensitive to warmer temperatures (Schirrmeister et al., 2020).

Above permafrost, there is the active layer, which is traditionally identified as the portion of soil that experiences seasonal freeze and thaw (Ping, 2005) (see Figure 16 below). The active- layer is deeper in warm permafrost regions than in cold permafrost regions (Changwei et al., 2015). It is involved

in the regulation of soil carbon and the soil hydrology (Anisimov & Zimov, 2020). Monitoring the thickness of active layer provides information about decadal trends in each region.

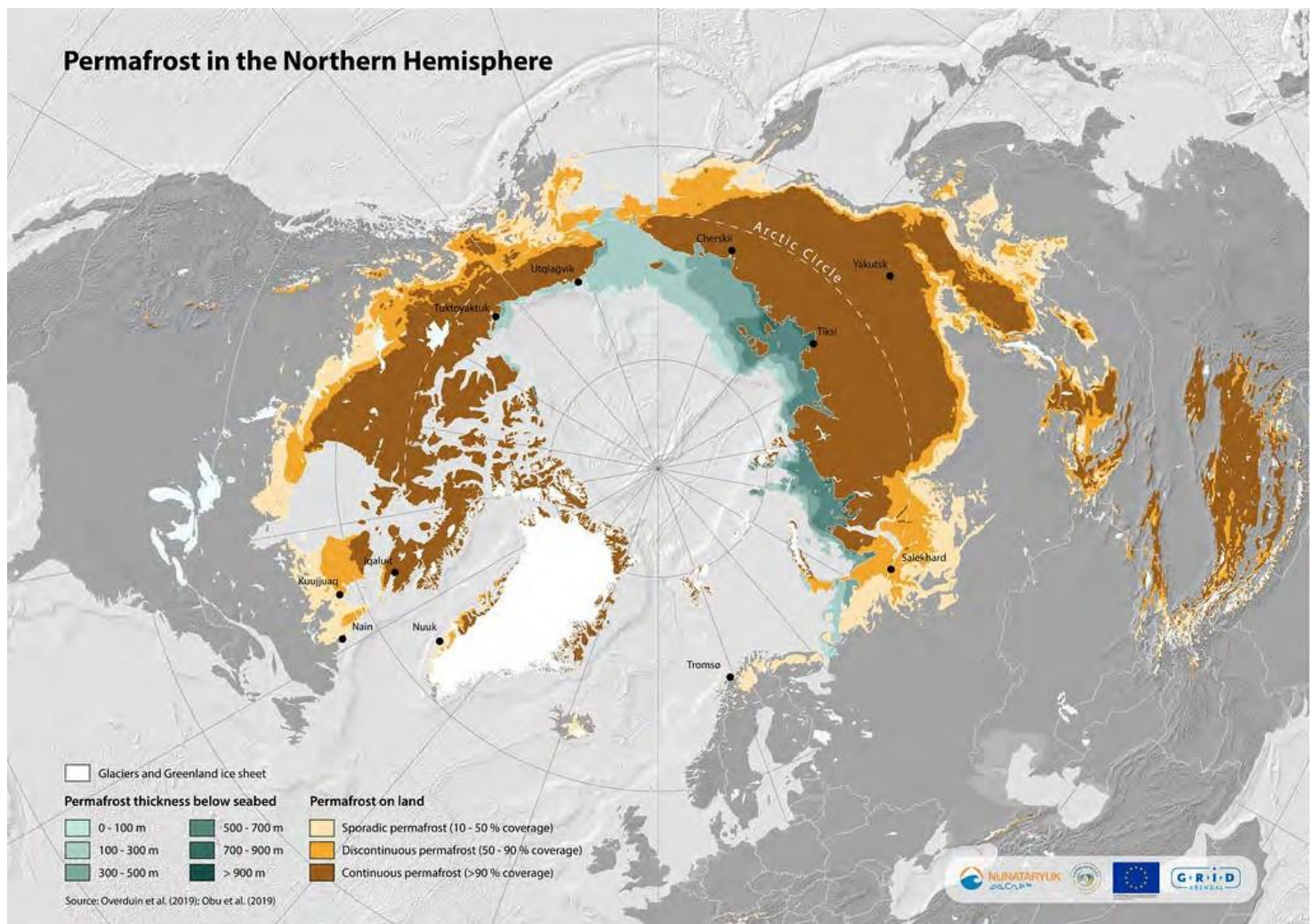


Figure 15: Terrestrial and submarine permafrost distribution in the Northern Hemisphere.
Source: GRID- Arendal / Nunataryuk

The zero annual temperature is considered to be the deepest point inside permafrost which is not affected by annual temperature variations. The thawing season is closely related to climate: at the beginning of June, seasonal thaw usually begins in snow-free areas. By the end of July and early August, this process reaches its maximum, varying between a couple of centimeters in the far north (Tedrow, 2005) and 20 meters or more in other areas (Dobiński, 2020). Below permafrost, there is a deep layer of unfrozen ground.

The state of permafrost is best defined by two main characteristics:

- the soil temperature and
- the active layer thickness

The first one contributes to the understanding of mid to long term climate variability, while the second one reflects changes in summer temperatures (Anisimov, 2017) and is usually measured at the end of summer when the maximum thaw depth is reached (Connon et al., 2018). Rigorous and systematic permafrost temperature monitoring in Russia started in the 1950s at hydrometeorological stations (Lemke et al., 2007).

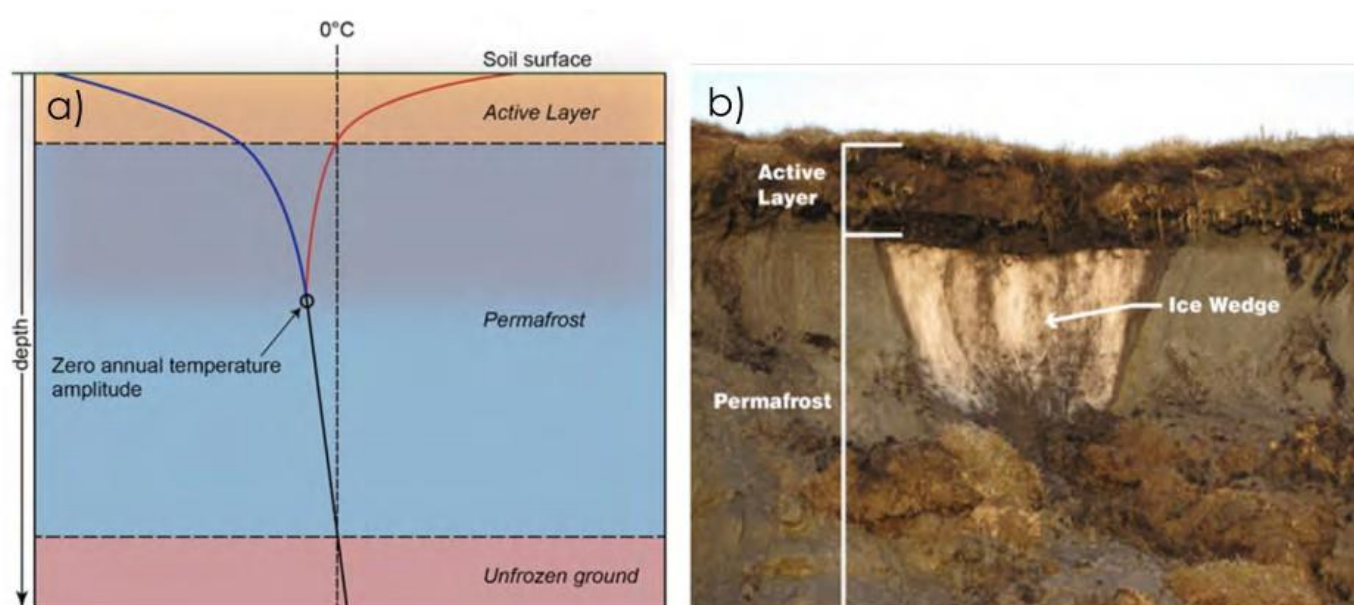


Figure 16: Permafrost and the active layer distribution.

Source: ADAPT, <http://www.cen.ulaval.ca/adapt/communications/permafrost101.php>

II.C) PERMAFROST THAW

Russia is the country with the largest extent of permafrost, especially in its Arctic region, (French, 2018). The entire territory of the Republic of Sakha contains some form of permafrost (see Figure 17 below). The Republic of Sakha is characterized by the wide distribution of ice complex permafrost, covering more than 1 million km² (Desyatkin & Desyatkin, 2019). Although population in the Russian Arctic is sparsely distributed, its contribution to the economy represents 20% of the national GDP and 22% of the total exports are original from arctic regions (Khrustalev et al. 2011).

One of the most visible current impacts of warmer temperatures in the Arctic is accelerated permafrost thawing. In accordance with the global warming trend, the temperature of the active

layer has also been increasing since 1980s by about 3°C in the Arctic region, and consequently, became deeper in most areas where permafrost is monitored (AMAP, 2017). The seasonal frozen ground has decreased by about 7% in the Northern Hemisphere since 1900 (IPCC, 2007).

Changing climatic conditions – more specifically, rising air temperatures and changing snow regimes- influence the overall thermal state of permafrost (Biskaborn et al., 2019). Recent reports have registered increasing permafrost temperatures during the last decade of up to $0.39 \pm 0.15^{\circ} \text{C}$ in the continuous and $0.20 \pm 0.10^{\circ} \text{C}$ in the discontinuous zones (Biskaborn et al. 2019). However, it is important to take into consideration other local factors that may also alter permafrost conditions, such as snow cover (Park et al., 2013), vegetation variations (Fedorov et al., 2019), organic layer, soil moisture/ice content, drainage conditions and human activities, for example: forest fires can lead to the removal of the insulating organic layer, resulting in an increase of permafrost temperature. Sea and river erosion can also lead to shifting shorelines. It has also been demonstrated that building heated structures (such as buildings and pipelines) on permafrost can also alter its properties (Callaghan et al., 2011).

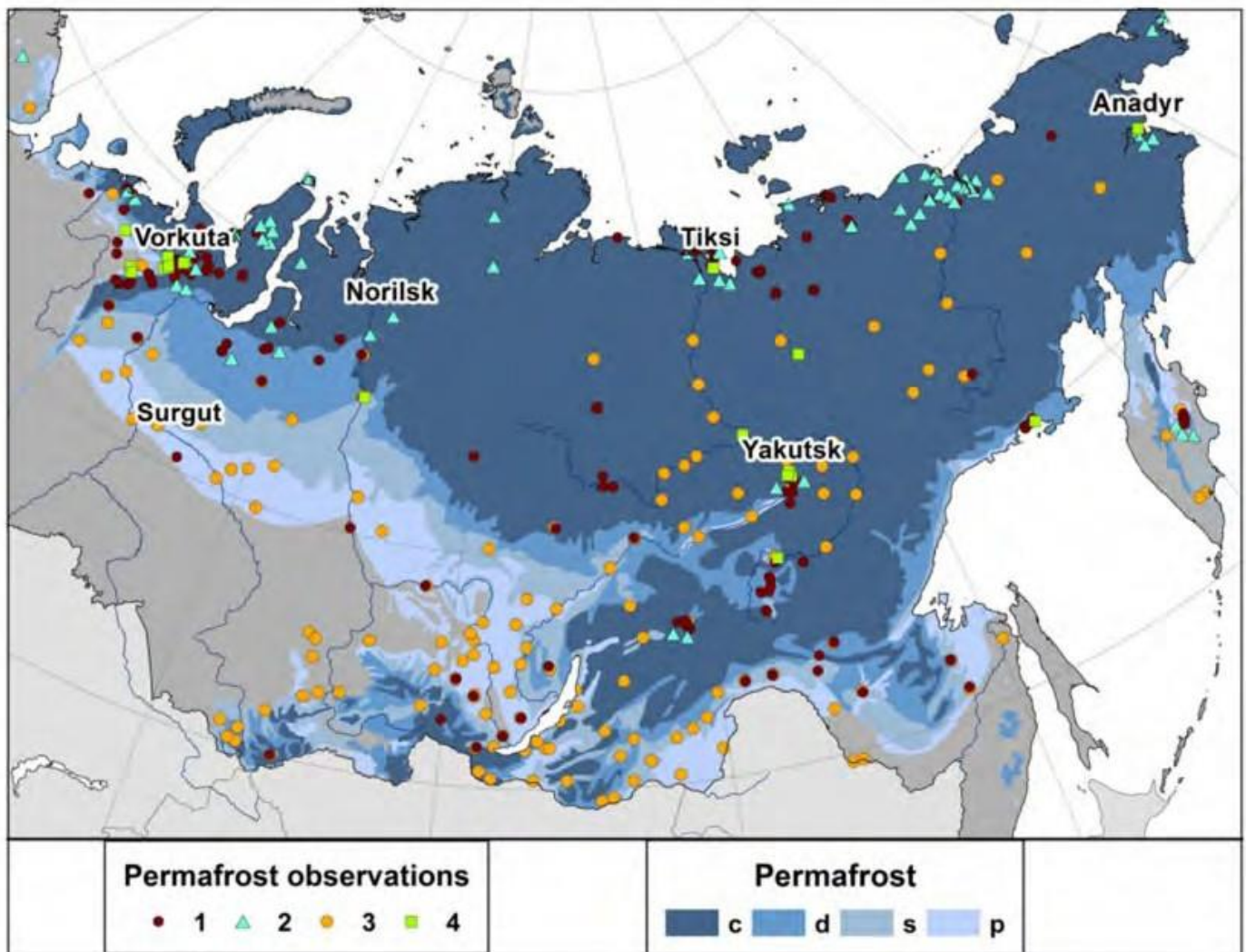


Figure 17: Map with permafrost zones designated c (continuous), d (discontinuous), s (sporadic), and p (isolated patches).

Source: Anisimov & Zimov, 2020.

II.D) LANDSCAPE MODIFICATIONS ASSOCIATED TO PERMAFROST THAW

The aforementioned elements will introduce several modifications in permafrost conditions. This has profound impacts on several spheres including the ecology, greenhouse gas emissions, human infrastructures, etc. There exists a wide variety of manifestations, according to the local conditions and emplacement. There are several thaw-related landscape modifications resulting from thawing permafrost, subsidence, and the removal of soil material. However, most of them are the result of the interaction of multiple events/processes at the same time (Jones et al., 2013). For example: the deepening of the active-layer, the water accumulation on the soil surface, permafrost degradation, changes on lake shores and coastal bluffs, among others (Shur & Osterkamp, 2007).

Below, I introduce a non-exhaustive list of six geomorphic features which characterize upper

latitudes permafrost terrains under permafrost thaw conditions:

- 1) coastal erosion ;**
- 2) ice-wedge polygons ;**
- 3) thermokarst terrain ;**
- 4) taliks ;**
- 5) pingos (conical ice-cored hills);**
- 6) sinkholes**

II.D.I) Coastal erosion

Depending on the data used, between 30-34% of world's coastlines are permafrost coasts (Lantuit et al., 2013). Changes in the coastline are the result of multiple – and sometimes simultaneous - events such as the fall storms, high-water events and summer ground thaw, among others (Overduin et al., 2014). Anthropogenic and technogenic factors can also unchain erosive processes (Streletskiy et al., 2014).

Coastal erosion in Arctic settlements occurs at a faster pace than in temperate coasts (Salman et al., 2004). Each cryosphere components influence coastal erosion differently. For example, sea ice bounded to the shore (or ice floes during the open-water season), does not prevent waves from eroding Arctic coasts but reduces the rates of sediment transport processes in comparison to nearshore ocean (Barnhart et al., 2014). Permafrost can accelerate coastal erosion by reducing the cohesion existing in the sediments (Lantuit et al., 2013), especially as they are highly sensitive to increases in air temperature and modifications in sea-ice cover extent (Callaghan et al., 2011). Ground ice contained in permafrost coastal systems (see Figure 18 below) accelerates “thermal abrasion” (Aré, 1988), which encompasses the coordinated action of waves and thawing permafrost (Lantuit et al., 2012). Melting ground ice increases coastal susceptibility to erosion, (Hequette & Barnes 1990; Kobayashi et al. 1999). This is particularly relevant when it appears as massive ice in coastal cliffs, or when thermokarst features are developed in the coastal zones (Lantuit & Pollard 2005; 2008).

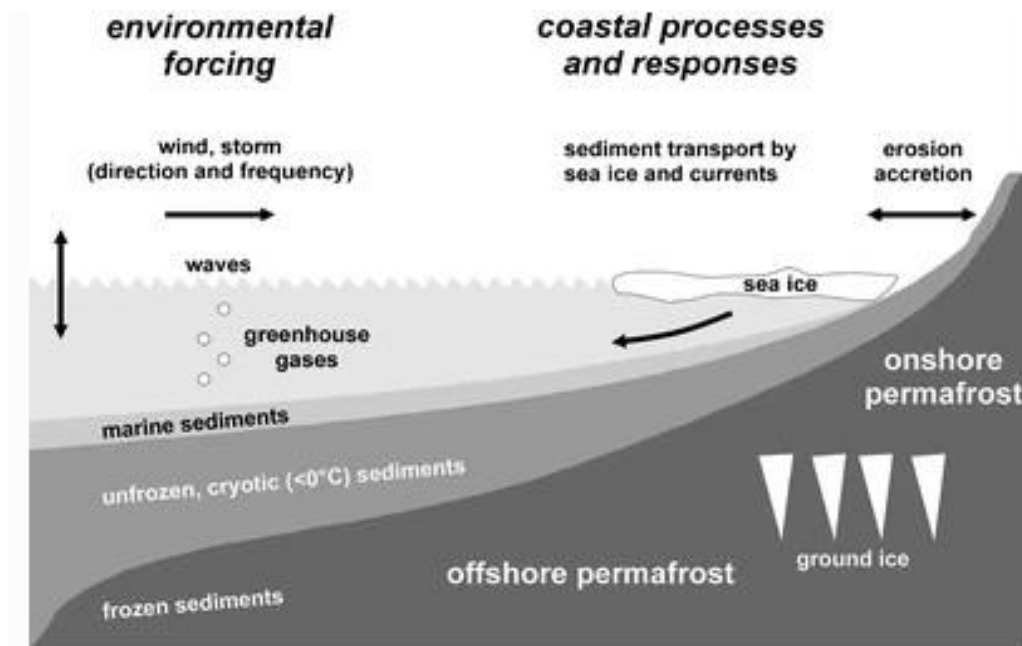
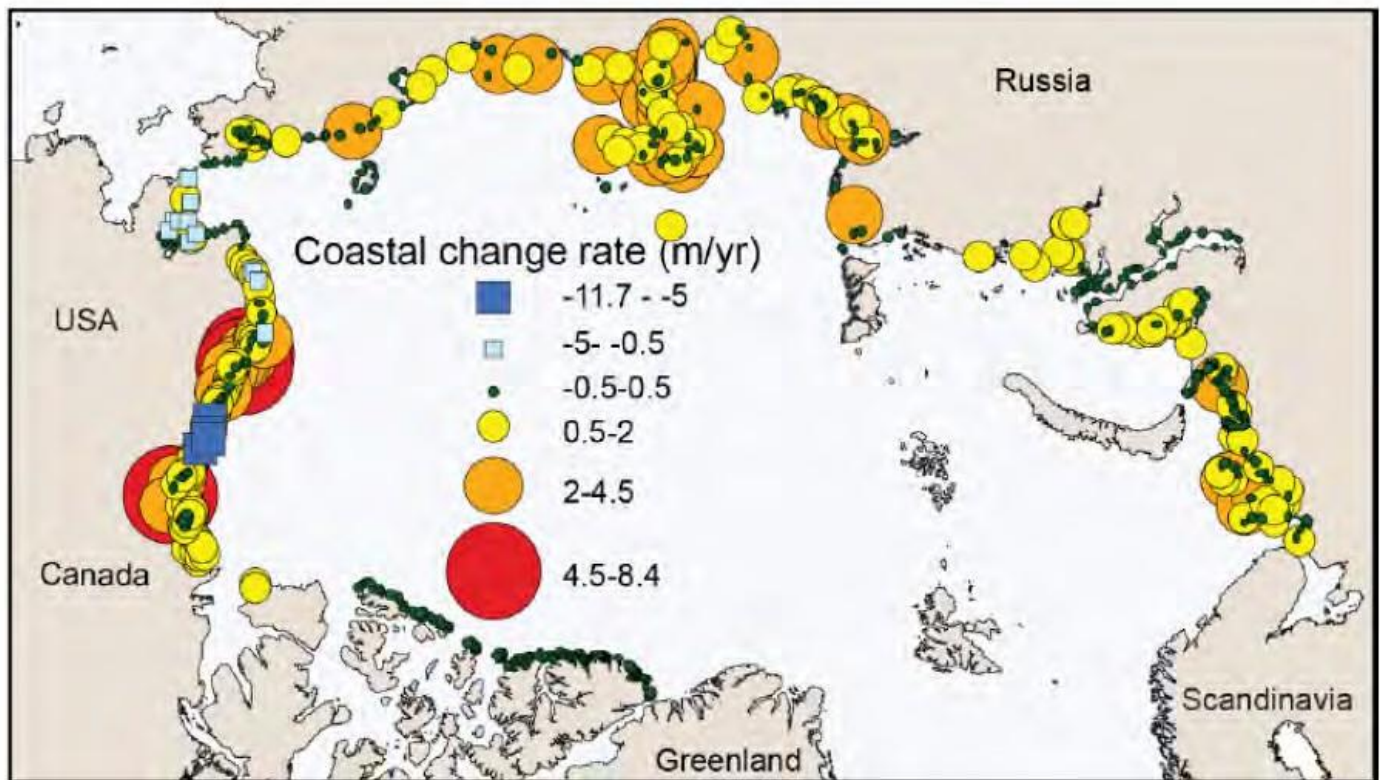


Figure 18: Setting and active processes on Arctic permafrost coasts.
Source: Lantiut et al., 2012.

The relationship between the number of days of open water, the erosion rate and the ice content is not linear nor easy to determine. According to Barnhart et al. (2014), higher coastal erosion rates are associated to longer open-water seasons and higher amounts of ice. Nevertheless, high rates of coastal erosion have also been registered in areas with different pre-conditions. Based in satellite data and in situ observations, different maps containing information about coastal erosion rates at different scales have been elaborated (e.g: figures 19 & 20). The Russian Arctic is one of the regions experiencing major coastal erosion and it has been estimated that every year, about 30 km² of coasts are eroded and lost. The Laptev Sea retreat rates vary from 0.5 to 5.9 m/y (Anisimov, 2017). However, these are rates are lower than those registered in the Kara and Barents Seas (Pizhankova & Dobrynina, 2010; Pizhankova, 2011). Such differences can be predominantly explained by the particular local topography which prevents the development of waves in the coastline.



*Figure 19: Coastal erosion rates (expressed in meters per year) along the circum-Arctic.
Source: Frederick et al., 2016 adaptation from Banhart et al., 2014; Lantuit et al., 2012.*

Coastal erosion can also release big amounts of heavy metals into nearshore waters which can alter the local food webs. This can represent a real threat for the food security of northern residents. Further research is still required in order to better understand the role of released nutrients into the ecosystems, and how these may impact traditional activities like fishing and hunting (Fritz et al., 2017), which are two bases of many northern households and community economies.

Similarly, when coastal permafrost thaws, organic carbon is added into the sea. According to Hugelius et al. (2014), about $1,035 \pm 150$ Pg (1015 g) of soil organic carbon are stored in permafrost, which represents 20% more carbon than is currently circulating in the atmosphere (Houghton, 2007). Oceans absorb carbon dioxide, contributing this way to slow the buildup of this greenhouse gas. But when new sources of carbon are added to the oceans, the atmospheric absorption of CO₂ can decline (Couture et al., 2018). Once terrestrially derived organic carbon is released, there are three main possibilities: it can either be remineralized in the water column, it can be buried on the shelf, or transported deeper into the ocean (Fritz et al., 2017).

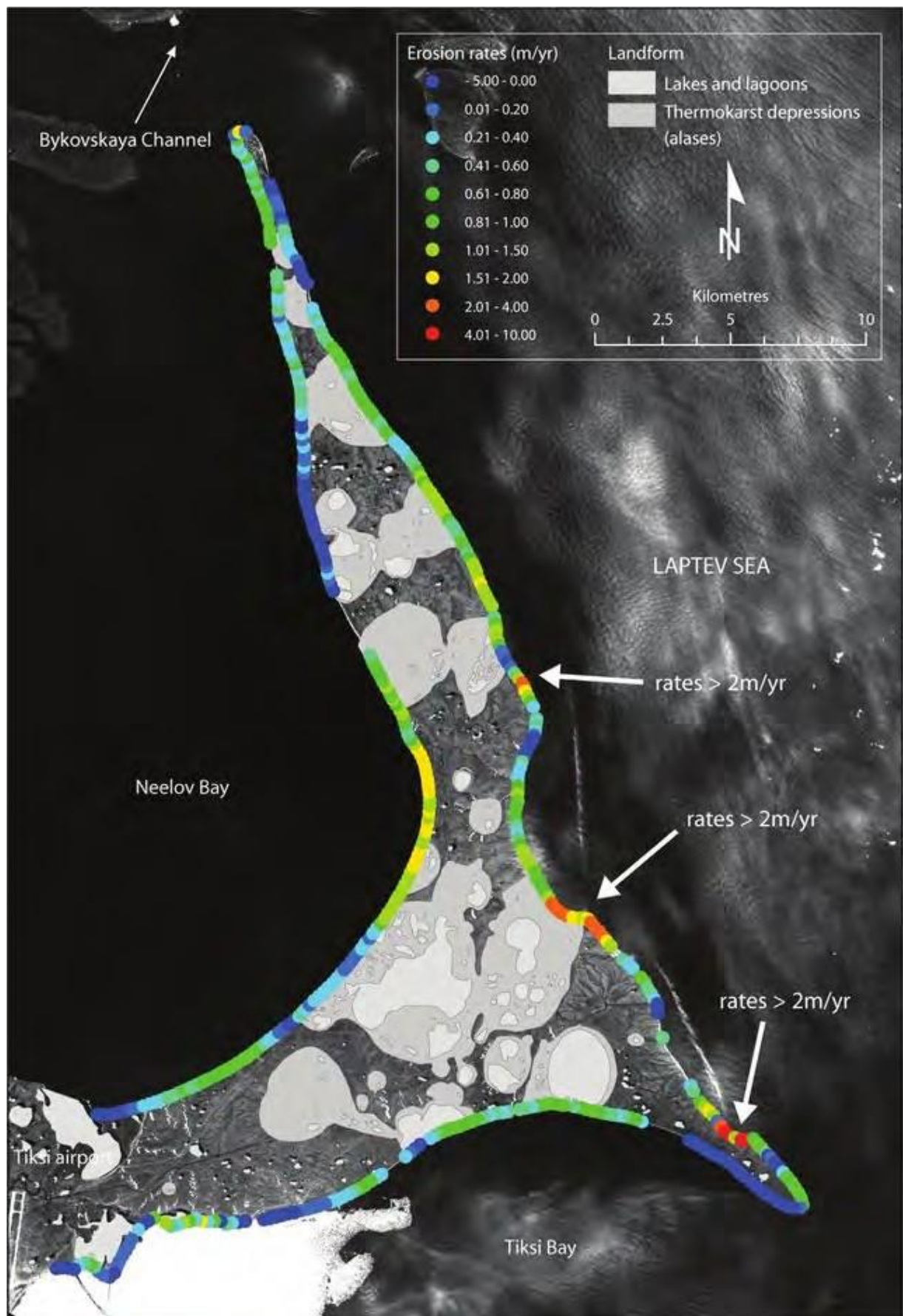


Figure 20: Coastal erosion rates on the shores of the Bykovsky Peninsula for six periods between 1951 to 2006. Source: Lantuit et al., 2011.

Excavations and the removal of shoreline sediments for human constructions can also lead to an increase of the active layer thickness (Anisimov, 2017). On the other hand, infrastructure, buildings and houses (see Figure 21 below), archeological sites, geodesic and navigational infrastructure, fuel tanks and light houses built on the coastlines are increasingly vulnerable to coastal erosion. Some settlements have already been relocated in Republic of Sakha (Filippova, 2020) and some other communities will require to be relocated in the near future due to persistent flooding and accelerated bank erosion processes associated to permafrost (Furgal, 2008; National Round Table on the Environment, & the Economy, 2009). This process represents an additional challenge for local governments' as it increases engineering and maintenance costs.

Engineering adaptive strategies have already been implemented in some areas and new technologies are constantly emerging, but at very high costs, which make them unaffordable for many. A wide and flexible range of tools still need to be developed in order to continue adapting to new processes, including hazard index calculations, high spatial resolution projections of permafrost change and probabilistic active-layer change maps, among others (Callaghan et al., 2011).



Figure 21: Left side: Local residents' houses in the coastal settlement of Bykovsky. Right side: Cemetery of Bykovsky experiencing coastal erosion.

Source: Photos taken during the fieldwork of 2019.

II.D.II)Ice wedge polygons

Ice wedges are one of the most characteristic features of northern permafrost landscapes and are considered to be an important climate archive (Opel et al., 2018). It is one type of ground ice within permafrost that is formed when new cracks open in winter due to thermal contraction. The polygons

are filled with snow meltwater during the following spring, rapidly refreezing under subzero ground temperatures (see Figures 22 & 23 below). As a result of these processes, underground ice veins are formed (Meyer et al., 2015). Due to these freezing/cracking processes, ice wedges grow in polygonal patterns (Opel et al., 2018) that enclose cells of frozen ground. Ice wedges develop with repeated winter cracking, refilling, and refreezing (O'Neill & Christiansen, 2018). Repeated cracking year after year leads to lateral growth, exerting strong lateral forces which push up adjacent sediments. This is how the edges and centers of the ice-wedge polygons are formed (Tedrow, 2005). Generally, they can measure between 10 and 30 meters in diameter and their formation can take up to thousands of years (Murton et al., 2007). The troughs are the top of the ice wedges and are underlain by vertical ice wedges across on the top that are kept together under the form of a honeycomb network (see Figure 22 below). In some areas, drainage follows the troughs of the polygons and at ice wedge junctions, melting may occur, leading to the formation of small pools. The joining of these small pools by a stream forms the so-called "beaded drainage".

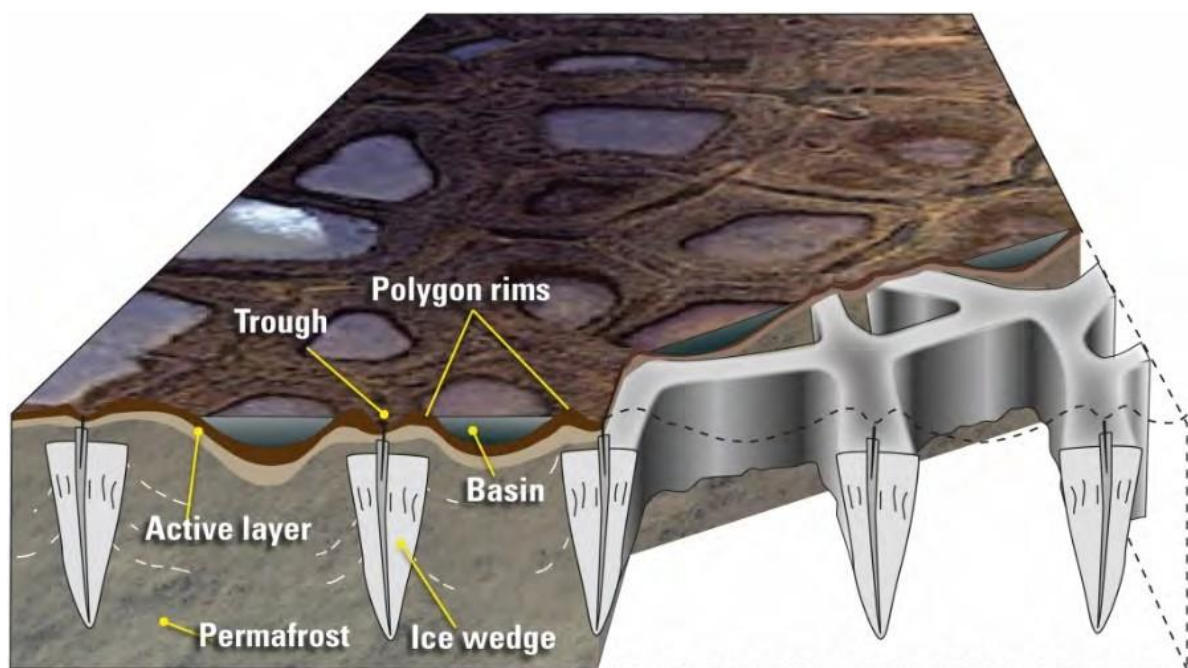


Figure 22: Illustration of ice wedges formation.

Source: *Elaborated by R. Mitchell/ U.S. Fish and Wildlife Service workshop report, Wildlife Response to Environmental Arctic Change (WildREACH)*

Water trapped within the polygon ridges usually leads to peat formation. These new polygon mires are particularly relevant in the Arctic ecosystems due to their high content of carbon and methane (Walter et al., 2006). Climate change will impact these ecosystems, increasing the emissions of greenhouse gasses. However, it is still difficult to estimate the real impacts due to the complex and

simultaneous interactions between different components. On the one hand, specific site-conditions can remain stable in spite of climate change under certain circumstances. For example, when permafrost thaw is retarded by the development of a denser and insulating layer of vegetation cover and when soil becomes dryer (Walker et al., 2003). On the other hand, conditions can be altered when thresholds are surpassed (Camill & Clark, 2000), for example, when permafrost-thaws and wet surface conditions are developed (De Klerk et al., 2011).

Ice wedges degradation due to warmer temperatures, affects different spheres of the Arctic environment, including the topography, hydrology, vegetation, soils, and human infrastructure (Kanevskiy et al., 2017). When ice wedges degrade in continuous permafrost zones, two characteristic landforms are formed: thermokarst pits and troughs (Shur & Osterkamp, 2007; Jorgenson et al., 2008; Kokelj & Jorgenson, 2013). Initially, only scattered pits at ice-wedge intersections can be identified. During the following stages, a polygonal network of water-filled or drained troughs surrounding high-centred polygons becomes finally visible (Kokelj & Jorgenson, 2013). Wide troughs are called "baydjarakhs" in Russia. Although these processes have already been observed in the past, current research indicates that this is now occurring at a faster pace, especially in cold continuous permafrost regions (Jorgenson et al., 2015; Liljedahl et al., 2016). More specifically, there has been a rapid increase in changes in the extent of ice-wedge thermokarst which are mainly indicated by water-filled troughs (Swanson, 2016; Steedman et al., 2017).



*Figure 23: Ice wedge in permafrost along the Aldan River, Siberia.
Source: Tedrow, 2005.*

II.E) THERMOKARST

The term "thermokarst" originally appeared in Russian literature and has been evolving through time (Jones et al., 2013). Recent research in the Arctic, Subarctic and Antarctic regions have identified 22 different thermokarst landforms according to their topography and particular characteristics (Jorgenson et al., 2008). In general terms, thermokarst refers to the particular hummocky terrain resulting from the thawing of ice-rich permafrost and/or melting of massive ice that result in consolidation and deformation of the soil surface and formation of specific forms of relief (Shur, 1988). It is particularly common in areas underlain by ice wedges (Lemke et al., 2007). A small trough pond is formed when water accumulates in the depressions formed by ground subsidence, and may ultimately become a thermokarst lake. Thermokarst is the result of a disruption of the thermal equilibrium of permafrost and an increase in the depth of the active layer (Czudek

& Demek, 1970). Data gathered demonstrates that new thermokarst lakes are appearing in the Russian permafrost regions (Biskaborn et al., 2013; Bryksina & Kirpotin, 2012; Kravtsova & Tarasenko, 2011; Manasypov et al., 2014) and changes in their extent are useful regional climate change indicators (Anisimov, 2017).

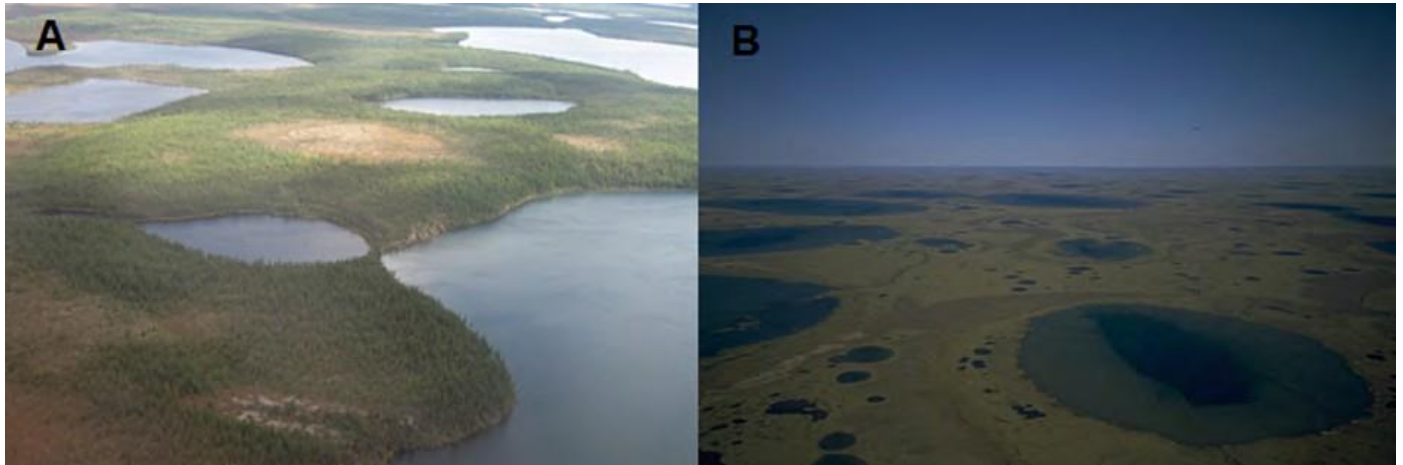
Thermokarst lakes are the result of interactions between several components and events in the Arctic environment (Kokejl & Jorgenson, 2013). For example: a reduction in albedo and increase in the absorption of long-wave radiation; high heat storage capacity of water; convective heat flux from moving water at the lake bottom and the shoreline interface; conductive heat transfers between sediments; erosive processes unchained by the action of waves and the consequent sediments transport at the collapsing bank; warming of ice-rich bluffs occasionally being exposed directly to direct solar radiation; and thaw settlement beneath lakes (Kokelj et al., 2009; Plug & West, 2009; Grosse et al., 2008).

Grosse et al. (2013) specified that thermokarst lakes (see Figure 24 below) are key components of permafrost landscapes for several reasons, as follows:

- **First of all, they alter the surface energy balance and therefore feedbacks on the ground thermal regime (Jorgenson et al., 2010) and the energy exchanges between the land and the atmosphere (Rouse et al., 2003).**
- **They contain carbon dioxide (CO²) and methane (CH⁴) (Zimov et al., 1997). Methane is released as a result of microbial decomposition of organic matter, contributing as a northern methane source to the current atmospheric carbon budget (Walter et al., 2006).**
- **They have an important role for wildlife as they provide habitat for different species, especially fishes and birds (Vincent & Hobbie, 2000; Alerstam et al., 2001).**
- **Northern residents use them as a residential freshwater source (Martin et al., 2007) and as fishing and hunting grounds. These are essential to maintain their subsistence lifestyle (Vincent & Hobbie, 2000; Berkes & Jolly, 2001).**
- **They are used for industrial purposes, principally for mineral and hydrocarbon resource exploration and development and winter ice road construction (Sibley et al., 2008; Jones et al., 2009), and as fishing and hunting grounds in the subsistence lifestyle of many people in remote northern communities (Vincent and Hobbie, 2000; Berkes & Jolly, 2001).**

In the context of climatic changes, it is important to analyze thermokarst lakes because they develop and expand through permafrost surface degradation (Grosse et al., 2013). The general distribution,

development and changes over time of thermokarst lakes in Russia are determined by several regional lake studies, sensing data and maps (Are, 1974; Anan'eva, 2000; Morgenstern et al., 2011). For example, Smith et al. (2005) analyzed lake changes between 1973 and 1997–98 and found two different trends: on the one hand, he found that in continuous permafrost zone in Siberia, thermokarst lakes have increased in surface area extent due to shoreline erosion. While in other regions, especially zones of discontinuous permafrost, the amount and extent of lakes have decreased due to the penetration of taliks and subsurface drainage.



*Figure 24: Aerial photos of thermokarst lakes in (A) Kolyma lowland, Siberia; (B) Lena river delta, Siberia (Photo: G. Schwamborn, AWI Potsdam).
Source: Grosse et al., 2013.*

Beyond drainage in thermokarst basins, other processes are unchained (Grosse et al 2013) such as permafrost aggradation (an increase in the thickness and/or areal extent of permafrost caused by natural or artificial causes), frost cracking of soils, ice wedge formation, basin floor inflation (Ling & Zhang, 2004; Jorgenson & Shur, 2007), slope relaxation (Plug & West, 2009; Ulrich et al., 2010), and peat accumulation (Hinkel et al., 2003; Bockheim et al., 2004).

When permafrost thaws, two different thermokarst landforms can appear near the banks of thermokarst lakes:

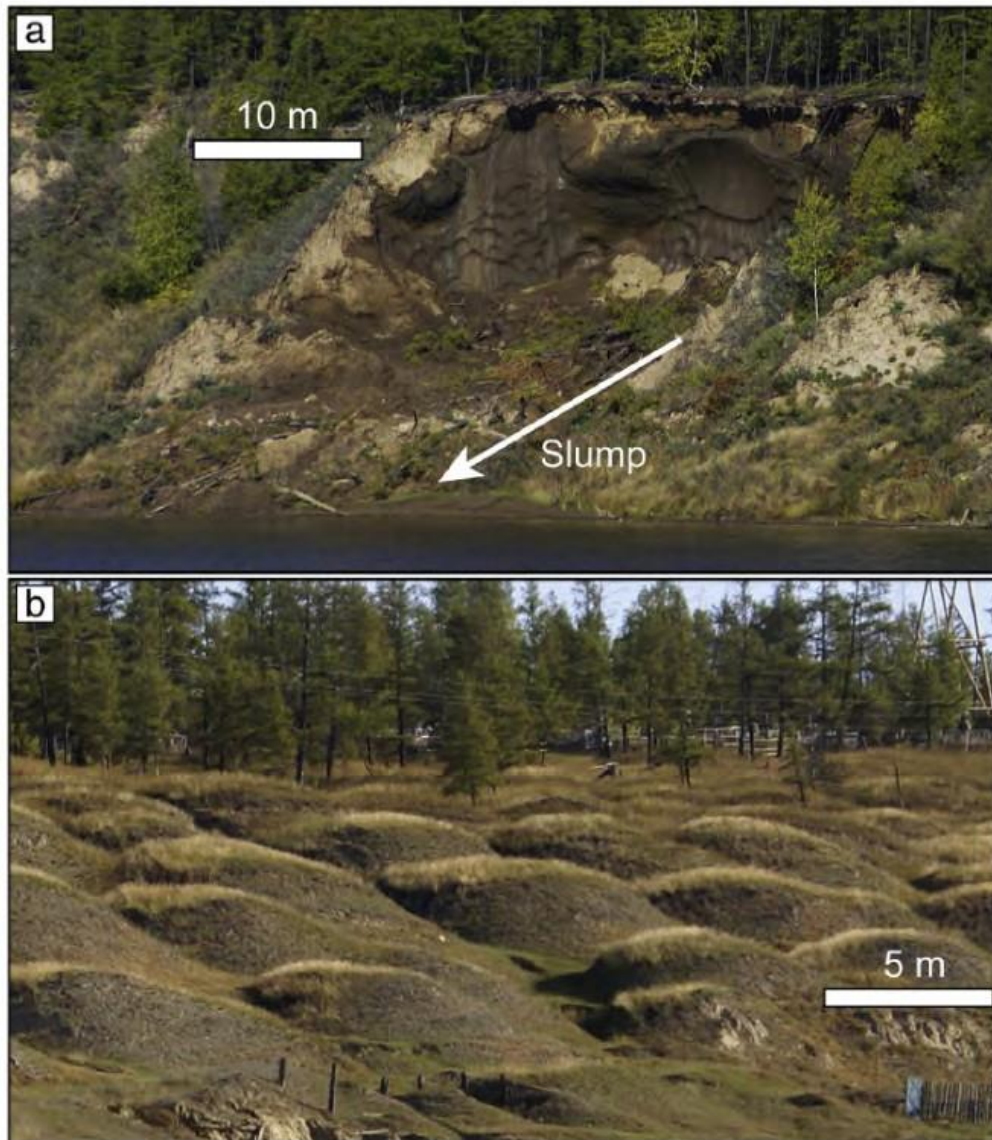
- 1) retrogressive thaw slumps (see Figure 25 below)
- 2) degraded ice-wedge polygons (known as "baydjarakhs" in Russian).



Figure 25: Retrogressive thaw slumps on the coast of the Bykovsky Peninsula. A man in the background gives the scale of the headscarp and is indicated by the black arrow.

Source: Lantuit et al., 2011.

The melting of ice-wedges can unchain the formation of conical polygons with wide troughs known as "baydjarakhs" in Russian (see Figure 26 below) (Popov, 1956; Soloviev, 1973). The continuous thawing of baydjarakhs can lead to the formation of thermocirques (Czudek & Demek, 1970). The water and suspended matter concentrated in the bottom of the thermocirques can be driven toward the lakes (Séjourné et al., 2011).



**Figure 26: (a) Thermocirques produced by retrogressive thaw slumping (b) Highly-degraded conical ice-wedge polygons or “baydjarakhs”.
Source: Séjourné et al., 2015.**

Retrogressive thaw slumps are localized terrain disturbances (Lewkowicz & Way, 2019) and usually include a headscarp of thawing ice-rich sediments or massive ice, an overlying headwall (the highest cliff of a glacial cirque) composed of the active layer, and a bowl downslope filled with mud, which is actually a mix of meltwater and soil resulting from the collapse of the under-cut headwall- (Burn & Lewkowicz, 1990). Their presence in high concentrations impacts different spheres: the stream sediment and solute transport (Kokejl et al., 2013; Rudy et al., 2017), lake water quality (Kokejl et al., 2005), coastal erosion and sedimentation (Lantuit & Pollard., 2008; Rudy et al., 20017; Ramage et al., 2017) and carbon cycling (Olefeldt et al., 2016; Schuur et al., 2014; Cassidy et al., 2017). Their initiation rates and spatial distribution are expected to be altered as a consequence of accelerated changes in climate (Lantuit et al., 2018; Rudy et al., 2017; Segal et al., 2016; Lantz & Kokejl, 2008).

Other forms of thermokarst are the active layer detachments on slopes, degrading peat plateaus and palsas (Lewkowicz & Way, 2019). It is important not to confuse active layer detachments with retrogressive thaw slumps (see Figure 27 below). In fact, active layer detachment consists of a rapid mass movement process with downslope movement of materials along the base of the active layer (Lewkowicz & Way, 2019). They usually have a scar area of degraded permafrost, highly disturbed soils along lateral shear zones and a downslope area where earth materials accumulate (Lewkowicz, 2007).

They usually occur in summer and are caused by mechanical discontinuities in the substrate (Lewkowicz, 1990). They can severely damage structures (Lemke et al., 2007). Active layer detachments stabilize in autumn, when air temperatures drop and the melting of the ground ice ceases and reactivate the following summer. At this moment, the ground ice becomes re-exposed (Lewkowicz & Way, 2019).

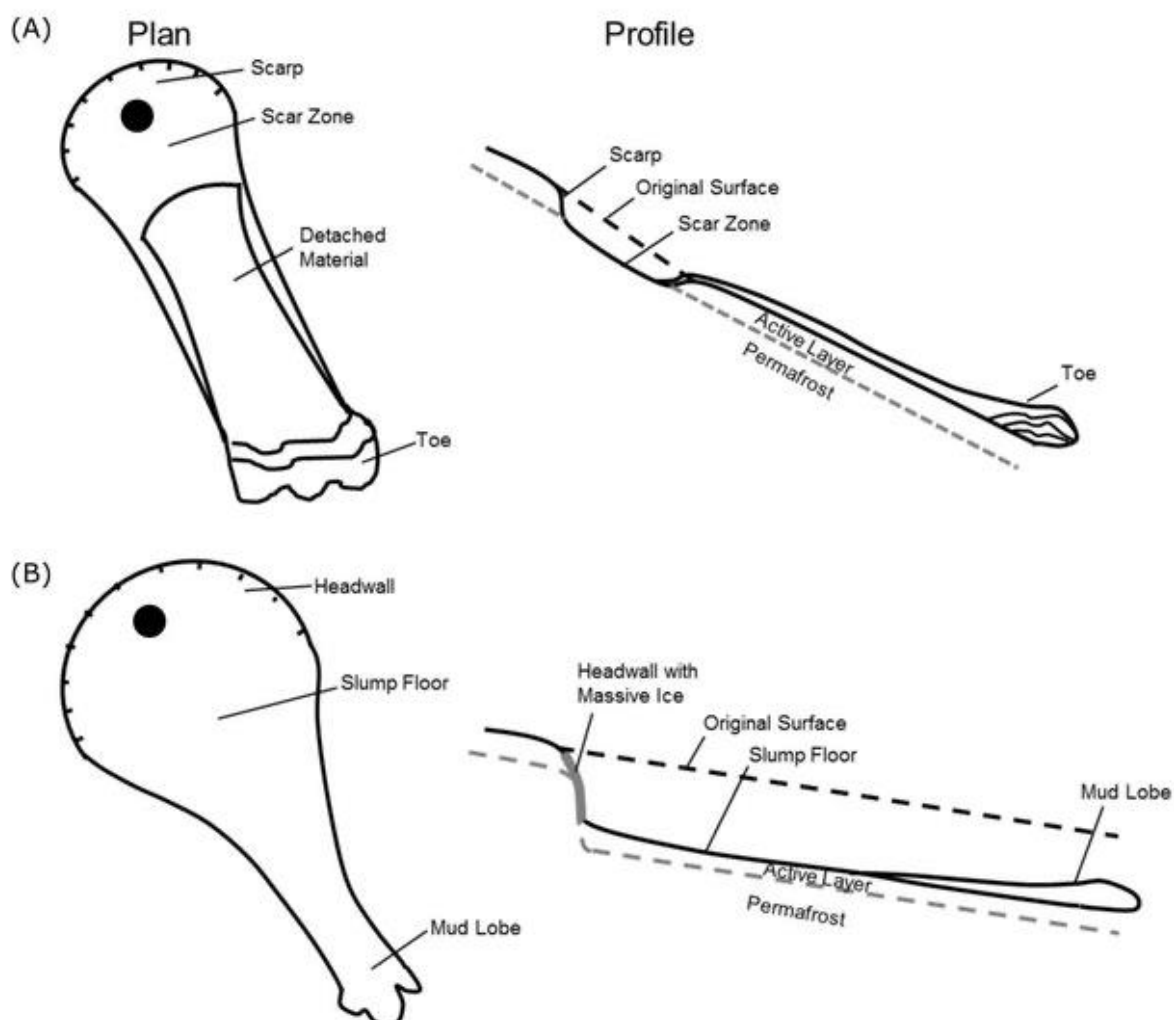


Figure 27: Plan and profile schematics for (a) an active layer detachment and (b) retrogressive thaw slumps. Black dots represent digitized initiation zones.
Source: Rudy et al., 2016.

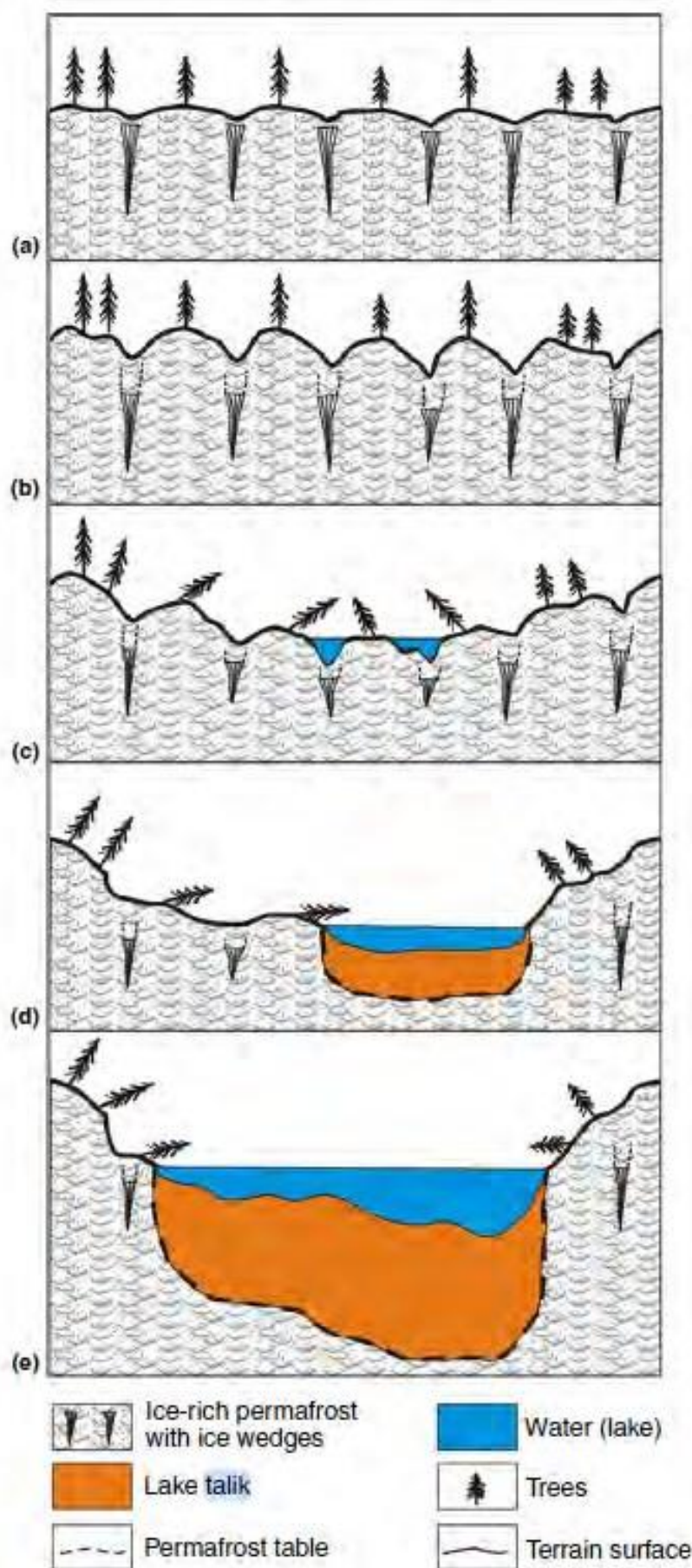
II.F) TALIKS

A talik, or thaw bulb, is a layer or body of unfrozen ground which usually occurs in a permafrost area as a result of a local anomaly in thermal, hydrological, hydrogeological or hydrochemical conditions (Burn, 2002) and their presence beneath a lake is essential for the development of thermokarst lakes (see Figure 28 below).

Liquid water has low albedo, it absorbs long-wave radiation and has a strong capacity to store heat in comparison with ice and dry ground. This is how the long-term heat flux from the waterbody into the ground thaws permafrost and melts the ground ice which is underneath the lake, leading to an increase of the lake depth and its basin volume. When its depth exceeds the maximum thickness of winter ice cover, lake-bottom temperatures enhance thawing and taliks start to grow (Grosse et al., 2013).

During summer, the energy from the atmosphere is dissipated into the waterbody and then transferred to the sediments contained in the talik and to the surrounding permafrost (Vtyurina, 1960). In cold seasons (autumn and winter), the lake cools rapidly, but the talik remains warmer due to the late summer warmth pulses. At this moment, the summer heat flux is reversed and now pointing from talik into the lake. Meanwhile, heat is also transferred from the talik into the surrounding permafrost (Grosse et al., 2013).

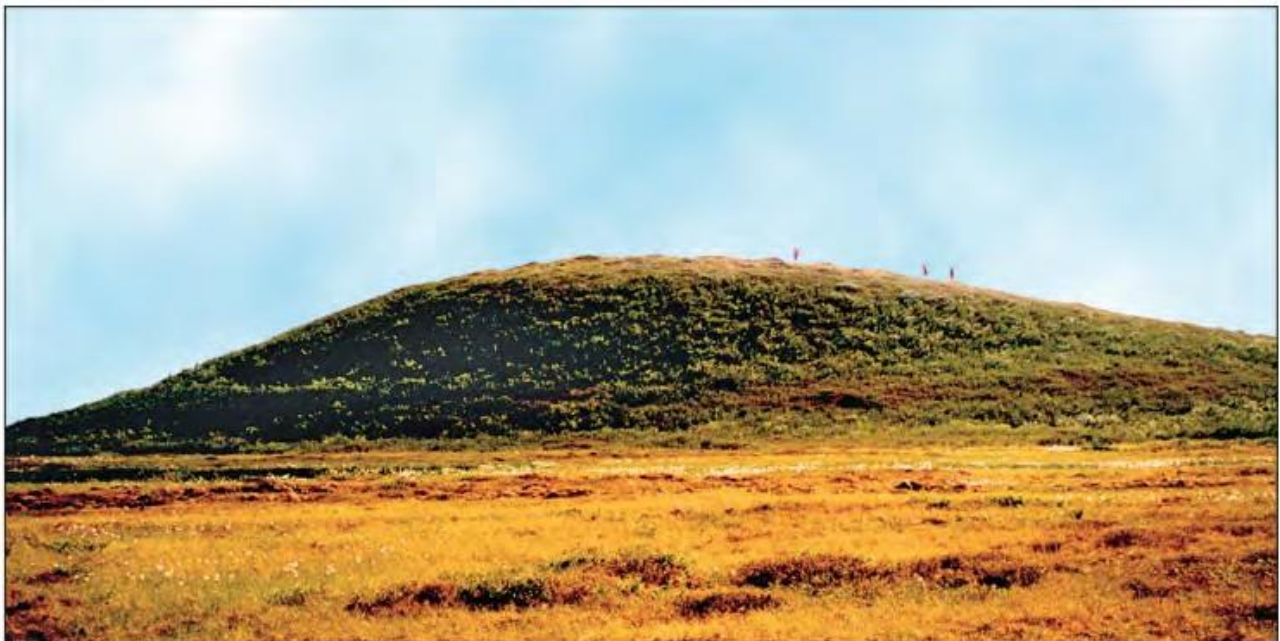
In winter, lakes emit heat into the atmosphere and transfers energy into the talik, which continues with its expanding process and transferring heat into the permafrost. The overall balance indicates that the waterbody heat flux into the talik, while the talik transfers heat to permafrost. As a result of these processes, the year round thawed zones expands, exacerbating the degradation of adjacent permafrost, producing lake-bottom settlement and lake basin expansion. In Central Yakutia, for example, thaw depth below thermokarst lakes increased by 5–10 cm year⁻¹ (Brouchkov et al., 2004). Taliks are also responsible for causing deeper carbon stocks to become bioavailable (In't Zandt et al., 2020).



*Figure 28: Thermokarst lake formation in ice-rich permafrost in central Siberia.
Source: Grosse et al., 2013.*

II.F.I) Pingos

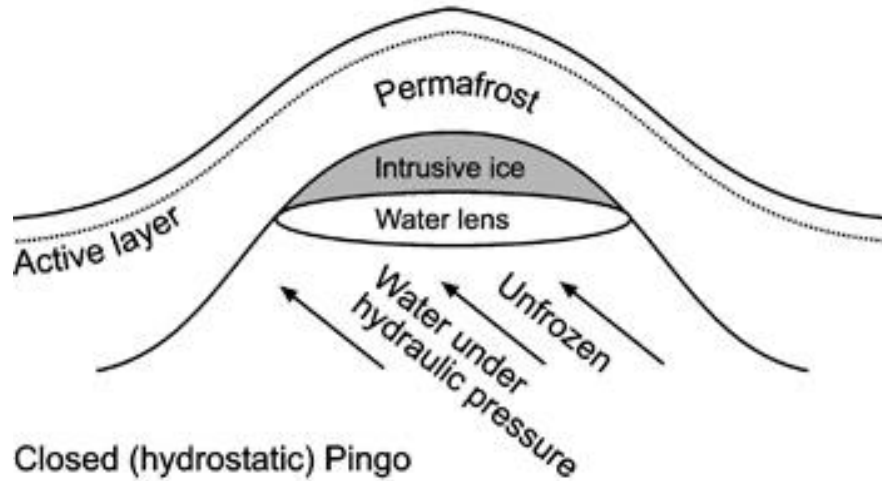
Another prominent landform related to changes in permafrost are pingos (or “bulgunniakh” in Russian) which are dome-shaped hills that can be formed in drained thermokarst-lake basins (see Figure 29 below) (Mackay, 1985). They can be open or closed systems. They have a circular or oval shape that usually measures between 10-12 m, with a basal diameter of tens or even hundreds of meters, and is surrounded by depressions (Vasil’chuk et al., 2014). Their distribution is closely associated to permafrost and landscape characteristics, to surface geology and morphology, as well as to hydrology and local climate (Wetterich et al., 2018). Open-system pingos are usually formed in zone of discontinuous permafrost. When the pressure forces groundwater to the surface, it gets cumulated under the permafrost layer and starts pushing the overlying material vertically. This is how, water freezes in lens shape, and uplifts the surface to form a conical hill. On the other hand, closed-system pingos are formed by permafrost aggradation within saturated sands that are generally found in areas of permafrost talik or drained lakes (see Figure 30 below) (Bennett, 2009).



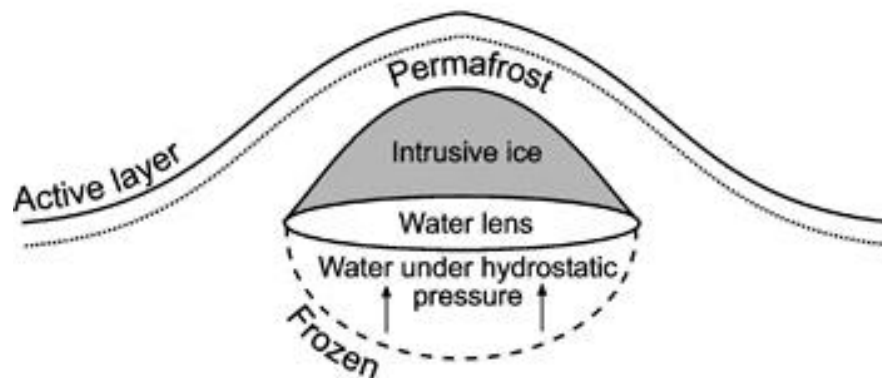
*Figure 29: 17 m high closed-system pingo in the area of Pestsovoye field (Russia).
Source: Vasil’chuk et al., 2014*

Along the north of Western Siberia Russian territory, over 6000 pingos have been already identified and mapped (Grosse & Jones, 2013). They can also be found in the north of Alaska, Canada, Greenland, China and Antarctica.

Open (hydraulic) Pingo



Closed (hydrostatic) Pingo



*Figure 30: Differences between open and closed-system pingos.
Source: Bennet, 2009.*

II.F.II) Sinkholes

Ice wedge melting and degradation due to warmer temperatures or to thermal erosion lead to ground depressions which usually become sinkholes (Jorgenson et al., 2006). These pits in the ground are formed as a result of permafrost or ice water accumulated that fails to drain away (see Figure 31 below). Vegetation removal can also induce sinkhole development increasing infiltration and producing internal erosion (Gutiérrez, 2016). According to Fedorov & Konstantinov (2009) thermokarst sinkholes are not so much influenced by the rise in air and earth materials temperature but more particularly by the increase of precipitations.

Infiltration of water into sinkholes and permafrost degradation may induce the development of a network of interconnected underground conduits and tunnels (Olenchenko et al., 2017). This water can thermally erode both the ice wedges and the surrounding soil, altering the drainage patterns (Douglas et al., 2011). Some sinkholes and tunnels act as flow paths during the following snowmelt

runoff period (Fortier et al., 2007).

Thawing permafrost is particularly relevant for particular landform as it modifies the mechanical strength and permeability of sediments, as well as the capacity of liquid water to dissolve rocks. Human activity can unchain permafrost thaw, and therefore the development of new sinkholes. Such was the case of the Bratsk Reservoir, situated in Siberia. Its activity and the consequent thawing permafrost resulted in the accelerated development of collapse sinkholes along the coastal sectors. This caused severe damage to local buildings and structures (Trzhtsinsky, 2002).



*Figure 31: Funnel shaped sinkholes along an ice-wedge trough. The hole was about 2m deep.
Source: Fortier et al., 2007.*

Another well-known sinkhole appeared in the tundra (see Figure 32 below), on the Yamal Peninsula (Russia) in 2014. It has a diameter of 80-100 m and a depth of 45 m. Other similar holes appeared later in other points of the same Peninsula. However, different scientific theories have been proposed to explain such phenomena (Bayda, 2017).



*Figure 32: Yamal sinkhole.
Source: Bayda, 2017.*

This wide diversity of landforms associated to thermokarst terrains lead to surface collapse which is irreversible over time scales of decades to centuries (Lewkowicz & Way, 2019) and can severely impact northern buildings and important infrastructures due to the high volume of ground ice in these regions (Lunardini, 1996; Nelson et al., 2001). It also exerts extra pressure on Arctic ecosystems through oversaturation or drying (Hinzman et al., 2005).

II.G) EFFECTS OF PERMAFROST ON SOIL BEARING CAPACITY

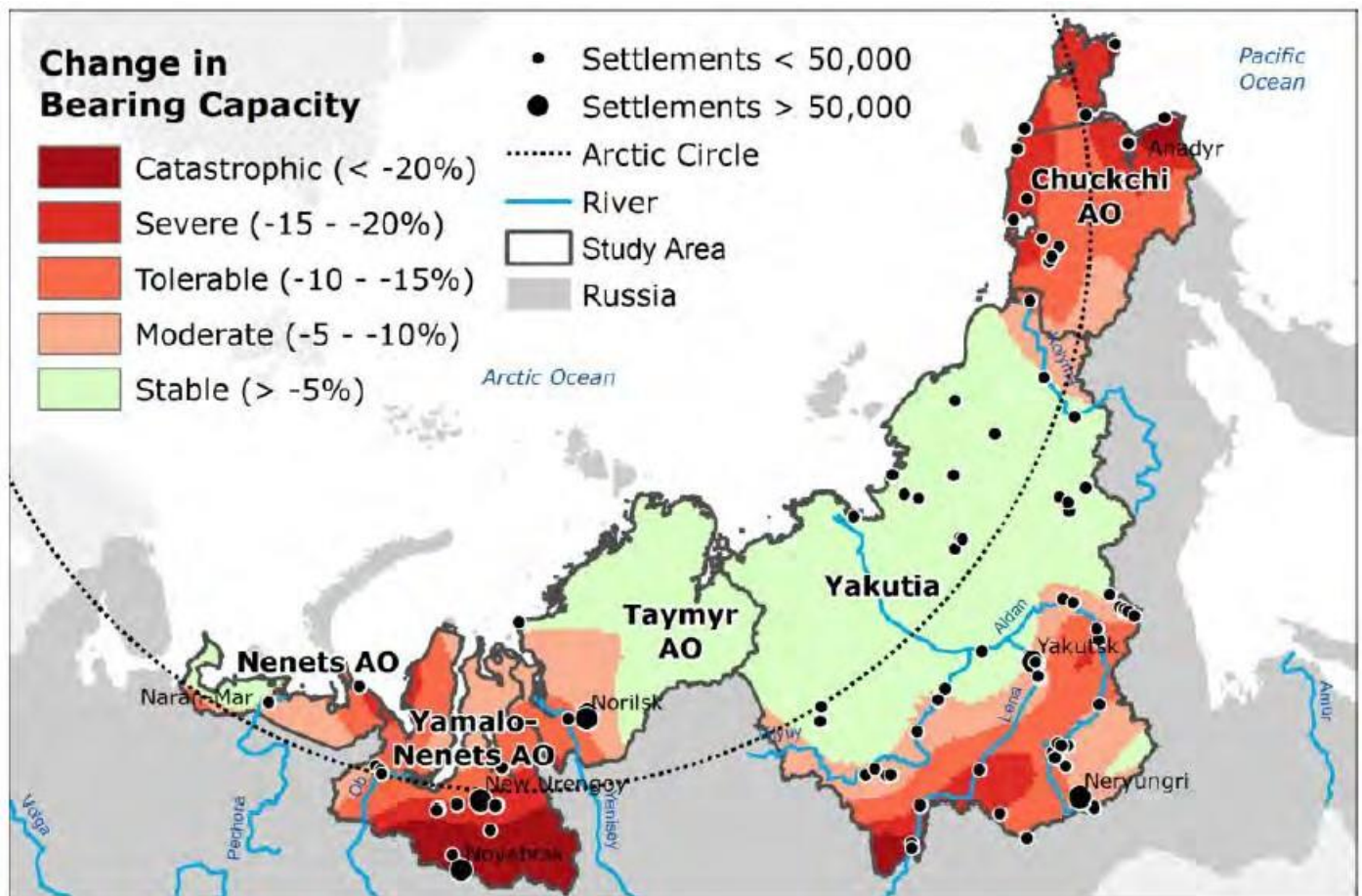
The ability of land to support buildings upon it is known as "bearing capacity." In permafrost areas, the soil's bearing capacity is directly linked to the presence of permafrost and decreases with warmer temperatures (Anisimov & Reneva, 2006). When permafrost thaws, the bearing capacity of the soil shrinks while heaving forces on foundations increase (Andersland & Ladanyi, 2004). This causes serious damage to buildings, industrial facilities, pipelines and other forms of infrastructure in the North as bearing capacity of foundations and adfreeze strength of piles are a function of permafrost temperature (see Figure 33 below) (Perreault & Shur, 2016). However, in such occasion, it was not confirmed whether climate change or a bad management of the construction caused the thawing underneath the building that finally collapsed. A reduction in permafrost bearing capacity can also pose threats to the utilization of natural resources in some regions of the Arctic (Hjort et al., 2018). Nonetheless, damage usually evolves gradually and can be estimated using different probabilistic permafrost scenarios (Anisimov & Reneva, 2006).



Figure 33: Part of a building in the town of Chersky collapsed in June 2001 due to the weakening of the foundation built upon permafrost.

Source: Photo taken by V.E. Romanovskiy, obtained from Anisimov & Reneva, 2006.

Foundations are designed with a construction-specific safety factor, which in practical terms, varies from 5% to 60% with respect to the bearing capacity and being 20% for most of the residential buildings in Russian northern cities (Anisimov & Reneva, 2006). Streletskiy et al. (2012) estimated the range of decadal changes in bearing capacity due to changes in climate (see Figure 34 below). This research was conducted using the average bearing capacity for the period between 1970 as 2000. The former one was chosen taking into consideration that at that time, the Russian Arctic underwent extensive construction and was therefore assumed that structures were designed adapted to climatic conditions of the period. While the decade around 2000 was selected to represent contemporary conditions (Streletskiy et al., 2012).



*Figure 34: Changes in bearing capacity between 1970-2000.
Source: Streletskiy et al., 2012*

This study revealed a significant reduction in permafrost bearing capacity in Russian permafrost regions. The most severe changes were observed at the southern fringes of the permafrost. The overall mean percent change in bearing capacity between the 1970 and 2000 has decreased by about 7%, but this was not a homogenous trend. In some settlements the decrease reached 9.6%. These differences were closely related to the mean annual temperatures of each settlement and the variation of temperature between both periods (Anisimov, 2017).

Adapting to a reduced bearing capacity in the North is possible but it is also very expensive as it requires implementing the latest building technologies. Additionally, buildings can also collapse under the weight of too much snow (AMAP, 2011).

This chapter listed some of the most visible and studied modifications on Arctic permafrost and landscape as a consequence of changes in climate and the surrounding environmental conditions. It was deemed necessary to provide a general bio-physical introduction of such processes in order to help the reader understand the multiple challenges that northern settlements are currently facing

in terms of infrastructure, traditional landscape and processes, buildings, sacred places, etc. – subjects which are developed in chapters 7, 8 and 9 -. However, understanding the social and cultural impacts of climate change in the coastal settlements of Tiksi and Bykovsky cannot overlook the influence of the historical, cultural and ethnical configuration in the region, which will shape the way people perceive and attribute meaning to each of its manifestations. This is why, the following chapter will provide an overview of the main historical processes that took place in the region – starting from the first human settlers, until the 20th century-. This is key to understand the current social configuration and to understand the specific ways in which climate change and permafrost thaw can affect lifestyles and Worldviews in the North.

CHAPTER III: ARCTIC COMMUNITIES

The first part of this chapter introduces the main commonalities of Arctic communities in terms of colonization and historical processes. It also highlights the main differences between Indigenous and non-Indigenous people living in the Arctic, the most relevant characteristics of Indigenous cultures and identities that should not be overlooked, as well as the challenges that they are currently facing due to accelerated changes in their environments. Finally, some of the main characteristics on Russia's Arctic communities and the main historical processes that led to the current socio-economic configuration of the Russian Far North will be presented.

III.A) THE ARCTIC: LAND OF CONQUEST

Harsh climate and particular environmental conditions of the Arctic have shaped both the way this region of the World has been occupied and the particular lifestyles developed by its inhabitants. Trying to understand the current demographic and socio-economic configuration and the potential implications of current climate change in the Arctic requires reviewing the main historical processes that took place in the area. Those associated to the main past explorations, population mobility, the establishment of new settlements and the interactions between indigenous and non-Indigenous peoples deserve an increased scrutiny. Assessing demographic composition and demographic changes is also essential in order to understand infrastructure development, regional economy planning and, more generally, Arctic policy-making.

Although nowadays there is much more information about the Arctic, when referring to this region of the World and to its population, a wide diversity of imaginaries and associations emerge. The Arctic Council's Arctic Climate Impact Assessment (ACIA) reports highlighted that snow and ice are the "most striking features" of the Arctic (Dodds & Nuttall, 2019). Many people imagine Arctic inhabitants as eskimos living in igloos, or associate it with the land of polar bears, among others. The Arctic was long considered to be wild, exotic and remote. In reality, the Arctic is the homeland of a wide diversity of ethnic groups, from the Inuit and Athabascans in the Northern American Arctic, the Saami of Fennoscandia and the Kola Peninsula and several small-Indigenous peoples living in the Russian Arctic (Csonka & Schweitzer, 2004).

Although it is still unclear who were the first Arctic settlers, it is known that humans have occupied the region since at least the last ice age. Archeological remains have been found in northern parts of Finland, Norway, Sweden, Russia and Alaska dating back more than 12,000 years (e.g., Anderson, 1988; Dixon, 2001; Thommessen, 1996). It is thought that the main first large mamal hunters arrived to the area around 4000 years ago after the icecap retreated in Europe. They moved along the vast territories of Siberia and the Russian Far North until they finally crossed the Bering land strait and moved along the southern coast of Beringia (Dixon, 2001). In the eastern European Arctic, settlements from 40,000 years ago have also been discovered (Pavlov et al., 2001). Living in such a fluctuating environment required strong adaptive capacity. New forms of technology such as dog traction, whale-hunting equipment, and intensive reindeer herding also shaped the social forms of organization of the first settlers in these lands (Csonka & Schweitzer, 2004).

More recently, Arctic Indigenous peoples have come into contact with “outsiders” that arrived to these unexplored lands. This led to a deep cultural and organizational transformation among Arctic inhabitants. Waves of explorers started to arrive since the early 16th century, especially from Europe. Their ambition was to find a commercial route that could connect the Old Continent with East Asia (e.g: The Great Northern expedition of 1733-1743) (see Figure 35 below). This was called the Northeast passage (from the European and northern Atlantic point of view). It consists of a route to the Pacific Ocean along the Arctic coasts of Norway and Russia. Contrarily, the route along the islands of Canada is called the Northwest Passage. The Northeast Passage includes the Northern Sea Route and traverses (from west to east) the Barents Sea, Kara Sea, Laptev Sea, East Siberian Sea, and Chukchi Sea.

The first explorers usually arrived to these new lands accompanied by Christian missionaries from different sects, including Roman Catholics, Russian Orthodox, Anglicans/Episcopalians, Lutherans, Moravians, Presbyterians, and Quakers, among others. Nowadays, and as a result of the interaction of numerous religious missions, different forms of syncretism have emerged in most Arctic regions (Einarsson & Young, 2004) and co-exist as part of this legacy.



*Figure 35: The Northwest Passage, the Northeast Passage, the Northern Sea Route and the Transpolar Sea Route.
Source: Dyrce, 2017.*

Although most Arctic expeditions were perceived as a mean that allowed sailors to annex new lands to the jurisdiction of their countries of origin (AHDR, 2004), there were also smaller expeditions based in commercial interests for hunting and whaling (e.g: Barrents reached Spitsbergen in 1596). Small scientific expeditions also gained importance during this period. However, Arctic explorations reached a peak of popularity between the 18th and the 20th century. The Great Northern expedition of 1733–43, conceived by the Russian Emperor Peter I the Great and led by Vitus Bering, skirted the Siberian coast and discovered the Bering Strait and Alaska (Roberts & van der Watt, 2015).

Between 1821 and 1824, Fyodor Petrovich Litke – one of the organizers of the Russian Geographical Society - led the expedition to the coasts of Novaya Zemlya, the White Sea, and the eastern parts of the Barents Sea. Moreover, he introduced the idea of creating a tide recorder. It was later installed in the current coastlines of the Arctic Ocean. The northwest coast of the Taymyr Peninsula and of

the New Siberian Islands were explored by Baron Eduard von Toll. Some areas like the Severnaya Zemlya archipelago were discovered as recently as 1913 (Gavrilo et al., 2019). After the Russian Revolution, developing the Northern Sea Route became one of the top priorities and the state started investing in both new expeditions and polar stations. Icebreakers were introduced and the last unexplored areas in the northern Kara Sea and the Laptev Sea were examined between 1935 and 1936.

Great Britain became particularly interested in finding new trade routes and wanted to extend the atlas in order to facilitate navigation. This is why, they also financed and sponsored several Arctic expeditions. The British "Magnetic Crusade" aspired to chart the entire globe, including the region around the north magnetic pole. After this expedition, they proceeded to search for the Northwest Passage, which was first traversed by the Swedish explorer Adolf Erik Nordenskiöld (1878 to 1880) and his crew. This became a landmark for Swedish history (Roberts & van der Watt, 2015).

This scheme was approved in 1839 and the Norwegian expedition led by Roald Amundsen completed the first traverse in 1906. This event was particularly relevant for Norway as it became independent from Sweden in 1905. He was then followed by Fridtjof Nansen who crossed Greenland by ski for the first time in 1888. Once again, this had more nationalist implications than heroic ones, as the ski was, until that moment, an iconic Norwegian technology. The consequent formation of the Norwegian Geographical Society in 1889 aimed at promoting Arctic exploration as a national symbol of strength (Roberts & van der Watt, 2015).

The Pole North was a source of fascination among the explorers of that time and its conquest became one of the biggest ambitions. Reaching the Pole was seen a symbol of marked cultural primacy and progress and the individuals who led the expeditions would therefore become national heroes. In this context, between 1893-1896, the Norwegian explorer Fridtjof Nansen sailed in a special ship into the pack ice north of Siberia trying to reach the North Pole. By letting his ship freeze into the pack ice, he expected to be carried by the natural east-west current of the Arctic Ocean, but when he realized this would not happen, he left the ship with Hjalmar Johansen and tried to reach the pole with dog sledges. Although they did not achieve their goal, they marked a record farthest North latitude of 86° 13.6' N and became a hero for Norwegians.

Two main explorers claimed having reached the Pole: the US Navy engineer Robert Peary on 6 April 1909 and his rival, Frederick A. Cook one year before. However, the former version obtained more

support.

By 1926, the Norwegian explorer Roald Amundsen had become the first man having visited both poles: he sailed Nansen's ship and was the first to reach the South Pole, the first to travel through the Northwest Passage, and one of the first to pass over the North Pole in a dirigible.

As previously mentioned, some explorers were interested in collecting information about life in the Arctic and how its inhabitants lived. Knud Rasmussen, born in Ilulissat, travelled to northern Greenland in 1912 and spent several years studying Inuit, among whom he had grown up with. Another example, the Canadian anthropologist Vilhjalmur Stefansson, focused on the domestication of different Arctic animals and how people survived and travelled.

In the early 30s, the Soviet aircraft gained international popularity after integrating new innovative technologies and their pilots were seen as talented and brave (Roberts & van der Watt, 2015). Technology became an undoubtedly new source of power and a source of national pride. One of the most significant events was the flight of 1937 from the pilot Valery Chkalov who travelled from Moscow to Vancouver (Canada) via the North Pole. This took the crew more than 62 hours (almost 9,000 kilometers) and therefore established a new long-distance flight record. This record was, one month later, beaten by Mikhail Gromov who flew from Moscow to San Jacinto, California through the North Pole (Josephson, 2014).

In 1936, two aircraft have established a base for the expedition on Rudolf Island and built a landing strip and two houses. One year later, the flight of Schmidt, Mikhail Vodopianov and other crew members landed near the North Pole in order to provide support for Ivan Papinin's drifting North Pole station (Josephson, 2014).

Although big Arctic expeditions did not completely disappear, smaller expeditions became more popular and aimed at discovering unexplored and remote regions up to, as late as, in 1945 (Roberts & van der Watt, 2015).

A new wave of expeditions emerged and aspired to conquer the Arctic by submarine, especially during the cold war. In 1958, the USS Nautilus - the world's first nuclear-powered submarine - arrived to the North Pole. It was commanded by Eugene Parks "Dennis Wilkinson" and represented an important American military showcase during this period of tensions. On the other hand, the

Soviet Union built the K-3 which was the first nuclear submarine of the Soviet Navy's Northern Fleet. On 17 June 1962, K-3 commanded by Zhiltsov reached for the first time the North Pole underwater. As a result of this successful expedition, it was awarded the name Leninsky Komsomol (Ленинский Комсомол) on 9 October 1962 (see Figure 36 below) (Hill, 2003).

During the 20th century, the Arctic experienced demographical changes. These were mainly characterized by the arrival of new migrants to the region who were looking for better living conditions and were attracted by the promising development of the area associated to the exploitation of resources such as gold, oil or fish (Huntington, 2001). This introduced, in some regions, social and cultural tensions due to the competition for both land and resources (Freeman, 2000; Minority Rights Group, 1994; Slezkine, 1994). This also deepened the gaps and incompatibility of traditional and modern lifestyles (Nuttall, 2000). This is how a new era marked by a series of claims began. In North America, for example, indigenous land and resources claims have been addressed through formal agreements. These even initiated the process of creation of self-governed regions such as Nunavut and Greenland within nation states (Freeman, 2000).



*Figure 36: K-3 Leninsky Komsomol on a Soviet postage stamp from the series "Soviet warships".
Source: Electronic catalog: stamps of the country of the Soviets⁴*

During the last decade of the 20th century, Alaska, Iceland and the Faroe Islands experienced accelerated population increase. On the contrary, in the Russian Arctic, many residents out-migrated due to the socio-economic consequences of the Soviet breakup. Other parts of the North did not present marked trends (ACIA, 2005). Although during the first decade of the 21st century the average global population kept increasing, the Arctic trends were not homogeneous between

⁴ "Электронный каталог: Марки страны Советов" in Russian.

regions (Heleniak & Bogoyavlensky, 2014) and the Russian Arctic kept being the region with the sharpest population decrease (see Figure 37 below).

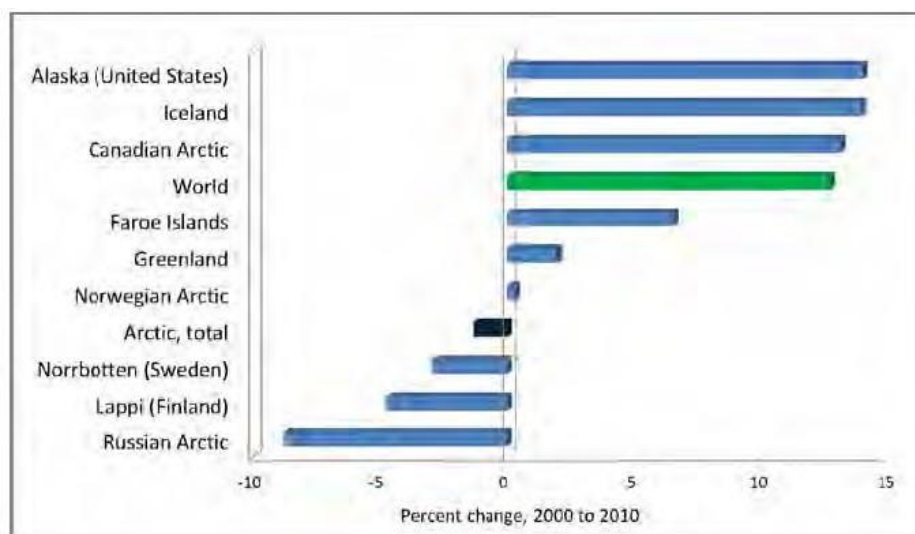


Figure 37: Global and Arctic population change between 2000-2010.
Source: National statistical offices and UN Population Division.

Overall, the Arctic became a stable and peaceful region without major conflicts. However, some disputes related to delimiting national maritime borders and asymmetric environmental conflicts emerged in some areas. The aforementioned historical review demonstrates that:

- Arctic demographic trends have strongly varied throughout the history and were strongly related to the geopolitical and economic situations.
- The Arctic was for a long period of time, a zone of disputes associated with national honor and captured the attention of different countries due to its richness in natural resources, especially in terms of minerals and hydrocarbons. It also became an attractive area for both natural and social scientists (Young & Elnarsson, 2004).
- It has also been a territory that served to install national military bases, especially during the Cold War period. Although the extension of this activity has now been reduced, there are still several military bases throughout the region (Young & Elnarsson, 2004).
- International cooperation became particularly relevant during the past two decades, especially taking into consideration the role of regional climate can have at a global scale in the context of climate change (Young & Elnarsson, 2004). This lead to numerous efforts to coordinate efforts to tackle undesirable impacts regionally and worldwide.

Today, most of the Arctic is well mapped and has been jurisdictionally allocated to each of the eight Arctic states (Young & Elnarsson, 2004). In 2013, there were 4,053,055 people living in the Arctic (Heleniak & Bogoyavlensky, 2014) while in 2017 the total population increased to 7,088,482 inhabitants. Northern residents were spread over 1,500 settlements. However, the main trend indicated high population concentration in only a few large Arctic settlements (see Figure 38 below). It was also observed that most of the settlements remained small in terms of population, with fewer than 5,000 inhabitants. Russia has the highest share of people living in cities of all the Arctic countries (Zamyatina & Goncharov, 2018). Arctic settlements widely differ according to their social and physical conditions (Jungsberg et al., 2019). This is reflected in the population size, the growth rates, the structure and migration patterns of each settlement (Heleniak et al., 2020), creating considerable differences between Arctic regions and countries.

Due to the relatively small size, the geographical remoteness and the great distance between each other, Arctic cities usually do not benefit from agglomeration economies, synergies nor dense interaction networks (Zamyatina & Goncharov, 2018). Currently, there are only a few urban centers with more than 100,000 inhabitants in the Arctic (see Figure 39 below).

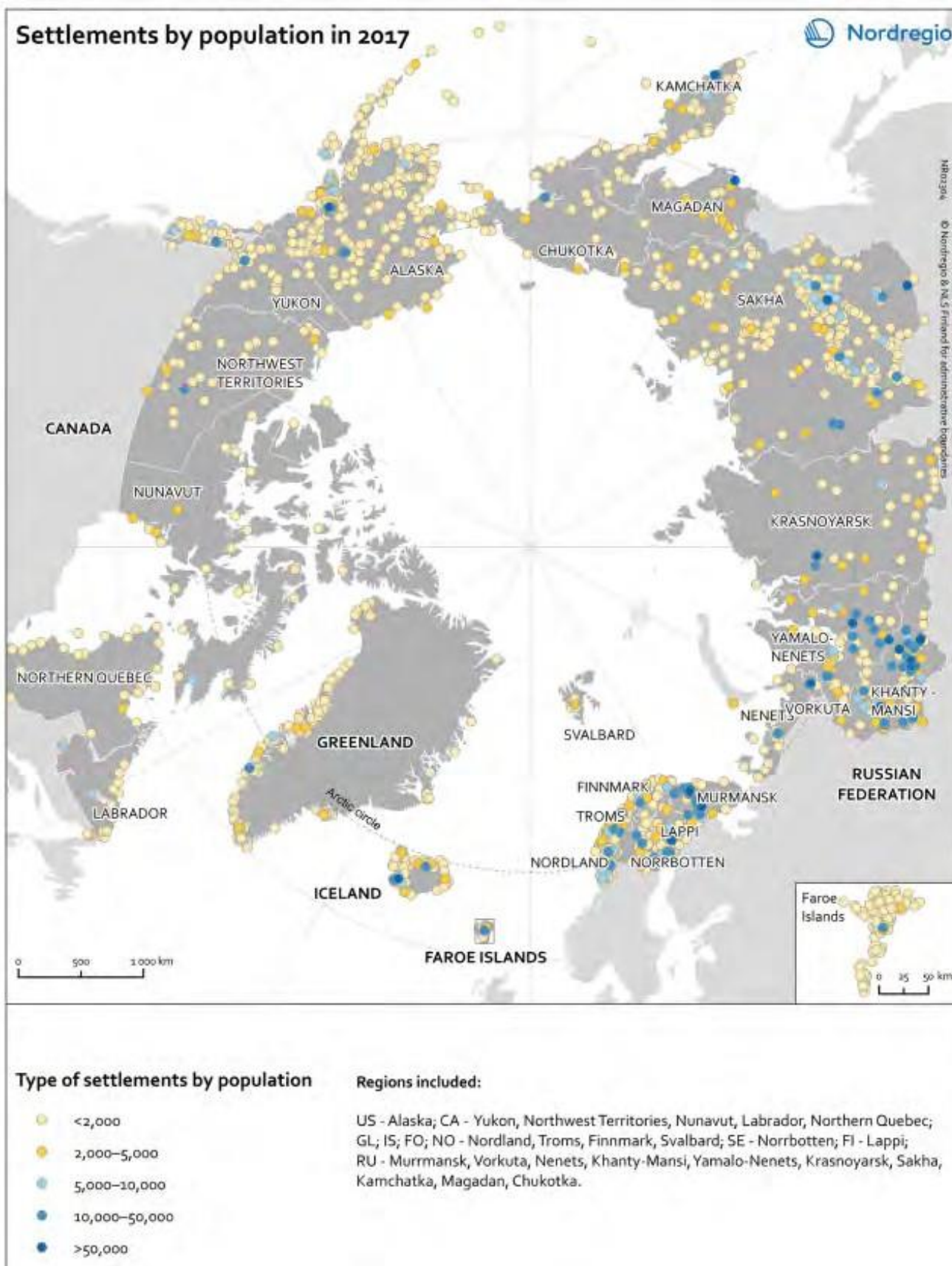


Figure 38: Map of settlements by population in 2017.
Source: Jungsberg et al., 2019



*Figure 39: Map of population centers in the North.
Source: Arto Vitikka, Arctic Centre, University of Lapland.*

III.B) ARCTIC INDIGENOUS PEOPLES

Arctic permanent residents include indigenous and non-indigenous inhabitants and their proportion can strongly vary according to the region (Fondahl et al., 2015). This is closely associated to the cultural, historical and economic backgrounds, but also to the definition of indigenes and levels of self-governance in each country (see Figure 40 below). It is also possible to identify important differences within one same indigenous group. In some region, indigenous people represent the majority of the population (Einarsson & Young, 2004). For example, Inuit constitute about 85 % of the total population of Nunavut in Canada while in some regions of Siberia, indigenous people represent less than 2% of the population. Arctic countries are the homeland of numerous groups and some groups can be spatially distributed throughout several countries

simultaneously, such as the Sami living in some parts of Norway, Sweden, Finland and Russia or the Dene in Canada and Alaska (Fondahl et al., 2015).

Taking these elements into consideration, it is not surprising that many indigenous individuals consider themselves being of mixed heritage and currently have mixed identities which have been - and keep being - constructed and redefined over time (Fondahl et al., 2015).

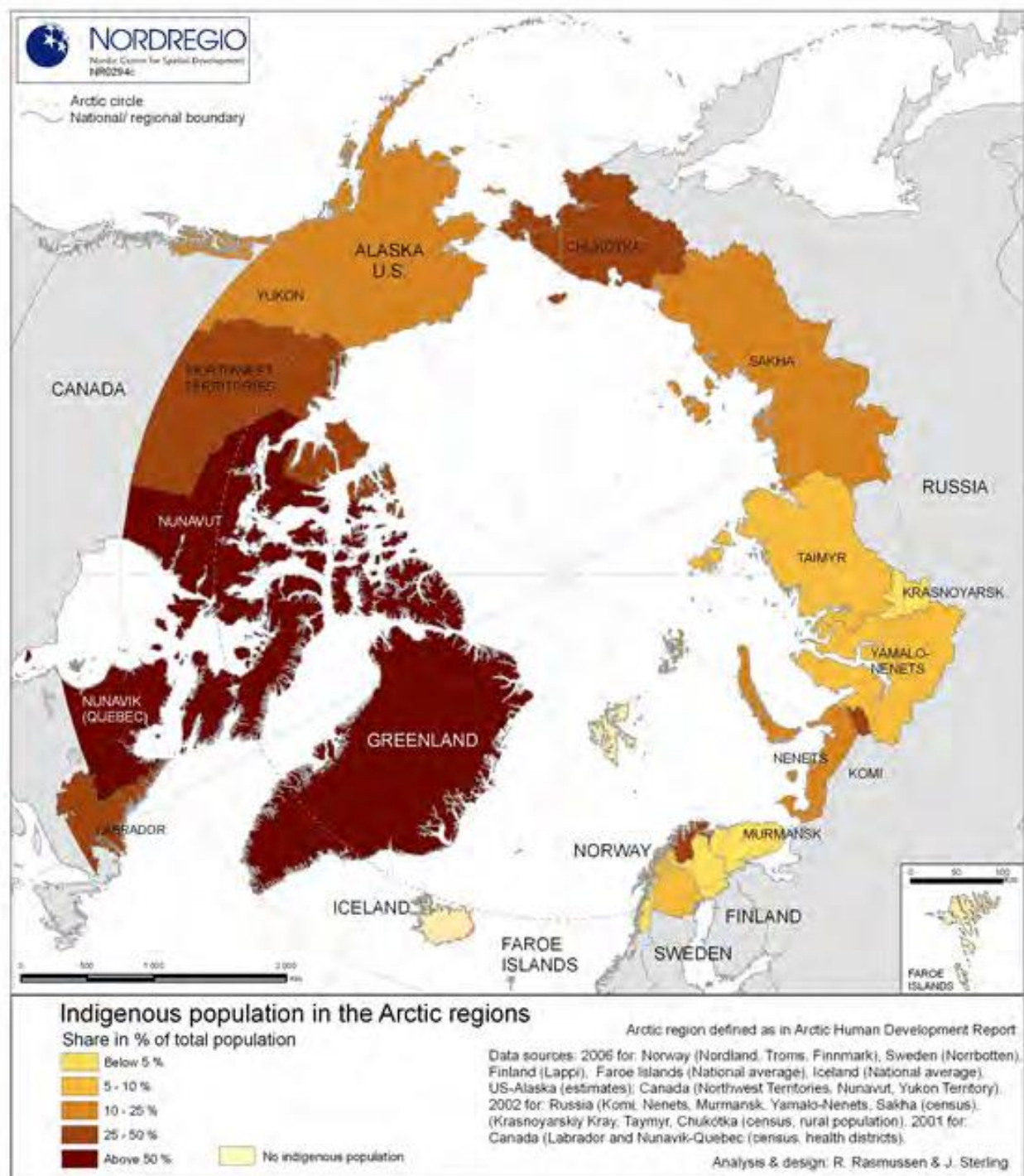


Figure 40: Share of indigenous population in percentage of total population in Arctic regions.

Source: NORDREGIO

In many Arctic regions, non-indigenous residents outnumber Indigenous peoples. This is partially explained by the commonly-shared colonial past. It is also due to broader scale migration trends. In some cases, current residents arrived to the area as migrants or as settlers. This multiplicity of historical backgrounds explains the multiple forms of interacting between northern residents and their surrounding environment. This also shapes the way they interpret and delimit "their" places. This is how multiethnic and multicultural homelands currently coexist in harmony within a same geographical region (Dodds & Nuttall, 2019). Such is the case of the Republic of Sakha, where Indigenous peoples (Yukaghir, Dolgans, Evens, Evenks, and Chukchis) and other ethnicities (Yakuts, Russians, Ukrainians, and Tatars) have been coexisting for centuries. Similarly, several Indigenous peoples live in Alaska, including the Inuit, the Aleut, Yup'ik, Tlingit and several Dene-language peoples (Ahtna, Deg Hit'an [Ingalik], Dena'ina [Tanaina], Doogh Hit'an [Holikachuk], Dichinane Hwt'ana [Kolchan], Eyak, Gwich'in [Kutchin], Hän, Koyukon, Tanana) (Fondahl et al., 2015) (see Figure 41 below).

Indigenous lifestyles include particular ways of interpreting and interacting with the surrounding physical environment (Freeman, 2000). This also shapes the ties that they develop with their lands, which are often said to be a defining attribute of Indigenous identities (Fondahl et al., 2015). Such interactions can also be reflected in the use of specific words that describe different forms of snow and ice, for example, according to their physical properties (AMAP, 2017; Lavrillier & Gabyshev, 2017; Eira et al., 2018). In most cases, northern indigenous communities depend on activities like fishing, hunting, herding, breeding and gathering. However, there exist historical, cultural and dialectical differences between groups and it is therefore important to preserve the particularities of each of them, avoiding to treat them as a homogeneous unit, especially when addressing climate change and its impacts.



Subdivision according to language families

- Na'Dene family**
- Athabaskan branch
 - Eyak branch
 - Tlingit branch
 - Haida branch
- Penutan family**
-
- Macro-Algonkian family**
- Algonkian branch
 - Wakasha branch
 - Salish branch
- Macro-Sioux family**
- Sioux branch
 - Iroquois branch
- Indo-European family**
- Germanic branch

- Eskimo-Aleut family**
- Inuit group of Eskimo branch
 - Yupik group of Eskimo branch
 - Aleut group
- Uralic-Yukagirian family**
- Finno-Ugric branch
 - Samodic branch
 - Yukagirian branch
- Altaic family**
- Turkic branch
 - Mongolic branch
 - Tunguso-Manchurian branch
- Chukotko-Kamchatkan family**
-
- Ket (isolated language)**
- Nivkh (isolated language)**
- Ainu (isolated language)**

Notes:

For the USA, only peoples in the State of Alaska are shown. For the Russian Federation, only peoples of the North, Siberia and Far East are shown.

Majority populations of independent states are not shown, not even when they form minorities in adjacent countries (e.g. Finns in Norway).

Areas show colours according to the original languages of the respective indigenous peoples, even if they do not speak these languages today.

Overlapping populations are not shown. The map does not claim to show exact boundaries between the individual groups.

In the Russian Federation, indigenous peoples have a special status only when numbering less than 50,000. Names of larger indigenous peoples are written in green.

compiled by W.K. Dallmann
© Norwegian Polar Institute



Figure 41: Indigenous peoples of the Arctic according to the language families.
Source: Norwegian Polar Institute

As a result of globalization, local economies underwent deep transformations and now merge both modern and traditional activities. It is now possible to find more indigenous people working in wage-earning professions such as machine operators, teachers, lawyers, among others. As a result of broader social, economic and political processes, it is also possible to find new economic activities gaining importance at a regional/local scale which are mainly adopted to complement their monthly incomes. For example, recently, in northern Yakutia, more men got involved in tusk gathering activities. In other cases, traditional activities became secondary pursuits. Climate change too exerts extra pressure on their environments and therefore hinders practicing traditional activities in some areas of the Arctic. This has already provoked forced outmigration in several northern settlements, especially in coastal ones. This process can be accompanied by cultural identity loss and demographic changes (Landauer & Juhola, 2019).

Outmigration also appears as a solution for those seeking for better educational and employment opportunities, or to access better social services (Christensen, 2013). Moreover, according to Heleniak (2014), gender and the associated roles seem to bias migration patterns: while indigenous women tend to leave small, rural settlements, men tend to experience stronger attachment to their traditional activities and therefore tend to stay in their lands to a greater degree. In the recent decades, an increasing number of indigenous persons migrated to urban centers (Fondahl et al., 2015), such as Yakutsk in the Republic of Sakha.

Indigenous traditional lifestyles have been – and still are - influenced by government policies implemented in different spheres of their lives, for example, in education, language, religion and sedentarization (Fondahl et al., 2015).

BOX 3: DEFINING INDIGENOUSNESS IN THE ARCTIC

Knowing how many Indigenous people live in the Arctic is a challenging task as there is not a universal definition and this category varies according to the existing cultural diversity, the levels of self-governance and their legal status in each country (Fondahl et al., 2015). Some international references, such as the United Nations Declaration on the Rights of Indigenous peoples adopted in 2007, did not define them but instead enumerated certain criterion that facilitates their identification as a group. This document acknowledges that peoples and individuals have the right to belong to an indigenous community or nation according to their traditions, beliefs, and

customs of the community or nation concerned, and most importantly, that they have the right to determine their own identity. Gaining international recognition and defending their rights, especially those related to land and natural resources, required the political organization and coordinated efforts of Indigenous peoples throughout the world.

Nowadays, within the Arctic countries, the idea of indigeneity can strongly vary.

- In Alaska, for example, it depends on blood quantum.
- In Norway, Sweden and Finland, speaking Saami or having a parent/grandparent who spoke it allows people to vote in the Saami Parliament (Fondahl et al., 2015).
- In Russia, the concept of "indigenous people" does not exist. Instead, The Soviet Union created the concept of "natsionalnost"⁵ –ethnicity-, which is presently used (Hirsch, 2005). One of these ethnicities are "indigenous small-numbered Indigenous peoples of the North, Siberia and the Far East"⁶ In order to be considered part of this category, individuals should live on the territory of traditional occupancy of their ancestors - while maintaining traditional lifestyles, numbering less than 50,000 persons, and considering themselves as ethnic communities with a distinct self-identity (Sikora, 2020). The Russian Government currently recognizes 47 peoples of its nearly 200 "nationalities" or ethnic groups as meeting such criteria, from which 40 are considered to be "small-numbered Indigenous peoples" (Young & Bjerregaard, 2019). Other Indigenous groups like the Sakha (Yakut), Komi and Karelian peoples exceeding 50,000 individuals are excluded by the Russian legislation from the 'Indigenous' category and therefore, do not benefit from any special legal protection or benefit.

Until 2002, the ethnic identity of a person was indicated in the Russian citizen's main identity document. This was enough to prove that one person was Indigenous. In 2002, such information on one's nationality was removed from the internal passport and Indigenous people lost the tool to prove their nationality. In February 2020, the government adopted the law 11-FZ⁷ in order to establish a list of people that belong to the "numerically small peoples" of the country – that is,

⁵ "национальность" in Russian.

⁶ "Коренные малочисленные народы Севера, Сибири и Дальнего Востока Российской Федерации" in Russian.

⁷ Federal Law of 06.02.2020 on Amendments to the Federal Law On Guarantees of the Rights of the Indigenous Peoples of the Russian Federation "in Terms of Establishing the Procedure for Registering Persons Belonging to the Indigenous Minorities" 11-FZ (Федеральный закон от 06.02.2020 N 11-ФЗ "О внесении изменений в Федеральный закон "О гарантиях прав коренных малочисленных народов Российской Федерации" в части установления порядка учета лиц, относящихся к коренным малочисленным народам").

to create a registry of Indigenous people. This is expected to address the administrative problem that Indigenous peoples face to prove their nationalities. Unlike the previous version, this law uses the term “numerically small peoples” (Fondahl et al., 2020).

Another important element to take into consideration for analyzing Arctic demographic indicators is the way Indigenous peoples are identified and considered in the official statistics of each country.

- Nordic countries do not collect information on ethnicity in their censuses. Therefore, the Saami – the only indigenous groups in Nordic countries – are not considered separately in official statistics and there are only approximate estimations.

- The indigenous population in Greenland call themselves Kalaallit in Greenlandic and Grønlændere in Danish. However, Greenland considers anyone born in Greenland a ‘Greenlander’, irrespective of ethnic identity (Fondahl et al., 2015). Therefore, the amount of Indigenous peoples living in the territory can only be estimated indirectly with additional information about self-perceived ethnicity collected from population surveys. The last census in Greenland was held in 1976. (Young & Bjerregaard, 2019).

- In the US census, Indigenous peoples include both American Indians and Alaskan Natives (Bogoyavlenskiy et al., 2017).

- Canada defines as indigenous or aboriginal the following groups: Inuit, First Nations, and Métis. Census are held once every 5 years and provide data about indigenous people.

- Information on ethnicity is available from the Russian census conducted in 2002 and 2010 (Young & Bjerregaard, 2019).

III.C) ARCTIC NON INDIGENOUS RESIDENTS

The Arctic is also the home to non-Indigenous residents. In fact, in most regions, they outnumber Indigenous peoples. The relative share of indigenous and non-indigenous populations has significant impact on the socio-economic dynamics of the region (Bogoyavlenskiy et al., 2017). These ethnically dissimilar populations’ lifestyles and demographic characteristics strongly vary (Bogoyavlenskiy et al., 2017) between countries, regions, population subgroups but particularly

between Indigenous and non-Indigenous inhabitants (Rautio et al., 2014). For example, the latter ones usually have lower birth and death rates, their families are smaller in size with an older age structure and tend to concentrate in bigger urban cities (Heleniak et al., 2020). Most of them are either recent settlers who established in northern cities or settlements, or people who were born in the circumpolar North after their families settled to work in different sectors. These include mining/resource development projects or in different sectors like the administration, protected areas management, health, education, armed forces, the service sector economy, and tourism on a smaller scale (Dodds & Nuttall, 2019).

The end of the World War II introduced dramatic changes within northern communities. The industrial expansion, rapid militarization, the increasing concerns about national sovereignty, resulted in the massive arrival of non-Indigenous people to the Far North. The arrival of new settlers to the Arctic made religious and political differences with Indigenous peoples evident. This often lead to general disregard for Indigenous spirituality and livelihoods, and imposed new economic, educational and government systems (Coates & Broderstad, 2020).

In the 1930s, Russia's Far North experienced a sharp increase of population - from 120,000 in 1926 to 520,000 in 1939 –many of which were prisoners and deportees. Between the 1940s- 1950s, the population growth was particularly rapid in Alaska. In the 1950s, the overall population of the Arctic region was increasing (Bogoyavlenskiy et al., 2017). The Soviet Union, for example, fostered inner national migration through numerous state-financed programs, in order to build and develop new settlements oriented to exploit different natural resources and then distribute them within the territory. Some cities and towns are still associated with sensitive industries and armed forces, like Tiksi. Both foreigner visitors and national residents from other regions require special permission to access (Dodds & Nuttall, 2019). The Canadian North experienced a stronger growth trend between the 1950s and 1960s, and an overall slow-down during the three past decades. Arctic Finland too experienced an increase of its population in the 1960s. While northern Norway in the 1980s, and in northern Sweden in the 1990s. Only Canada, Alaska and Greenland kept growing during the beginning of the 21st century (Bogoyavlenskiy et al., 2017).

These new demographical trends and new drivers of change triggered some governmental measures trying to improve Indigenous conditions by promoting sedentarization, the integration to the formal educational systems (Hamilton 1994) and building new amenities, services and

infrastructure. In general, northern residents, authorities and Indigenous peoples obtained benefits from these new activities in a smaller proportion. Switching to regular wage employments was one of the biggest challenges that Indigenous peoples faced during this transition (Coates & Broderstad, 2020).

Arctic residents have a strong sense of mobility and motility (see Chapter 9). Many new settlers still come to the North attracted by the region's economic, cultural and environmental characteristics (Dodds & Nuttall, 2019). Many rely on daily mobility to work, study and practice their traditional activities; others leave their places of birth temporarily and then come back; while others will settle in other regions or countries. This explains the wide variety of lifestyles, occupations and forms of interacting with their environment that we can find among Arctic communities. For example, Red Dog Mine in northwest Alaska is seasonally inhabited by 300 people – most of them are miners and support staff financially supported by the mining company (Dodds & Nuttall, 2019).

III.D) INDIGENOUS PEOPLES IN FACE OF ARCTIC CHANGES

The Arctic has been inhabited since the end of the last glacial age, or even for far longer (Pitulko et al., 2004, 2017) and since then, there was no single Indigenous North (Coates & Broderstad, 2020). Arctic residents have learned how to adapt to environmental variability, cold, extended winter darkness, and fluctuations in animal populations, biodiversity and landscape changes triggered by geographical and climate processes throughout history (ACIA, 2005). Northern communities remained small and isolated from each other for a long period of time. However, they developed the necessary techniques of housing, clothing, transporting and harvesting to live in these territories (Coates & Broderstad, 2020).

Since the 20th century, Indigenous peoples encountered new stressors and their lifestyles underwent accelerated modifications, including the introduction of new forms of technologies, the degradation of indigenous languages, traditional cultures and landscapes, rapid industrial development of some areas and biodiversity loss. The region was also impacted by other sociocultural challenges such as high rates of Indigenous suicide, alcoholism and drug addiction, teenage pregnancy, violence, HIV AIDS, among others. The demographical composition was influenced by two major processes: massive outmigration from traditional homelands and the arrival of newcomers, especially after World War II. Government interventions, poor educational and health systems also contributed to the overall degradation of livelihoods in the North (Coates & Broderstad, 2020) and have

undoubtedly shaped the current patterns of the Arctic. The legacy is still visible: for example, most settlements and villages in the Russian Arctic do not have 2G-4G network coverage (see Figure 42 below) and further investments are still required.



*Figure 42: 2G-4G coverage in the Russian Arctic provided by the “Megafon” company.
Source: www.geo.minsvyaz.ru*

Extreme environmental conditions have largely determined demographic distribution in the Arctic due to the challenge that this represented for human survival (Pitulko et al., 2017). This is still valid for current northern inhabitants and climate change now dominates contemporary discussion of the Arctic (Dodds & Nuttall, 2019). This is essentially explained by the fact that it simultaneously impacts several spheres of northern residents’ livelihoods and identity: subsistence, travel on sea ice, reindeer herding, fishing, among others (Larsen et al., 2010; Hovelsrud et al., 2011; Magraw et al., 2008). New stressors and accelerated changes can lead to the loss of social identity, social alienation or even unchain destructive behaviors (Larsen et al., 2010). In this context, future climate projections can be useful tools for quantifying - and therefore preventing - undesired effects on northern livelihoods and cultures. In this context, integrating indigenous observations and perceptions about these changes is essential (ACIA, 2005), especially in order to capture and to integrate the different ways of experiencing its effects. For example, in Greenland, residents of Nuuk perceive changes in the weather as inconvenient rather than disruptive (Dodds & Nuttall, 2019).

Identifying and characterizing environmental and socio-economic changes in the Arctic will also facilitate understanding how these impact northern identities. The latter ones are defined and redefined only in interaction with the surrounding environment, this is why identities should be analyzed as fluctuating processes rather than as a fixed category (Schweitzer et al., 2014).

Over the past 40 years, Indigenous peoples gained international visibility and played a key role in the evolution and definition of the Arctic agenda (Coates & Holroyd, 2020). There has also been progress in certain social markers: more Indigenous communities started sending young people to high school and then pursued upper studies and there are now an increasing number of language revitalization programs within the Arctic territory (Coates & Broderstad, 2020). Despite the progress, the overall trend indicates that they still require financial and political support in order to strengthen their agency and the decision-making processes at a local, regional and national scale (Coates, 2004).

III.D.I) Linguistic diversity

Among Arctic communities, a wide variety of languages are spoken. These do not belong to the same languages families nor are related to Russian or any other European languages. Not only are they means of communication, but they are also vital for the survival of any culture as it preserves commonly-shared memories, it reinforces the usage of particular terminologies and traditional knowledge (Schweitzer et al., 2014). In other words, languages contribute to reflect the particular way in which a human group interprets and gives sense to the world they live in.

In face to the aforementioned stressors and drivers of change, many indigenous groups are currently facing acculturation, frequently reflected in the loss of native languages and posing a threat to their cultures and identities (Kozlov et al., 2007). The indigenous linguistic diversity in some occasions can even face extinction (ACIA, 2005). In some northern settlements, both the small population size in addition to the low rates of native language proficiency, represent serious threats for preserving certain indigenous languages. This is particularly relevant as the few remaining speakers of those languages tend to be the elderly sectors of these communities (Rohr, 2014). Recently, some efforts have been made to increase young people's interest in their native languages, for example in some northern communities of Russia. Traditional indigenous holidays have been reintroduced in order to promote these almost extinct languages and revitalize them. Additionally, films, videos and internet are now considered to be powerful tools that can also

contribute to language preservation (Arruda & Krutkowski, 2017). An important element that must not be overlooked is the preservation of traditional environments of Indigenous peoples. In Russia, for example, it has been observed that nomadic communities best preserve native languages. On the other hand, ethnically and linguistically mixed settlements, people predominantly communicate in Russian. In fact, according to the 2010 Russian National census, fewer than one fourth of indigenous individuals were perfectly fluent in their native tongue. Some other indigenous groups with strong native language proficiency were not considered in the census because according to Russian laws, they do not respect the conditions of the “small-numbered Indigenous peoples” category (Rohr, 2014). It was also frequent to find a larger amount of respondents self-identifying from a particular ethnic group yet only a small proportion of them declared speaking the corresponding language. All in all, the trend reveals a downward trend in the proportion of native speakers in Russia between 2002 and 2010 (Schweitzer et al., 2014).

III.D.II) Spirituality and worldviews

Worldviews, spiritual life, knowledge and well-being cannot be interpreted separately and they are closely related to a complex series of meaningful interactions between Arctic indigenous people and their land, animals and ancestral beings (Schweitzer et al., 2014). Indigenous knowledge and forms of living are holistic and are based in the concept of interconnectedness between every element of the Universe (Lavallée, 2009). According to Castellano (2000), the three main forms of Indigenous Knowledge include:

- 1) Traditional Knowledge obtained from previous generations;
- 2) Empirical Knowledge accumulated from empirical observations and
- 3) Revealed Knowledge which is manifested through dreams, visions, and intuition. All these forms correspond to the spiritual sphere and often transcend time. Intuition is based in receiving and processing information about an event even if this actually happens (McCraty et al, 2004). It can also go beyond physical locations, for example, when a mother knows that her child is hurt even if they are not physically together (Barrett & Wuetherick, 2012).

Revealed Knowledge is often dismissed or ignored by western science (Burk & Sadler-Smith, 2011). However, it is particularly relevant within indigenous worldviews as both intuition and the animist ontology – widely extended among Arctic Indigenous peoples - are closely related to each other (Barrett & Wuetherick, 2012). The animist ontology is one of the most outstanding features of

indigenous worldviews and revolve around the idea of killing to survive, which requires being in close contact with animals. According to Willerslev (2007), animism consists of a “set of beliefs, whereby nonhuman animals (and even nonanimals such as inanimate objects and spirits) are endowed with intellectual, emotional, and spiritual qualities paralleling those of human persons”. Moreover, it supports the idea that plants, animals, and spirits communicate and interact with humans. This communication implies that insights are received by humans under the form of revealed knowledge, which in western cultures are usually explained by other assumptions (Barrett & Wuetherick, 2012).

Sami reindeer herders, for example, consider that there are no borders between spirit and matter and that every single being in nature has soul or spirit (Helander-Renvall, 2008). An animist ontology accepts that animals and spirits have emotions, values, goals, ways of communicating, acting and caretaking, just like humans do (Reed, 1988; Bird-David, 2002; Mitchell, 2003).

When Yukaghir people go hunting, they call and appeal their master-spirits of the rivers and hunting grounds as “fathers”, “mothers”, “grandfathers” or “grandmothers”, while they themselves identify as the “children” or “grandchildren”. In accordance with these existing ties, hunters consider that they are meant to prey and that the spirits should provide them with animals. Similarly, the act of sharing between humans the meat and other goods obtained from nature strengthens their relationship within a cosmic economy of sharing (Willerslev, 2007).

Shamanism (the word originated in Siberia) is also an important element of Indigenous worldview in the Arctic. In 2012, the North Norwegian county of Troms recognized the regional Shamanic Association as a religious denomination (Fonneland et al., 2018). Two years later, shamanism was officially recognized by the Ministry of Justice of Russia in the Sakha Republic as a religion (Schweitzer & Ulturgasheva, 2014). Shamans play a key role as they mediate the spiritual and the material worlds. It represents a constitutive element of the Sakha culture, but it is also associated to the feeling of well-being by connecting their land and its spirits, which are perceived as a guarantee of a healthy and balanced lifestyle in the Arctic.

Shamanism and animism have some elements in common such as the blurred boundaries between animate and inanimate entities, as well as the transformability of its human and non-human, spiritual and material components (Vitebsky, 1997; Willerslev, 2007; Lavrillier, 2012). For example, bears can “be” shamans or they can transform themselves into humans. Similarly, shamans too are

capable of transforming themselves into bears (Kwon, 1999; Lavrillier, 2012). Shamans adopt animal behaviors to embody their ways of thinking and behaviours. This is known as “shapeshifting”, this is, a transformation of a shaman into an animal; and behaving like a particular animal. There are numerous shapeshifting stories from Siberia (Saniotis, 2019): in the Srednaia Kolyma region in Russia, there was a shaman called Parilop. It was said that he had healing and precognitive abilities and his spirit helper was a woodgrouse. One day, he went to the Khatingnaakh village to visit a friend called Karkha. His friend tried to shoot a bird with a gun, but the bird escaped. A few days later Parilop asked Karkhi: “Why did you try to shoot me the day before yesterday?” (Balzer, 1996).

The Sami People perceive themselves as an integral part of nature and communicate with each of its aspects (Helander-Renvall, 2010). For example, a reindeer herder in Sweden explained to Timm Rochon (1993: 46): “I am part of the forests and the mountains.” Moreover, both animate and inanimate aspects of nature are equally respected (Rochon 1993:58).

Shamanism and animism can also adopt alternative forms in other regions: through the feeding of the fire, the interpretation of dreams and omens practiced by the hunters and reindeer-herders in the Siberian forest (Vitebsky, 2005; Lavrillier, 2012).

The shamanic culture is characterized by a connection with the patterns of nature: the topography of the human body is constantly interacting with each feature of the surrounding landscape. The importance of the latter one relies on the fact that it will delineate the scheme of human experience. Before the introduction of Christianity by European colonizers, Inuit groups saw “the angakkoq”, the shaman, as the one in charge of organizing and maintaining the relations and exchanges between humans, animals, and spirits (Dodds & Nuttall, 2019). Shamans still play a key role in some northern communities negotiating between the visible and invisible worlds, this is, between different psychic realms (Saniotis, 2019).

These particular dynamics and conceptions about life contribute to the reproduction of kinship patterns and strengthen the human-animal relations (Schweitzer et al., 2014). This also highlights the importance of taking into consideration such elements when analyzing the extent of climate change impacts in Arctic Indigenous cultures.

III.D.III) Landscape, place and identity

Landscapes too have a central role in the delimitation of northern identities. This is why the wide

variety of interactions and connections between Arctic residents with the landscape should not be overlooked. According to Oosten & Remie (1999), identity is bounded to place and time, and is relationally determined. It is only within the multiple interactions between the environment and each of its components that the meaning and value of places are defined. Places are also defined according to the physical activities and the knowledge that emerges from them. Knowing, understanding and predicting the way a certain landscape interacts, usually requires recurrent practice throughout the time (Patrick, 2005). Acquiring these capacities become essential for the survival in Arctic territories.

Place names (toponyms) are not neutral: they reflect deeper forms of understanding, perceiving and appropriating the landscape for Arctic communities. Furthermore, they can provide information about relevant sites for animals, human activities, directional references, the topography, changes in the climate, among others (Collignon, 2006). Living under traditional relation to nature, is for many a particular way to insert themselves into this world, to give meaning to their lives, or to define what they consider quality of life (Schweizer et al., 2014).

Consistent with northern worldviews and spiritual understandings, the way indigenous people conceive and understand their environment and each of its aspects, is also reflected in the specificity of the terms used to refer to them. It is possible to find a wide diversity of place names which are hard to be translated into western languages due to the richness of its content. For example, Inuit use the word "nuna" to refer to their land. However, this is a broader concept and also englobes the place which is underneath, above and all around them, where people live and interact with animate and inanimate aspects (Dodds & Nuttall, 2019).

A Sami reindeer-herder told to Åsa Nordin: "Today it's a lifestyle. So long as we carry on reindeer herding the way we do, with extensive herding, migrations and guarding, it's a lifestyle. [...] Especially when reindeer herding doesn't bring in most money, you factor other Sami values into it, values which cannot be stated in money terms, and when you assimilate and experience those values as well, it's a lifestyle (Nordin, 2007:82).

Arctic inhabitants have developed a particular sense of place and understanding of homeland which are strongly related to a landscape characterized by water in solid state and harsh cold climate. Such characteristics provide familiarity, comfort and well-being to most northern inhabitants (Nuttall, 1992). This is particularly relevant for Indigenous peoples. For example, a Sakha elder

woman told Susan Crate:

"It is not bad to have warm winters, being an old person, it is great! But as Sakha people, we need strong cold here. It is how our lives are organized and how the nature works here. The big cold is good. The diseases are gone. When it is warm it snows too much and it is not warm or cold. The winter warmth affects people's blood pressure. And the heat in the summer is different, humid and very hard for people to go. It is bad for the way of life here and for survival. The nature, people, animals and plants here are supposed to have very cold winters and very hot dry summers. That is the best for all life here." (Crate, 2008).

Place identity is not predefined nor immutable, but rather a constantly redefined outcome of a process of place-making. Due to the multiple colonization waves in the Arctic, Indigenous peoples had to cope with the impacts of disruptive incursions of new settlers who arrived to their homelands, altering their lifestyles and therefore, their identities and sense of place too (Schweitzer et al., 2014).

Climate change and extractive activities currently threaten the ties existing between northern residents and their meaningful places, both in symbolic and practical terms. More specifically, the potential material loss due to infrastructure and land degradation can unchain forced displacements or the irrecoverable loss of numerous sacred sites. Executing such projects can disrupt northern livelihoods, impact inner social articulation and result in an overall cultural diminishment. According to Oliver-Smith (1992), displacements can threaten the identification with a particular environment which was once perceived as nurturing and central to cultural identity.

III.D.IV) Traditional activities & northern identities

Northern cultures strongly rely in the practice of their traditional activities (hunting, fishing and herding), and are not only conceived as a source of monetary income, but as a constitutive element of their livelihoods and well-being (Schweitzer et al., 2014). In this sense, their traditional lands, land use and seasonal cycles are three key pillars of their life-support system (Gladun & Ivanova, 2017). Some differences appear among Indigenous and non- Indigenous peoples practicing these activities: the former ones do it in the search of harmony with their traditional subsistence economies and the exercise of their right to possess and to occupy their ancestors' lands (Larsen et al., 2010; MacLennan, 2008). Many non-Indigenous peoples usually do it as a sport or hobby, but some others already integrated them as part of their livelihoods and identity (Keskitalo et al., 2013).

The type of activity and the frequency strongly depend on the region and ethnicity. In the Faroe Islands, for example, people principally hunt and fish. They depend on sheep (meat and wool), whales (meat and blubber), sea birds, dairy cattle (milk), and crops of potatoes (Schweitzer et al., 2014).

Nomadic reindeer pastoralism requires large surfaces of land and is a key feature of other northern cultures like the Sami and other Indigenous peoples from Siberia. The establishment of new extractive industries and the implementation of large-scale infrastructural projects in Arctic territories currently represent a threat for this traditional activity. Such activities have irreversible impacts on the landscape: natural boundaries and migration routes have been altered. Dammed rivers altered the quality and amount of pasturage and the natural water regulation system. Most effects are interconnected: winter pasturage areas have been artificially divided, leading to a sharp reduction of winter grazing for reindeer (Schweitzer et al., 2014). The Inuit in Nunavik and the Cree First Nations of James Bay Region feel the impacts of hydroelectric power station as it floods their traditional hunting grounds (Schweitzer et al., 2014). The Sami people are also facing a sharp reduction in the amount of people engaged in reindeer herding, hunting and fishing. This is translated into an increasing pressure on their ethnic and cultural identities (Sköld, 2011).

National and international visibility of these types of conflicts established a new environment for negotiations: relations between industrial companies, regional governments and Indigenous peoples are now based on mutual benefits and aim at the active reduction of burdens on traditional landscapes and activities (Gladun & Ivanova, 2017). In some occasions, Indigenous peoples are paid for loss of profit when practicing their traditional activities is negatively impacted by industrial developments. However, many esteem that this does not prevent environmental degradation and can even increase the arrival of new settlers, exacerbating Indigenous vulnerability in financial and spiritual terms (Gladun & Ivanova, 2017). These types of conflicts leading to changes in occupations and the social structure of settlements also triggers the re-definition of northern identities (Schweitzer et al., 2014).

Simultaneous changes in their lifestyles pushed Indigenous peoples to find new alternative ways of economic development while trying to find the balance with their traditional lifestyle and worldviews. However, this has presented some challenges: for example, in Northern Yakutia, climate change accelerated coastal erosion, making mammoths tusks more easily findable, and therefore

more young people are getting involved in this activity. Some of the most traditionalist sectors of northern communities perceive this activity as an “threat to their worldviews”. Other forms of protecting traditional activities include legal and governmental action. For example, the government of the Republic of Sakha established a law in 1997 that declares reindeer herding as a “national property” and therefore, it requires state support⁸. This law guarantees a salary for both private and public nomadic herders in order to raise and maintain herds.

III.E) THE RUSSIAN ARCTIC

Two major differences of the Russian Arctic in comparison with other Arctic countries are: the fact that it was developed under a centrally-planned economy (Heleniak 2009, 2010) and in even harsher climate conditions.

Numerous ethnic groups – most of them nomadic hunters, reindeer herders and gatherers - have inhabited the Russian Arctic for thousands of years. They lived in accordance with their environment, and have already developed complex guiding regulations regarding different spheres of social life: mutual aid, support of the disabled, regulations of collective use of certain territories (such as hunting or fishing grounds), property and inheritance. It was not until the 16th century that they had contact with foreigners (Schweitzer et al., 2014).

The era of resource-exploitation in the Russian Arctic officially began right after the Bolshevik Revolution of 1917 (Heleniak et al., 2020). The first attempt was to industrialize the territory by extracting natural resources such as gold, oil and timber, and to conquer the permafrost areas. Between 1930s-1940, Stalin concentrated the forced labor into gulag camps. This period was characterized by a boom in the Siberian population, resulting in unprecedented growth in the region. World War II was a reminder of the importance of relocating Russian industries far away from the front line, mostly in Siberia which was seen as remote and inaccessible (Reisser, 2016). In 1953 gulag camps were abolished and a new settlement era - based in wage incentives – began. The new piling foundations for permafrost construction allowed the rapid development of numerous centers in the Russian North. The typical Soviet-era five story apartment building had on average 80 households, totaling about 185 residents. (Streletskiy & Shiklomanov, 2016). The 1960s were characterized by the first majors’ discoveries of oil, natural gas, metal and mineral resources,

⁸ Law of the Republic of Sakha (Yakutia) on reindeer husbandry 179-I, 25 June 1997 [Закон Республики Саха (Якутия) от 25.06.1997 3 N 179-I "Об оленеводстве" (принят постановлением ПП ГС (Ил Тумэн) РС(Я) от 25.06.1997 3 N 180-I)]

and the development of new technological methods that contributed to accelerate the production (Reisser, 2016). In order to keep the rhythm of economic development in the area, the government created a series of benefits known as "Northern delivery"⁹ (Heleniak, 2001) which consisted on the one hand, of subsidies, and on the other hand, of pay raises for workers (Reisser, 2016). These aimed at encouraging more people to resettle in the North. In some cases, workers in the North could be paid double or more for doing the same job in southern regions in Russia (Heleniak et al., 2020). This was an effective measure that captivated many migrants willing to develop their professional career and to undertake an adventure. Some Siberian cities began producing basic goods on a small scale, however, only enormous financial resources subsidizing could guarantee satisfying the local and regional demand. These subsidies could represent up to 6% of the entire Soviet GDP (Heleniak, 2001).

When the Soviet Union disintegrated in 1991, Russia switched to a market economy, liberating prices, the costs of northern development systems. Additionally, all forms of subsidies and political support based in the Arctic region were equally cut down (Heleniak et al., 2020). By then, there were numerous sizeable urban centers like Arkhangel'sk (417,000 inhabitants), Murmansk (472,000), Petropavlovsk-Kamchatskiy (273,000), Noril'sk (180,000), Magadan (152,000), and Vorkuta (115,000) (Heleniak, 2017). Social and economic crisis led to a deep reorganization of populations and enterprises. This period was principally characterized by deindustrialization, population loss and political tensions while they tried to reorient the economy from a centrally-planned to a market one (Reisser, 2016). Such changes brought massive out-migration from smaller towns, leaving behind "ghost cities". Larger cities population sharply decreased as well. The Magadan oblast was one of the most impacted regions, reaching almost 60% of out-migration and Chukotka's population declined by three quarters. While all regions experienced a population decline, only the Khanty-Mansi and Yamal-Nenets okrugs had their populations growing due to their key role as petroleum and mining centers in the Russian North. The Republic of Sakha had population decline too, but also had high birth rates, which softened the resulting effect (Heleniak et al., 2020).

Although the overall trend in Arctic populations indicate a decline since 1991, there were some exceptions: some urban centers have registered growth, especially those cities controlled by energy exploitation, as well as those with good infrastructure and transit accessibility (e.g: Yakutsk). The

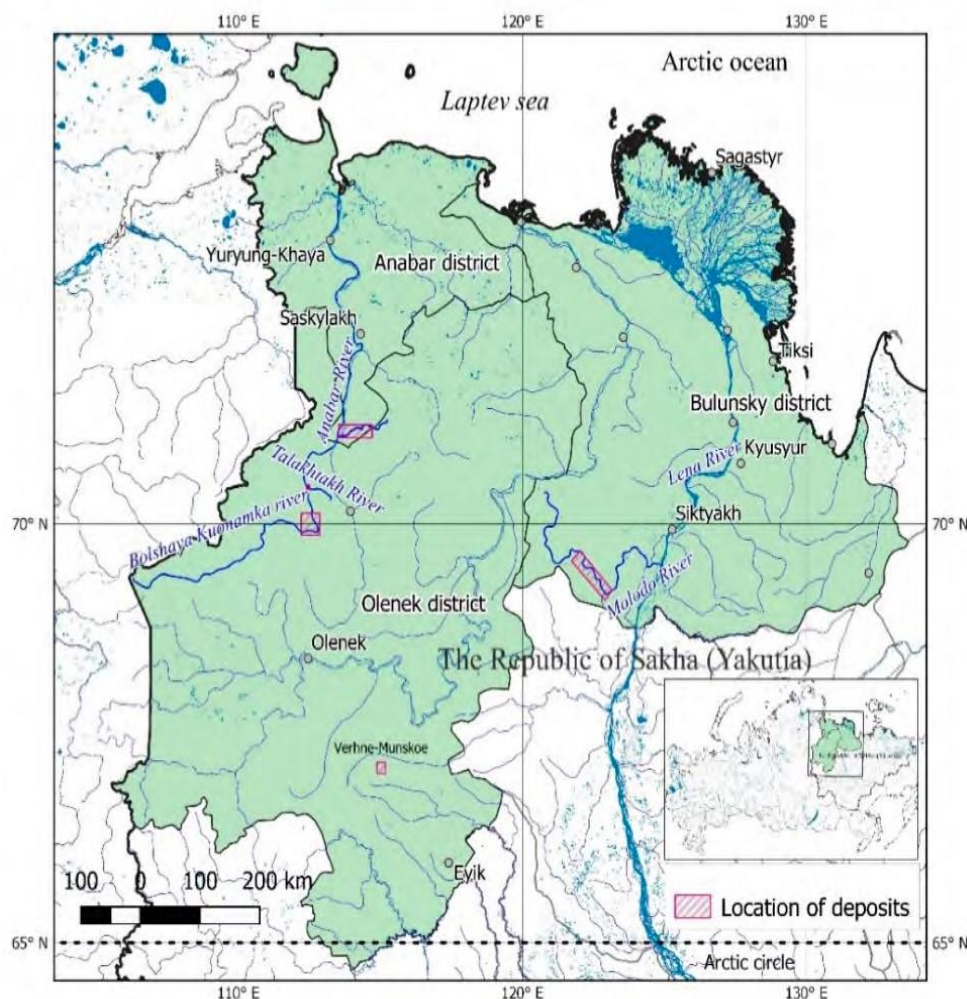
⁹ "Северный завоз" in Russian.

largest population declines were registered in cities based on lower-profit sectors, such as timber or low-value mining (coal) (Reisser, 2016).

The arrival of Putin to the government represented a new era: he became interested and involved in the energy sector and coordinated its development. The federal government currently has a strong presence in cities largely run by state-owned energy firms (Reisser, 2016).

BOX 4: EXTRACTIVE ACTIVITIES & INDIGENOUS LIVELIHOODS IN THE RUSSIAN ARCTIC

The Arctic Zone plays a key role in the development of the Russian economy due to its richness in natural resources, especially in terms of oil, gas and diamond deposits (see Figure 43 below). However, extracting them sometimes collides with indigenous forms of living and traditional activities. Social tensions have been increasing during the last decades as a result of to the environmental degradation associated to extractive activities. Environmental preservation is particularly relevant considering that most indigenous peoples living in the Arctic region depend on traditional subsistence activities for their survival. As a result of the increasing changes in their physical environments, numerous northern communities have been struggling to uphold their identities and cultures while living in accordance to their worldviews and needs (Rohr, 2014).



*Figure 43: Diamond deposits in the Republic of Sakha.
Source: Novoselov et al., 2020.*

During the past decades, indigenous peoples have been increasingly coordinating efforts to partake in the definition and implementation of extractive projects in their homelands.

Most common forms of Indigenous participation include negotiating agreements with extractive private companies and participating in the environmental impact assessment processes (Kuokkanen, 2019).

However, the process to obtain some degree of participation took several years and was not homogenous between Arctic countries. While in Canada and Alaska, Indigenous involvement has been increasing under the form of negotiating impact and benefit agreements or land claims settlements, other regions did not experience much progress (Forbes & Kofinas, 2014; Keeling & Sandlos, 2016). In these regions, the sustainability principles and the necessity to find an adequate balance for all the implicated parts have been overlooked (Alexander, 2009; Ross, 2002; Pierk & Tysiachniouk, 2016). Moreover, participating in structures and procedures which are externally designed and executed (often by governments or the private sector) can shrink Indigenous peoples' agency, stress ethnical marginalization (Trigger et al., 2014) and negatively impact indigenous governance mechanisms.

III.E.I) Russian Arctic Indigenous peoples

Indigenous peoples played an important role in the recent history of the Russian state and established mutual collaboration – mostly trade-based relations – between them. During the tsarist era, Indigenous peoples were obliged to pay the “yasak¹⁰” (the fur tax) and therefore, became part of the Russian tributary system. During the Soviet times, laws were modified and Indigenous peoples faced two major external stressors: Christianization and the Soviet modernization that included both sedentarization and collectivization (Kozlov et al., 2007). This region of the country, as well as its inhabitants, were for a long time, part of the design of projects defined by economic and political interests (Tishkov et al., 2015). It is important to underline that the current socioeconomic configuration and the most serious problems of Indigenous numerically small peoples in Russia are predominantly founded in the measures and state policies taken during the 20th century (Kozlov et al., 2007).

¹⁰ “Ясак” in Russian.

Nowadays, traditional territories of Indigenous numerically-small peoples cover almost two- thirds of the Russian Federation’s total territory, in spite of being far outnumbered by non-Indigenous peoples in most regions. According to the 2010 national census, the Nenets are the biggest group, with a population of 44,000. The Evenks follow them, with 38,000. One fourth of the peoples have more than 10,000 members, while another fourth of the peoples have less than 1,000 members (Rohr, 2014).

According to Kozlov et al. (2007), Indigenous peoples can be classified according to the type of resource-based culture as follows (see Figure 44 below):



Figure 44: Indigenous peoples of the North, Siberia and the Far East of the Russian Federation.
Source: Norwegian Polar Institute

- Maritime hunters (e.g: Eskimos, Coastal Chukchi and Koryaks) who lived from seasonal seal, whale and walrus hunting.
- Tundra reindeer hunters: (e.g: the tundra Yukagirs, Evens, Nganasans, Tundra Enets and some

Saami groups). They permanently lived next to the area where migrating wild reindeer herds crossed rivers. They hunted with boats and nets.

-Taiga hunters and fishermen: reindeer, elk and mountain sheep were the main animals hunted by them. They also fished in some rivers and lakes. Some of them became semi- nomadic or nomadic.

-Reindeer herders: they tend large reindeer herds which are moved in search of adequate pastures. There were two main groups: those who travelled from the taiga zone to the tundra and back (The Saami of the Kola Peninsula, Nenets and Enets), and those who moved to the sea coast in summer (the Chukchi and Koryaks).

The Yakutsk settled far in the North and were mainly cattle and horse breeders. Some of them fished too. In the northern areas, reindeer herding and hunting were popular. Agriculture was developed in the mid-19th century. Harvesting of wildgrowing plants and berries was frequently practiced.

Chapter 3 provided an in-depth description of the most salient historical events that participated in the shaping of the current social and cultural configuration in the Arctic, and more specifically, in the Russian Arctic. It also provided useful information that facilitates understanding the different characteristics associated to Indigenous and non-Indigenous peoples. Bearing this in mind it is essential to qualitatively analyze the interviews collected during the fieldwork and insert local residents' narratives within a broader social, cultural and ethnic background. Chapter 4 will span a specific analysis of the sites, including the administrative, political and historical context of Tiksi and Bykovsky. It will also describe the main traditional activities that are practiced in the region, which is essential to understand their interplay within the local and regional economies and the intensity of the effects of climate change and permafrost thaw (developped in chapters 8 and 9).

CHAPTER IV: FIELDWORK DESCRIPTION AND SITE CONTEXT

This chapter presents the concrete dimensions of the fieldwork that has been conducted for this thesis. The general scientific, project-centered, context of this thesis serves as an introduction. A presentation of the administrative, political, social economic and local context of the fieldsites - regionally and locally - follows.

IV.A) GENERAL CONTEXT OF THE THESIS

This thesis was conducted within the course of, and funded by, the European project “Nunataryuk.” World-leading specialists from a wide diversity of disciplines were brought together in order to determine the impacts of thawing coastal and subsea permafrost in coastal areas in the Arctic. The Nunataryuk project is currently developing targeted and co- designed adaptation and mitigation strategies for the Arctic coastal populations. More specifically, it aims at:

- **developing quantitative understanding of the fluxes and fates of organic matter released from thawing coastal and subsea permafrost;**
- **assessing the risks related to thawing coastal permafrost, to infrastructure, pollution, indigenous and local communities and people’s health;**
- **based on this understanding, try to estimate the long-term impacts of permafrost thaw on global climate and economy**

This thesis contributes to the 2nd objective, with a focus on Siberian populations. The project is accompanied by a Stakeholders’ Forum of representatives from Arctic coastal communities and Indigenous peoples. It nurtures a collaborative community and provides a mechanism for developing and applying innovative evidence-based interventions. The project focuses on ten sites distributed in three focal geographical areas: The Beaufort Sea, the East Siberia and the Nordic areas, located along the Arctic permafrost coast (see Figure 45 below).

The work conducted in communities in these focal areas is targeted and addresses community-specific issues related to permafrost thaw and its impacts. Many of the coastlines of the Nordic Area are, for instance, stable rocky coastlines where permafrost-related challenges are mainly limited to onshore infrastructure, while the East Siberia, our focus here, and the Beaufort Sea coastlines are mostly unconsolidated ice-rich permafrost, leading to threats from coastal erosion. Some

communities, such as Tiksi (part of this thesis) and Longyearbyen, are important regional hubs facing different demographic shifts that differ from pressures unique to the smaller communities. It is essential to include different communities in order to improve the projection of impacts and to promote the exchange of knowledge that will can lead to better adaptation strategies at the circum-Arctic level.

Within this project, the research laboratory CEARC (UVSQ), that has hosted the work for this thesis, forms part of the WP7. It aims at creating new datasets on the socio-economic situation of the Arctic coastal zone and developing a framework for natural resource management which are currently being affected by accelerated thawing permafrost. The French team of the CEARC Laboratory is covering the coastal settlements of Tiksi and Bykovsky (Sakha Republic, Russian Federation).



*Figure 45: Map indicating Nunataryuk's geographical areas of study.
Source: Nunataryuk's official website*

In collaboration with Russian partners from the North Eastern Federal University of Yakutsk (NEFU) and the Institute for Humanitarian Research and Indigenous Issues (Siberian branch RAS), the CEARC team coordinated two fieldworks in different locations inside the Sakha Republic. The first one was conducted between June and July 2018. It was led by the Director of the Laboratory and supervisor of this dissertation, Jean-Paul Vanderlinden and Natalia Doloisio. The second fieldwork was conducted between July and August 2019: The French team was integrated by Mateo Cordier (assistant professor, Economics at the University of Versailles Saint-Quentin-en-Yvelines), Magali Vullierme (Post-Doct. in Political Sciences, CEARC/IRSEM) and myself, Natalia Doloisio. In both opportunities, the Russian team was integrated by Inga Nikulkina (Professor of Economics at NEFU) and Vyacheslav Shadrin (Researcher in Indigenous Studies, RAS Siberian Branch). Additionally, in each fieldwork, at least one local translator was hired to collaborate with live translations and daily life. In 2018, an English speaking Yakutian student named Anna Svinoboeva joined the French team. Additional help was provided by both Vyacheslav Shadrin (Representative of the Indigenous peoples of the North) and Marina Mordinova (NEFU Senior Instructor). In 2019, two translators joined the teams during the fieldwork to Tiksi: Lena Grigorieva (Senior Lecturer in Foreign Languages, NEFU) and Pavel Garasyuta (Freelance translator). Interviews from Bykovsky were conducted by Mateo Cordier and Vyacheslav Shadrin who speaks both English and the Yakut dialect.

IV.B) GENERAL ADMINISTRATIVE, POLITICAL AND HISTORICAL CONTEXT OF THE REPUBLIC OF SAKHA

The Arctic zone of the Russian Far East includes the Chukotka Autonomous Region and five uluses of the Republic of Sakha: Allaikovsky, Anabarsky, Bulunsky, Nizhnekolymsky, and UstYansky. All of these territories have in common a sharp continental climate, presence of permafrost in their territories, low population density, high resource-intensiveness, focal nature of industrial-economic development, dependence on deliveries of goods to the Northern Territories (Stepanko, 2019), and vulnerable ecological systems. The fieldworks for this PhD have been conducted in the Republic of Sakha with a special focus on the communities of Tiksi and Bykovsky, in the Bulunsky district.

Tiksi and Bykovsky were chosen because of their site-specific characteristics. Regardless of their relative geographical proximity and thus their shared remoteness in the Russian Arctic territory, their physiography presents some key differences. The Bykovsky Peninsula is covered by ice-rich deposits, also called Ice Complex, which is subject to thermoabrasion on the Laptev Sea coast and

to different thermoerosional and thermokarst processes (Meyer et al, 2002), whereas Tiksi is naturally protected by this Peninsula. There is the coastal mountain range of the Kharaulakh Ridge in the west and remains of a former accumulation plain, including the Bykovsky Peninsula, in the east (Grosse et al, 2003).

The ethnical-demographical composition and economic profile of each settlement might also influence inhabitants' perceptions concerning climate change and permafrost thaw. The settling and historical processes that each of these settlements went through, strongly influenced the way they function and their roles at the local (Bulunsky District) and regional scale (Sakha Republic). They are typical examples of Russian Northern settlements (Tiksi being urban and Bykovsky rural) that have gained importance during Soviet times, and therefore, also underwent deep transformations in terms of socio-economic and migratory processes after the Soviet breakup.

Obtaining a better grasp of how climate change and permafrost thawing are impacting local lives and livelihoods in these two settlements, serves as an example of local dynamics within the Russian Arctic, different territorial and socio-economic sub-units can coexist with their own functioning systems, concerns, priorities and adaptive strategies. We argue here that this is a foundational point to conduct comparative studies with other settlements in Sakha Republic or other Northern regions in Russia that could contribute to obtain an overall understanding of the current situation in the Far North.

Their population composition, as well as economic profiles also make these urban and rural settlements respectively, important to be analysed. The interaction of these elements will undoubtedly shape the local population's perception of changes in climate and permafrost conditions. Historical processes and the cultural background of their inhabitants will also exert a strong influence in terms of mobility patterns to and from the region. Both settlements are located within the Sakha Republic, region that will now be presented.

The Republic of Sakha is the biggest administrative region of the Russian Federation – occupying one-fifth of the Russian territory and is located in the North-East of the country. It covers three time-zones along the coast of the Arctic Ocean. Administratively, the Republic is divided into 34 districts plus the city of Yakutsk from which 13 are Northern districts which are part of the Russian Arctic Zone (Decree of the President of Russia from 02.05.2014 N 296 "On land territories of the

Arctic zone of the Russian Federation¹¹). They are located North the Polar Circle and share the following general characteristics: harsh climate conditions, low infrastructure development, low population density and low transport accessibility. The predominant ecosystems are tundra and forest-tundra. In January 2019, the total population of the Republic of Sakha accounted for 967.009 inhabitants including urban (637.451) and rural population (329.558). More than 68 thousand people (about 7% of the Republic of Sakha) live in villages and settlements located in the Arctic Zone¹². Additionally, around 30 thousand people live in settlements which are categorized as "places of residence of small-numbered Indigenous peoples"¹³. Another particularity of this region is the big distances that separate one from each other and from any other populated place. Settlements are autonomous, although they are financially dependent on the budgetary planning from the municipal district, the Republic and/or the Federation.

The Republic of Sakha is famous worldwide for being the coldest place in the Northern hemisphere, reaching an annual temperature variability of up to 100°C in some areas. This is explained by the strong continental climate of the region. Its lands and seabed are located on continuous permafrost. Permafrost's depth can vary: the shallowest are in the southern districts, and the deepest in the mountainous valleys and lowlands. The landscape is predominantly mountainous with large lowland prairies in Central Yakutia and tundra zones in Northern latitudes. The coastal permafrost of Laptev and East-Siberian seas are points of interest in the Republic of Sakha and several scientific research projects are currently taking place in this area.

¹¹ Decree of the President of Russia from 02.05.2014 N 296 "On land territories of the Arctic zone of the Russian Federation" (Указ Президента России от 02.05.2014 N 296 "О сухопутных территориях Арктической зоны Российской Федерации")

¹² Results of the Russian Census of 2010. Book 4: Ethnic composition and language proficiency, citizenship of the population of Republic of Sakha (Yakutia) / Territorial Body of Federal State Statistics Service for Republic of Sakha (Yakutia) - Yakutsk (2019) – p. 652) (Итоги Всероссийской переписи населения 2010 г. Том 4: Национальный состав и владение языками, гражданство населения Республики Саха (Якутия) / Территориальный орган Федеральной службы государственной статистики по Республике Саха (Якутия) – Якутск, 2019. – 652 с.).

¹³ Kondratieva, V.I., Stepanova, N.A., Trubina A.V., Lukovtseva, A.S. (2018). On strategic vectors of socio- economic development of the Arctic Zone of Republic of Sakha (Yakutia)). *Innovatsii*, (11 (241)). (Кондратьева В.И., Степанова Н.А., Трубина А.В., Луковцева А.С. (2018) О стратегических векторах социально- экономического развития Арктической зоны Республики Саха (Якутия) *Инновации*, (11 (241)).

BOX 5: HISTORY AND THE REPUBLIC OF SAKHA¹⁴

The first primitive groups of people were already inhabiting the current area of the Republic of Sakha by the end of the Ice Age. More specifically, they lived in the basins of the current mighty high-water northern rivers - Lena, Yana, Indigirka, Kolyma, Anabar, Olenka, as well as their tributaries - Aldan, Amga, Vilyuy, Olekma and others. Archaeological remains of the inhabitants that created an adapted-to-extreme-conditions culture were found in this vast territory.

The cultural and economic development of this region was strongly influenced and enriched by Indigenous peoples: Sakha (Yakuts), Evenks (Tunguses), Evens (Lamuts), Yukagirs (Oduls), Chukchi, and Dolgans. They were principally hunters, reindeer and cattle breeders and occupied the most severe areas of the Northern Hemisphere. By the time the Lena Territory was included into the Russian state, the main indigenous population in the area were the Yakuts or Sakha. They introduced an economy based on horse and cattle breeding which contrasted with the hunting and reindeer herding economies of the smaller local populations, such as the Even, Evenk, and Yukagir. They were adherents of shamanism and believed in the forces of the nature. Natural and climatic conditions shaped their traditions and economies. Most of the indigenous groups in the area lived in clans and only the Yakuts had larger tribal communities.

The first Russian adventurers met the Sakha people on the banks of the Lena river in the 17th century. Cossacks were sent here by the Tsar in the quest for furs, which led to the establishment of a monetary economy in the region. Tygyn Darján, the King of the Yakuts, granted the territory for Russian settlements and in 1632 Russian Cossacks built the Lenski Fort on the bank of the Lena, which then became the current city of Yakutsk. Russians introduced agriculture in the basin of the Lena River and members of religious groups that were banned from Sakha in the second half of the 19th century started producing wheat, oats and potatoes.

Yakutsk was not only an important administrative, military, trade, cultural and religious centre of the region, but also a support base that contributed to the exploration of new territories in the Far East and northeast Asia. In the first half of the 17th century, the Lenski territory – rich in natural

¹⁴ Esterev, V.I., Shishigin, E.S. (2002). Yakutia-Russia: 370 years together" Yakutsk: Bichik ISBN: 5-7696-1720-9. (Естеров, В.И.; Шишигин, Е.С. (2002) Россия-Якутия. 370 лет вместе Издательство: Якутск: Бичик ISBN: 5- 7696-1720-9).

resources - was annexed to the Russian centralized state. The exploitation of such resources strengthened its financial and economic position. In fact, in the 18th century, Siberian furs accounted for 1/3 of the total income of the royal treasury. Policies for developing new lands aspired not to jeopardize the collection of the regular yasak¹⁵. In 1676, the most influential Yakut princes arrived to Moscow to manifest the most urgent problems of the region, including the administrative rights of the indigenous population. The territorial expansion within the Republic of Sakha included the establishment of new "yasak ostrozhki"¹⁶ and winter huts near the settlements of local residents, leading to an increase in the number of permanent Russian population.

Since the second half of the 19th century, agriculture became the second branch of the economy of local residents. The region was characterized by a peaceful cohabitation and the strengthening of ties was facilitated by the Christianization of Indigenous people and mixed marriages.

In Yakutia, Soviet power was established on July 1, 1918. However, in November 1918, the power of Alexander Kolchak – the head of the resistance in Siberia - spread in Yakutia. On December 15th 1919, the Soviet power was again established in the city of Yakutsk and throughout the territory of Yakutia. This new government nationalized large private enterprises and trading firms, among others. Moreover, the land use system was largely eradicated and the arable hayfields were distributed according to the equalizing principle. Since March 1921, under the conditions of the economic and political crisis, Soviet Russia switched from military-communist methods of governing the country to the New Economic Policy (NEP).

The 1920s and 1930s were characterized by new industrial projects in the region. In the spring of 1929, the Yakutsk mining and technical office began mining coal in the Sangarsk mines. In 1930, a sawmill, leather and shoe and brick factories were launched in Yakutsk. Fishing continued in the Lena River; salt mining at the Kempendyaisky and Peleduysky deposits, the production of a number of types of food products, etc. By July 1940, 96.6% of all farms were collectivized in Yakutia.

In the post-war years, the geological exploration has intensified. By 1974, the transformation of collective farms into state farms was completed. If in 1961 there were 28 state farms, then in 1986 there were 121. Only one fishing collective farm "Arktika" in Bulunsky ulus has survived. Social and

¹⁵ "Yasak" is a Turkic word for "tribute" which was used during the Imperial Russian to designate fur tribute that ingenious peoples of Siberia had to pay.

¹⁶ "Yasak ostrozhki" were fortifications built in areas where indigenous peoples lived in order to collect the fur tax.

political life were monopolized by the Communist Party and the public organizations led by it. Party organs were in charge of organizing labor competition, educational, cultural and recreational work. In 1960, there were 810 circles and seminars in the Komsomol political education system. The Komsomol of Yakutia made calls for "Youth for diamonds!" (1958), "The whole class - to the collective farms!" (1961), etc. In 1961, 56% of all Komsomol members worked in production, including the construction of a hydroelectric power station, a gas pipeline, and sponsored livestock farms. In the post-war period, the republic has achieved great success in the field of education, health care, culture, literature and art.

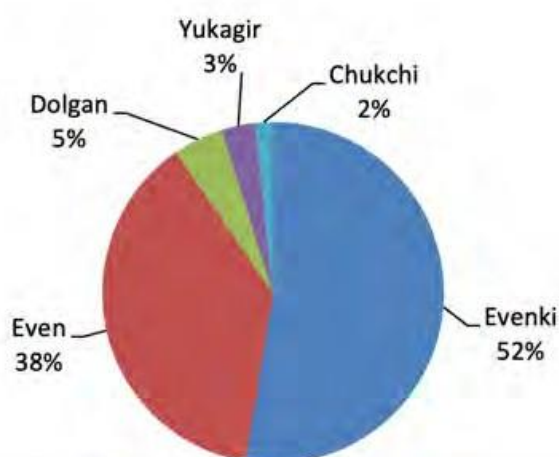


Figure 46: Share of individual nationalities in the total number of Indigenous peoples living in the Republic of Sakha (Yakutia), expressed in percentage.

Source: Elaborated based in information from the Russian Population Census 2010

In 2019, the Republic of Sakha has a unique ethnical diversity and cultural pluralism¹⁷ which is strongly associated to historical mobility processes in the region. Russian Legislation does not provide a definition of Indigenous peoples, instead, it includes the concept of "Indigenous Small-numbered People of the North". According to the Federal Law N 82-FZ "On guarantees of the rights of the Indigenous peoples of the Russian Federation"¹⁸, Indigenous small-numbered peoples of the Russian Federation are living in the territories of their ancestors and preserve their traditional ways of life (including farming and crafting). They must number less than 50.000 people in the Russian Federation and identify themselves as independent ethnic communities. Nowadays, the Republic of Sakha counts five ethnicities classified as Indigenous Small-Numbered Peoples of the North: Evenki, Even, Yukagir, Chukchi, Dolgan. Sakha (or Yakut) people are not legally included in this

¹⁷ Results of the Russian Census of 2010. Book 4: Ethnic composition and language proficiency, citizenship of the population of Republic of Sakha (Yakutia) / Territorial Body of Federal State Statistics Service for Republic of Sakha (Yakutia) - Yakutsk (2019) – 652 p.) (Итоги Всероссийской переписи населения 2010 г. Том 4: Национальный состав и владение языками, гражданство населения Республики Саха (Якутия) / Территориальный орган Федеральной службы государственной статистики по Республике Саха (Якутия). – Якутск, 2019. – 652 с.).

¹⁸ Federal Law of April 30, 1999 N 82-FZ "On guarantees of the rights of the indigenous peoples of the Russian Federation" (Федеральный закон от 30 апреля 1999 г. N 82-ФЗ "О гарантиях прав коренных малочисленных народов Российской Федерации").

category as there are more than 50.000 members. Some Russian laws do not apply to non-numerically small, albeit indigenous, peoples living in the same territory (Xanthaki, 2004). They amount to almost 40.000 people (around 16.1% of the total number of Indigenous peoples in the Russian Federation territory)¹⁹.

Indigenous minorities are distributed in 70 settlements within 21 municipalities in the republic (see Figure 47 below), which are classified as places of compact residence of Indigenous peoples of the North; these are mainly located in the Arctic Zone of the Republic of Sakha (49 settlements in total). In fact, four Arctic regions where more than half of the population are representatives of the Indigenous peoples, are endowed with a particular national status: Anabar National Dolgan-Evenk ulus, Zhigansk national Evenk ulus, Olenek national Evenk ulus and the Even-Bytantai national ulus.

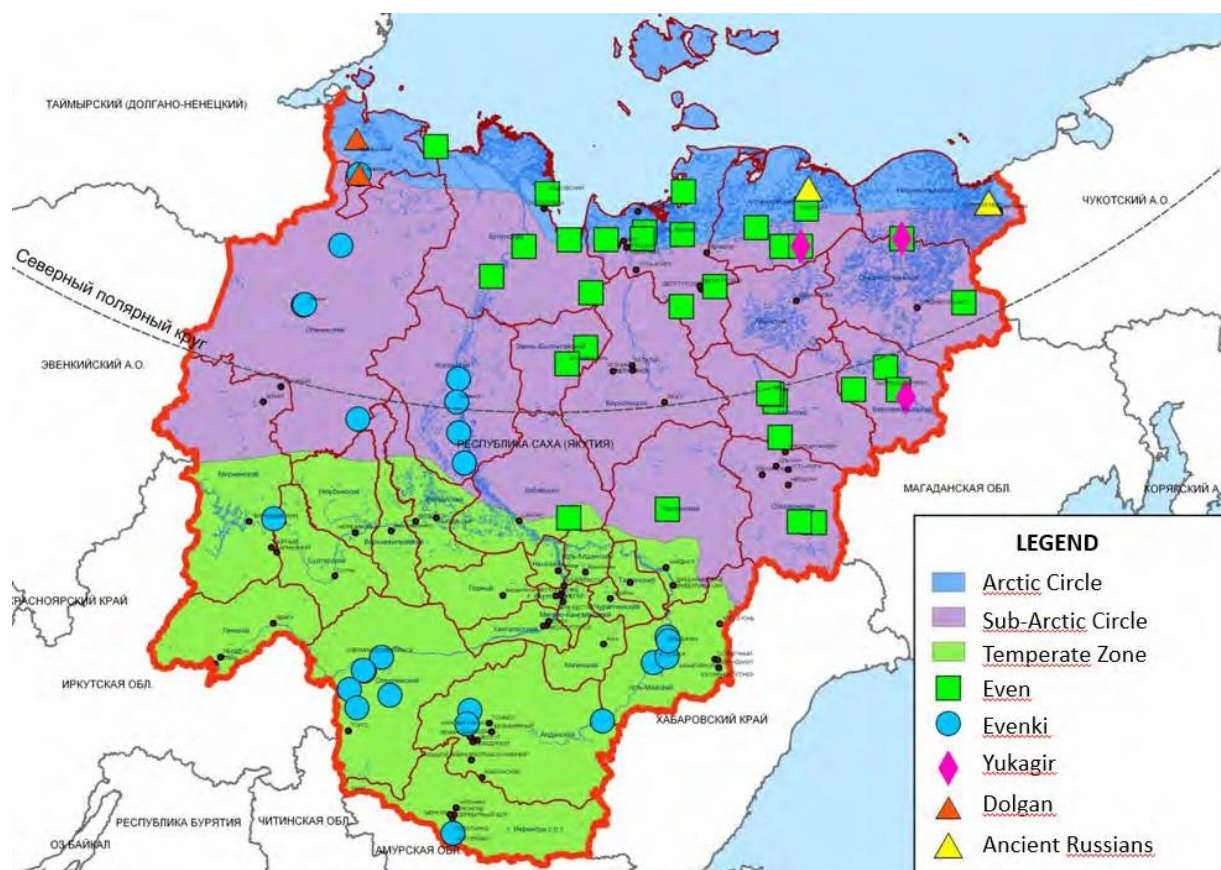


Figure 47: Geographical distribution of Indigenous Small-Numbered Peoples of the North in Yakutia.
Source: Filippova & Savvinova (2012)²⁰

¹⁹ Strategy for socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) for the period until 2035: Supporting Materials. "Appendix No. 1. A comprehensive analysis of the current socio-economic development of the Arctic territory of the Republic of Sakha (Yakutia) for the period 2010-2017." Yakutsk, 2020 (Проект стратегии социально-экономического развития Арктической зоны Республики Саха (Якутия) на период до 2035 года: обосновывающие материалы. «Приложение № 1. Комплексный анализ текущего социально-экономического развития арктической территории Республики Саха (Якутия) за период 2010-2017 гг.» Якутск, 2020).

²⁰ Filippova, V.V., & Savvinova, A.N. (2012). Clarification of the places of traditional residence and traditional economic activities of the indigenous peoples of the North of Yakutia using maps of different times. Arctic Environmental Research, (2) (Филиппова, В. В., & Саввинова, А. Н. (2012). Уточнение мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов Севера Якутии по разновременным картам. Arctic Environmental Research, (2)).

According to their ethnicity, the main share of the Indigenous peoples of the Republic of Sakha is made up of Evenks (52%) and Evens (38%), who live predominantly in small rural settlements. They live according to their traditional lifestyle and work in traditional industries of the North⁷. The third predominant ethnical group in the region is composed of Russians.

Six autochthonous ethnicities are considered as indigenous small-numbered (see more in Federal Law from 30.04.1999 N 82-FZ "On guarantees of the rights of Indigenous peoples of the Russian Federation"⁷) and both their culture and languages are considered to be endangered. In the Republic of Sakha, Indigenous traditional economies (see Box 6) are strongly dependent on reindeer herding, hunting and fishing activities which are at the core of their traditional lifestyle.

BOX 6: TRADITIONAL ECONOMIC ACTIVITIES ACCORDING TO RUSSIAN LEGISLATION

According to the Order of the Government of the Russian Federation of May 8th, 2009 N 631-r²¹, the traditional economic activities of the Indigenous peoples of the Russian Federation approved by the Russian Government are the following ones:

- Livestock breeding, including nomadic (reindeer breeding, horse breeding, yak breeding, sheep breeding);
- Processing of animal products, including collection, preparation and dressing of hides, wool, hair, ossified horns, hooves, antlers, bones, endocrine glands, meat, offal;
- Dog breeding (breeding of reindeer herding, sled and hunting dogs);
- Breeding of animals, processing and sale of fur products;
- Horticulture, beekeeping;

²¹ Order of the Government of the Russian Federation of May 8, 2009 No. 631-r On approval of the list of places of traditional residence and traditional economic activities of the indigenous peoples of the Russian Federation and the list of their traditional economic activities. (Распоряжение Правительства РФ от 8 мая 2009 г. № 631-р Об утверждении перечня мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов РФ и перечня видов их традиционной хозяйственной деятельности).

- Fishing (including marine hunting) and the sale of aquatic biological resources;
- Commercial hunting, processing and sale of hunting products;
- Agriculture (horticulture), as well as the cultivation and processing of medicinally valuable plants;
- Procurement of timber and non-timber forest resources for own needs;
- Gathering (harvesting, processing and sale of food forest resources, collection of medicinal plants) ;
- Extraction and processing of widespread minerals for their own needs;
- Artistic crafts and folk crafts (blacksmithing and iron-making craft, making utensils, boats, sledges, other traditional means of transportation, musical instruments, birch bark products, stuffed animals and birds, souvenirs made of deer fur and game animals and birds, etc. materials, weaving from herbs and other plants, knitting of nets, bone carving, wood carving, sewing national clothes and other types of crafts and crafts related to the processing of fur, leather, bone and other materials);
- Construction of traditional national dwellings and other buildings necessary for the implementation of traditional economic activities.

The official languages in the Republic of Sakha are both Sakha (Yakut) and Russian. It is a rich multicultural region characterized by additive acculturation²²). In settlements and villages, it is also possible to find a third language of local indigenous people²³

²² Strategy for socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) for the period until 2035: Supporting Materials. "Appendix No. 1. A comprehensive analysis of the current socio-economic development of the Arctic territory of the Republic of Sakha (Yakutia) for the period 2010-2017." Yakutsk, 2020) (Проект стратегии социально-экономического развития Арктической зоны Республики Саха (Якутия) на период до 2035 года: обосновывающие материалы. «Приложение № 1. Комплексный анализ текущего социально-экономического развития арктической территории Республики Саха (Якутия) за период 2010-2017 гг.» Якутск, 2020).

²³ The Constitution (the Main Law) of the Republic of Sakha (Yakutia) adopted by the Supreme Council of the Republic of Sakha (Yakutia) on 04.04.1992 (Конституция (Основной закон) Республики Саха (Якутия) принята Верховным Советом Республики Саха (Якутия) от 04.04.1992).

According to the articles 73 and 76 of the Russian Constitution, the Republic of Sakha has its Constitution (the Main Law), and possesses the full state power only beside the limits of the Federal government and of the joint jurisdiction. Thus, it exercises its own legal regulation²⁴.

The Republic of Sakha is a prosperous region in the Far Eastern Federal District characterized by a high resource potential; a wide variety of export-oriented enterprises, and geographical proximity to the sales markets of the Asia-Pacific region. Additionally, it has a touristic potential that creates attractive preconditions for the Republic of Sakha to become a new strategic outpost of Russia in the Far East.

The regional economy strongly relies on the extraction of natural resources such as diamonds, gold, antimony, coal, oil, natural gas, platinum, stone-colored raw materials, construction materials and other minerals destined for domestic consumption and exportation. The Republic of Sakha is the region with highest total reserves of all types of natural resources in Russia: the share of mineral reserves of the region in the mineral resource potential of Russia is: for diamonds - 82%, gold - 17%, uranium - 61%, antimony - 82%, iron ores - 6.2%, coal - 40%, tin - 28%, mercury 8%. Additionally, there are significant reserves of rare earth elements, silver, lead, zinc, tungsten²⁵. The Arctic Zone of Yakutia mainly exports fish and reindeer meat and some small forms of animal farming also take place in various northern villages²⁶.

Currently, regional and local authorities are working on the implementation of the Socio-Economic Development Strategy of the Republic of Sakha (Yakutia) having a target vision until the year 2050, which is expected to become the continuation of the 2020 Plan. According to the advantageous characteristics of the territories in the Republic of Sakha, different zones can be identified:

²⁴ The Constitution of the Russian Federation adopted by nation-wide voting on 12.12.1993 (Конституция Российской Федерации принята всенародным голосованием 12.12.1993).

²⁵ Information about the economic situation in the Republic of Sakha (n.d). (Информация об экономической ситуации в Республике Саха (Якутия). (n.d.)) Retrieved from <https://www.sakha.gov.ru/economy/obshtaya-informatsiya>.

²⁶ Territorial Body of Federal State Statistics Service for Republic of Sakha (Yakutia) (2019) Статистический ежегодник Республики Саха (Якутия): Стат. сборник. [Statistical Yearbook of Republic of Sakha (Yakutia): statistical compilation]. Yakutsk.

- **Southern region: mining and enrichment of coal, mining and processing of iron and uranium ores, gas chemistry, chemical production, timber processing, thermal and hydropower, gold and non-ferrous metals mining;**
- **Western region: oil and gas production, oil and gas processing and helium industries, diamond mining, timber processing;**
- **Central region: transport and logistics hub, scientific and educational complex, information technology, tourism, manufacturing industries: jewelry and lapidary production, agro-industrial complex;**
- **North-East Yakutia - mining of non-ferrous and rare earth metals.**

The Republic of Sakha is one of the largest oil and gas producers in Russia and is expected to play a key role in the diversification of hydrocarbon exports to the east. In fact, since the commissioning of the Eastern Siberia - Pacific Ocean oil pipeline system in 2009, oil production has increased 14 times. In 2015, despite the difficult situation, positive growth rates were registered in the republic, while in the Russian Federation as a whole there was a negative trend. Economic growth is mainly associated to the implementation of large investment projects, especially in the fuel and energy sector, as well as related infrastructure projects.

In 2015, 15.2 million tons of coal were produced. In 2015, oil production increased by 8.5% and reached 9.4 million tons due to the connection to the ESPO pipeline system and the ability of oil producing companies to organize oil supplies outside the republic. At the end of 2015, 25.1 tons of gold were mined (5.2% more than in 2014). Diamond production was 55.9% lower than in 2014 due to the low demand of diamond jewelry. At the end of 2015, the gross agricultural output was approximately 22 billion rubles (97.8% of 2014, including livestock (72.6%) and crop production (27.4%)). The gross harvest of grain crops decreased by 32.5% (potatoes a 5.5% and other vegetables 4.1%). In animal husbandry, at the beginning of 2016, compared to the corresponding date of 2015, the number of cattle in the republic had decreased by 2.2%: pigs by 3.4% and deer by 5.6%; while the number of horses and poultry increased by 2.8% and 17.1% respectively.

Budgetary policy in recent years has been aimed at improving the quality of public finance management, strengthening and increasing the revenue side of the republican budget, increasing the efficiency of budget expenditures, creating an effective system of interbudgetary relationships, both with the federal and local governments. Since 2010, the state budget of the Republic of Sakha

has increased from 95.1 billion rubles to 167.7 billion rubles (1.8 times). Tax revenues (92.3 billion rubles) remain the main source of generating regional revenues, which, at the end of 2015, accounted for 90% of their own revenues and 55% of the total budget revenues. More than 80% of tax revenues (76.8 billion rubles at the end of 2015) are provided by taxes on corporate profits, on personal income and on mineral extraction.

The expenditures of the state budget of the Republic of Sakha amounted to 171.8 billion rubles (108% by 2014), of which more than a half were allocated to develop the social and cultural dimensions. By the end of 2015, the economically active population of the republic amounted to 501.3 thousand people, of which 464.5 thousand people were employed in the regional economy. The overall unemployment rate has declined since 2010 from 8.9% to 7.3% in 2015.

In Russian Arctic settlements, demographic trends show a population decrease, primarily of working-age population and more specifically, to young people (between 16-35 years old) out-migrating. According to Kondratieva et al. (2018)²⁷ the main reasons for leaving the Arctic are:

- **General feeling of dissatisfaction with the quality and conditions of life;**
- **Low income;**
- **Prevalence of the public sector of economy;**
- **Lack of vacancies;**
- **Housing and public buildings in poor conditions;**
- **Dissatisfaction with the equipment of health and education facilities;**
- **Limited transportation network**

Yakutsk is the capital city of the Republic of Sakha. It is located in the Tuymaada Valley, on the left bank of the Lena River in its middle course, 450 km South from the Arctic Circle. Yakutsk is considered to be the largest city located in the Russian Federation permafrost zone. Yakutsk was officially founded in 1632 by Cossacks who initially built the Lenski Fort on the bank of the Lena River. One third of the total regional population of the Republic of Sakha lives in the capital city, the rest

²⁷ Kondratieva, V.I., Stepanova, N.A., Trubina A.V., Lukovtseva, A.S. (2018). On strategic vectors of socio- economic development of the Arctic Zone of Republic of Sakha (Yakutia)). *Innovatsii*, (11 (241)). (Кондратьева В.И., Степанова Н.А., Трубина А.В., Луковцева А.С. (2018) О стратегических векторах социально- экономического развития Арктической зоны Республики Саха (Якутия) *Инновации*, (11 (241)).

lives in central districts.

In terms of administrative divisions, the city of Yakutsk, together with the settlement of Zhatay and eleven other rural localities are categorized as the city of republic significance of Yakutsk (an administrative unit with a status equal to that of the districts). As a municipal division, Yakutsk and the eleven rural localities are incorporated as the Yakutsk Urban Okrug. The settlement of Zhatay correspond to an independent Okrug: Zhatay Urban Okrug.

Yakutsk currently has a population of over 250,000 people. The city presents a mixture of tall modern buildings, Soviet time apartment blocks and old traditional wooden houses. Due to the presence of permafrost, most of the constructions are built on stilts so that the heat from the buildings does not melt the layers below.



Figure 48: Relative position of the capital city of Yakutsk in the Republic of Sakha.
Source: Self-elaboration.

In the winter, Yakutsk is usually shrouded in “habitation” fog, which is produced as a result of the hot air from houses, people and cars not being able to rise due to the extremely low temperatures of the air. The city has several museums, including the Natural History Museum, the University

Museum of Archeology and Ethnography, the Museum of the Mammoth and the Fine Arts Museum.

IV.C) LOCAL ADMINISTRATIVE, POLITICAL AND HISTORICAL CONTEXT OF THE FIELDSITES OF THE BULUNSKY DISTRICT

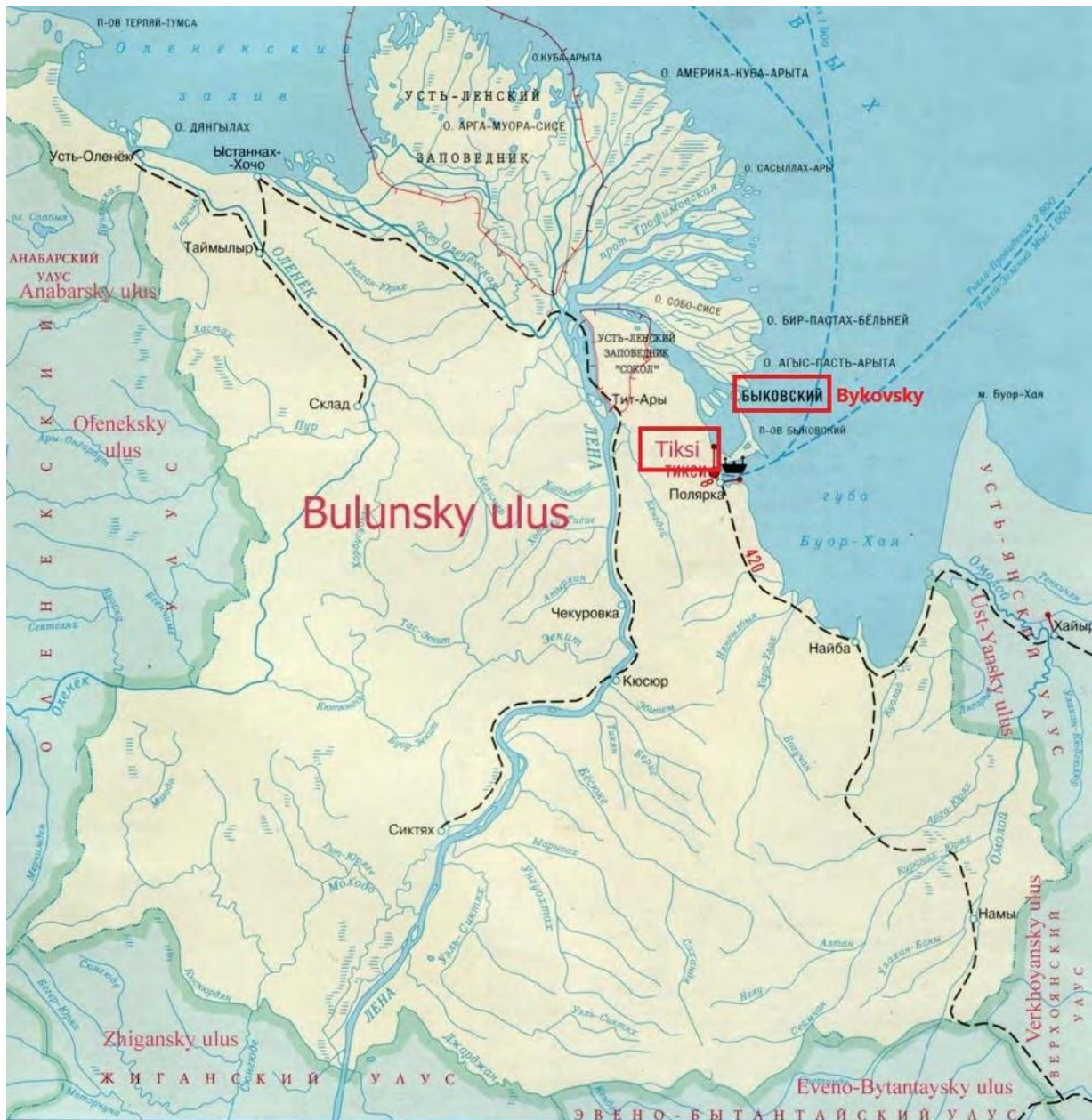


Figure 49: Relative position of Tiksi and Bykovsky in the Bulunsky District.

Source: Yakutia travel (n.d) Retrieved 30th July, 2020 from <https://www.yakutiatravel.com/map-of-yakutia/adminmap/bulunsky-vt-tiksi>

The Bulunsky District was officially established in December 1930 and covers a territory of 223.600 km². It was separated from its neighboring Zhigansky district and became a part of the Yakut Autonomous Soviet Socialistic Republic. Nowadays, in terms of municipal divisions, the Bulunsky Municipal District is divided into 1 urban and 6 rural settlements. Tiksi is the only urban settlement and the administrative center of the District. It is located 2000 km away from Yakutsk by land

transport, 1270 km by air and 1703 km by waterway. The district is located in the north of the republic and has borders with the Ust-Yansky District in the east, with the Verkhoyansky District in the southeast, the Eveno-Bytantaysky and Zhigansky Districts in the south, the Olenyoksky District in the west, and the Anabarsky District in the northwest. The main river in the district is the Lena and discharges in the Laptev Sea in the north. There Lena River delta has several lakes and the Lena Delta Wildlife Reserve is located in the district. The Bulunsky District also includes other rivers such as the Olenyok, the Omoloy, and the Khara-Ulakh.

The region of the Lower Lena was always an important place for Polar explorations. In fact, most of the geological discoveries of the 17th-20th centuries were set in this area. A new Siberian islands archipelago in the Laptev Sea was discovered in the 18th century. The islandshad abundant Arctic foxes and Mammoth remains. Thus, the exploitation of these tworesources began. In 1770s Ivan Lyakhov was the first person to get the exclusive rights forthe gathering of mammoth fauna remains, endorsed by Ekaterina II²⁸.

Local economy is strongly dependent in reindeer breeding, cattle breeding, horse breeding, fur and hunting. The total area of forest in the district is 9,027,312 hectares, while agricultural land is 4548.9 thousand hectares. There are 3 municipal unitary enterprises and peasant farms in Bulunsky. Nowadays, there are six ethnocultural centers in the District. One of them is the Sardana ethnocultural center of Bykovsky, which has been selected as the best ethno-cultural center (ECC) in 2017. The Bulunsky District forms part of the northern part of the Yakutsk diamond province. A diamond deposit was found in the valley of the Young and opened in 1960. In the northern part there is the Bulunsky coal-bearing region which is about 9000 km². Within this region, there are deposits of brown and hard coals: Taimylyrskoye, Chay- Tumusskoye and Soginskoye with reserves of over 323 million tons. In this area, exploration work is carried out by ALROSA (OJSC), OJSC Nizhne-Lenskoe²⁹.

In 2019, the District counted 8340 residents³⁰. About 54% of the population were living in Tiksi, the rest was spread throughout 223.600 km² in 9 villages. The largest ethnic group in the area is Sakha, and there are more than 2000 Evenki (Small-numbered Indigenous People) At the time of Russians

²⁸ Cohen, C. et al. (2002) The Fate of the Mammoth: Fossils, Myth, and History [Le destin du mammouth]. University of Chicago Press.

²⁹ Information about the Bulunsky District (Yakutia) (n.d) (Информация о Булунском районе (Якутия) (n.d.) Retrieved from <https://sakhagis.ru/raion/details/6>.

³⁰ Статистический ежегодник Республики Саха (Якутия): Стат. Сборник. / Территориальный орган Федеральной службы государственной статистики по Республике Саха (Якутия). – Якутск, 2019. – 654 с.

explorations in the Lower Lena in 1640s, the modern territory of the Bulunsky district was inhabited by people of both Tungusic and Sakha kinship. Their activity and supply procurement was hunting, fishing and domestic reindeer herding. Hunting was their main source of food while the other two activities were subsidiary. Fishing was predominantly practiced by those who did not have reindeer. At this time, the settlements were located in topographic areas with profitable fishing grounds³¹. Cattle breeding was practiced by Sakha people in the South-Eastern area of the district.

The first inhabitants of the area left a legacy and the current economy of the district still relies on fishing and animal breeding (reindeer, horses, cattle and in a small scale, pigs too). Fish is mainly caught in the Ust-Yansky and the Bulunsky districts (each catches 21% of total Yakutia). Bulunsky outstands as a leading district in terms of fish production. The district's main product is fish, notably omul, nelma, chir, muksun, vendace, and sturgeon. The fishing collective enterprises from this area provided with food during the Second World War. Later, the demand was caused by expansion of gold mines in the Southern region of the Republic of Sakha. People who were working in the fisheries were mostly local Evenki, Sakha, and forcefully displaced people (mostly Finns, Germans, Lithuanians, Russians and others)³². Following the decline of fisheries in the district, displaced people returned to their homelands.

In 2017, 24% (1035 tons) of all Arctic fish products were obtained in Bulunsky. Agriculture is scarcely developed in these lands. Another important activity for local inhabitants in the district, is berry gathering, which is also among the main traditional products together with meat and fish. Wild-herbs gathering is mostly done by households, but a few are gathered by food processing companies. According to the information from the Ministry, nearly 60 tons of wild-herbs were gathered in 2017 (in 1986 – more than 470 tons). Agriculture takes place in areas far from economic centers, with expensive costs of production and transportation; which in return create low demand and low marketability of Arctic agricultural production.

Since 1990s and between 2012-2013, the District underwent rapid changes in terms of population composition. The first one was closely related to the Soviet breakup and the consequent politic and

³¹ Struchkov, A.I. (2005) Essays on the history of the Bulunsky ulus. A.I Struchkov; Administration of the Municipality of Bulunsky District. Yakutsk: Bichik. 360 p. (Стручков А.И. (2005) Очерки по истории Булунского улуса / А.И. Стручков; Администрация муниципального образования «Булунский улус (район)». – Якутск: Бичик. – 360 с.).

³² Муниципальный район «Булунский улус (район) [Municipal district "Bulunsky ulus (district)] (2017, March 13) История Булунского улуса [History of the Bulunsky ulus] Retrieved from: <https://mr-bulunskij.sakha.gov.ru/ulus-rajon/Geograficheskaya-i-istoricheskaya-spravka/istorija-ulusa>.

economic crisis in Russia, while the second phase was related to the closure of the military base in Tiksi. Migration loss has increased since 2015, and in 2017 reached 118 people.

IV.C.I) Bykovsky

Bykovsky is a rural settlement located beyond the Arctic Circle at the Bykovsky Peninsula, 40 km north from the settlement of Tiksi. It forms a natural protection for the harbor of Tiksi and is surrounded by the Neelov Bay and the Laptev Sea. It is mainly a rural fishery-oriented settlement. It is near an arm of the Lena Delta, which is one of the main arteries of communication with Yakutsk. The eastern part of the village is located on the shore of the Laptev Sea, while the western part is on the shore of the Neelov Bay. The Bykovsky Peninsula is covered by ice-rich deposits, also known as Ice Complex, which is subject to thermoabrasion at the Laptev Sea coast and to different thermoerosional and thermokarst processes (Meyer et al, 2002).



Figure 50: Location of Bykovsky in the Peninsula

Source: Yandex (n.d) Retrieved July 30th, 2020 from

<https://yandex.ru/maps/?from=tabbar&ll=129.244826%2C71.868079&z=10.23>

The area where the modern village is currently located has been inhabited since ancient times by indigenous people who lived by hunting and fishing. The first records of people inhabiting the Bykovsky Peninsula date back to the 18th-19th century, when Polar explorers and merchants met and traded with local hunter-gatherers³³.

Nevertheless, the first settlement on the territory of the Bykov-Mys peninsula dates from the beginning of the 19th century. In 1812, the inhabitants of the village organized a massive slaughter of reindeer to support the Russian army in the Patriotic War of 1812 (the so called Russian Campaign of the Napoleonic Wars). Subsequently, 500 reindeer were sent by rafts rafting up the Lena River to the city of Yakutsk.

During Soviet times, Bykovsky as many others in the North, were strategically organized and structured as a part of a bigger National and Regional economic reality, based in the exploitation of the local natural resources which would be sold and sent to other regions of Russia. Bykovsky evolved as a former fishing settlement. It counted with two fish-related factories: A Soviet collective farm ("Kolkhoz" in Russian) called "Arktika" which was situated in the old village, and a fish processing factory which was located in the current location of Bykovsky. The latter was installed in 1949 on the basis of the motor-fishing station. Most people used to live in the old village and walked to the current Bykovsky (which is 3 km away and took around 45 minutes) to their work places. Population started to move to the current village after the Power Plant was built there.

During the early 1930s the first social and production facilities were built in the village: in 1936 the first diesel power plant was introduced; in 1939 the first school was built. In 1942 - a combined building was introduced, including a club and a nursery – which featured a garden, a canteen, and a library-. Twenty years later, the club, the library, and the canteen were moved to new buildings while the old building was reorganized as a kindergarten. In 1953, the commissioning of solid fuel (coal) boilers began.

Between the 60s and 80s the so-called unprofitable fishing villages (Tumat, Tit-Ary, Trofimovsk, Ystannakh-Khocho, Ary) were closed, which led to an influx of population arriving to Bykovsky increasing the new labor forces. Another influx of population came with the organization of the

33 Struchkov, A.I. (2005) Essays on the history of the Bulunsky ulus. A.I Struchkov; Administration of the Municipality of Bulunsky District. Yakutsk: Bichik. 360 p. (Стручков А.И. (2005) Очерки по истории Булунского улуса / А.И. Стручков; Администрация муниципального образования «Булунский улус (район)». – Якутск: Бичик. – 360 с.).

Bykovsky fish factory. People came to work in this enterprise from places all over the Soviet Union. The Bykovsky fish factory with its pickling shop handed over smoked, salted fish for the military units of the USSR Ministry of Defense³⁴.

The collective farm gathered fishermen and hunters for fur trading - especially the one obtained from polar fox- and it was considered multiple-product farming. Fish was the main product and during Soviet times, the profitability was facilitated by the existence of a well-developed transportation system. This included large helicopters and planes that regularly came to Bykovsky to collect several tons of fish. After the Soviet breakup, the fish processing factory closed, and the Kolkhoz outwent a structural crisis, becoming an "Artel" until the present. The predominant fish are: omul, whitefish, Siberian white salmon and European white fish and are sent to a fish factory in Yakutsk where they are processed. Despite the importance of the fur trade in Northern regions, this industry eventually disappeared after World market prices and demand dropped as they were no longer financially attractive. The international boycotts against the fur trade also provoked a reduction of this activity and led to the emergence of other synthetic materials in the market.

After the Soviet Union collapsed, financing was cut down and the Kolkhoz Arktika closed its doors. The shares of the Soviet Collective Farm were distributed among its members (or "employees"). After some years, the fishing businesses were united and re-organized and finally reopened under the legal entity of an "Artel", therefore, as a private cooperative association. However, the name of the Artel is still "Kolkhoz Arktika", which might lead to some misunderstandings (in particular in the course to the interviews that were conducted).

In 2003, the settlement received the status of an administrative center based on the organization of local self-government: the rural settlement "Bykovsky nasleg". Since 2009, it is categorized as a land of the Evenki small numbered peoples of the North.

Nowadays, the Power plant and the Artel Arktika are still working. However, Arktika is now a cooperative association and the settlement forming establishment that provides jobs to over 200 people living there. It is strictly focused on fishing activities and is considered the main source of employment for local inhabitants, according to themselves. The survival of the Artel Arktika is

34 Information about the historical monuments of the rural settlement of Bykovsky (Evenki) (n.d) (Информация об исторических памятниках села Быковского народного (эвенкийского) наслега" Retrieved from <https://mr-bulunskij.sakha.gov.ru/poselenija-mo-sp-bykovskij-natsionalnyj-evenkijskij-nasleg>.

considered to be an important element that prevented the settlement of Bykovsky from closing during hard times. The settlement also counts a kindergarten, a centralized boiler house, a diesel engine station, a post office and a meteorological station.

The ethnic composition of Bykovsky is (in decreasing order): Evenkis (47,1%), Sakha (32,5%), Evens (13,7%) and Russians 6,7%³⁵. The population of Bykovsky decreased several times throughout its history. Today there are 548 inhabitants who work in social facilities, administration, and "Arktika". Although during the 20th century there were several work-areas in the settlement (fishing, fur-hunting, and fish processing), today the economy is predominantly based on fishing activities. This increases locals' dependence on natural resources and climate.

35 Results of the Russian Census of 2010. Book 4: Ethnic composition and language proficiency, citizenship of the population of Republic of Sakha (Yakutia)]. Yakutsk. Results of the Russian Census of 2010. Book 4: Ethnic composition and language proficiency, citizenship of the population of Republic of Sakha (Yakutia) / Territorial Body of Federal State Statistics Service for Republic of Sakha (Yakutia) - Yakutsk (2019) – p. 652) (Итоги Всероссийской переписи населения 2010 г. Том 4: Национальный состав и владение языками, гражданство населения Республики Саха (Якутия) / Территориальный орган Федеральной службы государственной статистики по Республике Саха (Якутия). – Якутск, 2019. – 652 с.).

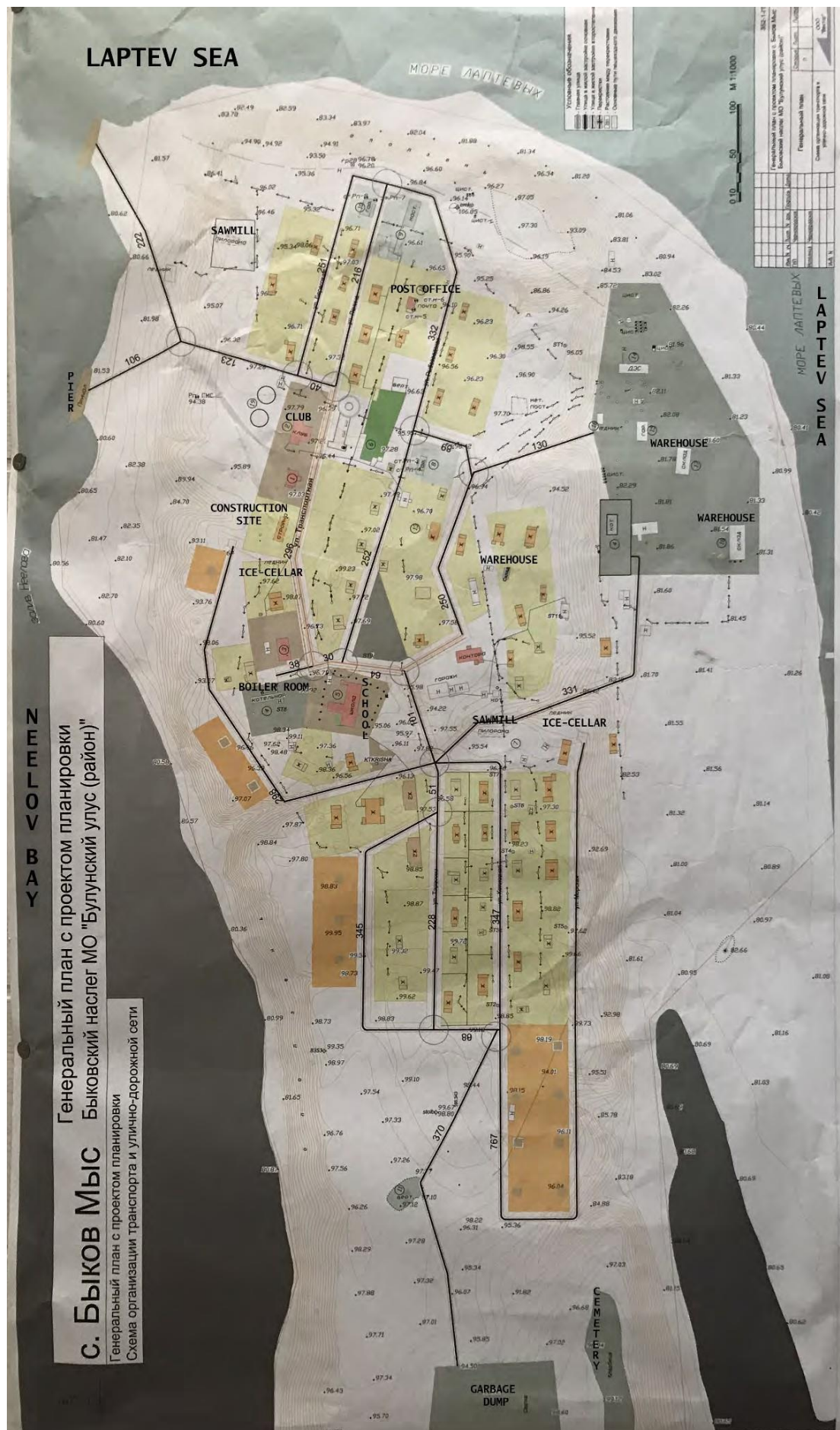


Figure 51: Municipal plan of the village of Bykovsky (with references) obtained during fieldwork.

IV.C.II) Tiksi

Tiksi is, since 1939, the sole urban settlement within the Bulunsky District and it is also its administrative center. It is located on the coasts of the Arctic Sea, on the Laptev Sea. It was originally created as one of the key points of the Northern Sea Route in 1933. In fact, the Department of the Northern Sea Route (NSR) was created in 1932 after the icebreaker “Alexander Sibiryakov” went across the Arctic Ocean from Arkhangelsk up to the Bering sea³⁶. This Department was created in order to maintain the navigation and sustain security along the Northern Sea Route. Before this time, the Tiksi Bay was not permanently inhabited but there was a radio-communication point and a meteorological station that supported geographic explorations and scientific research in the region. It was a temporary settlement for the expeditions, hunters and fishermen as well. During the 20th century with the development of Polar navigation and aviation Tiksi became a town of strategical importance. The district hosts scientific research and expeditions. Not far away from the center of Tiksi, there is a polar station which was built in 1932 as well as the Polar Geocosmophysical Observatory, built in 1957. The settlement and seaport of Tiksi were established shortly after the creation of the Department of the NSR, and it represented the beginning of socio-economic development in the Central Russian Arctic. In 1957 it became the capital of Bulunsky district³⁷.

Geographically, the coast of Tiksi is naturally protected by the Peninsula of Bykovsky. The emplacement of the settlement was chosen due to its accessibility from both river (Neelov bay) and sea (Tiksi bay). Therefore, it is a place where ships of both river and sea converge. There is the coastal mountain range of the Kharaulakh Ridge in the west and remains of a former accumulation plain, including the Bykovsky Peninsula, in the east (Grosse et al, 2003).

In Tiksi, economic activities are also practiced such as fisheries, reindeer husbandry, mining, production and distribution of electricity, gas and water, transport and communication. The relevance of the seaport of Tiksi resides in the fact that it serves as the base port of the North-East zone in the Arctic. Goods for other regional settlements are unloaded and subsequently sent further by river boat.

³⁶ The Ways of Great Achievements. The Second Book. Vol.3 Course – The Arctic. The Northern vector of Russia’s endeavors and role of Yakutia in the development of North-Eastern polar territories, exploration of Arctic seas. The 1860 – 1930s]. Vladivostok: Russian inland. – 132 p. (Боякова, С.И. (2015) Пути великих свершений. Книга вторая. Т.3. Курс – Арктика. Северный вектор устремлений России и роль Якутии в освоении северо-восточных полярных территорий, исследований арктических морей. 1860 – 1930-е гг. Владивосток: Русский Остров. – 132 с.)

³⁷ Муниципальный район «Булунский улус (район) История Булунского улуса (Municipal district “Bulunsky ulus (district)) (2017, March 13. History of the Bulunsky ulus) Retrieved from: <https://mr-bulunskij.sakha.gov.ru/ulus-rajon/Geograficheskaya-i-istoricheskaya-spravka/istorija-ulusa>

During Soviet times, Tiksi received migrants from all over Russia due to the existence of the KomSoMol employment program (Communist Union of Youth). This program aimed at promoting the development of remote areas. Young people received job opportunities that fulfilled their dream of adventure as well. This program contributed to a strategic distribution of the workforce throughout the Russian territory. Many Russian Arctic settlements were populated through the KomSoMol, including Tiksi. Many young people reached extremely remote areas to work. A massive out-migration was experienced during the economic crisis that followed the breakup of the USSR. The current lack of significant cargo in this part of Siberia and the fact that winter lasts 10 out of 12 months, led to a shift of the NSR line further to the West.

Immigration from surrounding villages and rural settlements represent an important input to the local economy of Tiksi. It is not only the official administrative center of Bulunsky, but is also as an attractive economic center for those aspiring to "improve" their quality of life in general, find better job opportunities and salaries.

Between October 2012 and 2013 the airport remained closed. The Federal Ministry of Defense closed the airbase in order to rebuild it and only helicopters could land in Tiksi³⁸. Since 2015 the airport belongs to the Federal company "Airports of the North"³⁹. Between the years 2017 and 2019 a Military base in Tiksi-3 was built⁴⁰. According to the "Strategy of socio-economic development of the Republic of Sakha (Yakutia) until 2032"⁴¹ the Port of Tiksi and research and exploration activities on the shelf of the Laptev Sea are expected to receive important investments during the near future. Authorities expect to build a Federal Arctic Scientific Centre in Tiksi⁴².

IV.D) TRADITIONAL ACTIVITIES AS FUNDAMENTAL CONTEXTUAL INFORMATION

An important topic that requires being treated separately are traditional economic activities of the

³⁸ Vedomosti (2013, April 16th) Tiksi Airport opened after Putin's intervention). (Ведомости (2013, 16 апреля) После вмешательства Путина открыт аэропорт Тикси. Retrieved from: https://www.vedomosti.ru/politics/news/2013/04/16/minoborony_otkrylo_aeroport_tiksi

³⁹ The Arctic (2015, August 3). Tiksi airport joins Airports of the North. Retrieved from: <https://arctic.ru/infrastructure/20150803/118153.html>

⁴⁰ Yakutia24 (2019) Russian Defence Ministry: The construction of a new air defence base in Tiksi will be completed in 2019]. (Якутия24 (2019) Минобороны РФ: Строительство новой базы ПВО в Тикси будет завершено в 2019 году) Retrieved from: <https://yk24.ru/index/obshhestvo/minoboronyi-rf-stroitelstvo-novoj-bazyi-pvo-v-tiksi-budet-zaversheno-v-2019-godu>.

⁴¹ Strategy for socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) for the period until 2035 (Проект стратегии социально-экономического развития Арктической зоны Республики Саха (Якутия) на период до 2035 года.).

⁴² Kondratieva, V.I., Stepanova, N.A., Trubina A.V., Lukovtseva, A.S. (2018). On strategic vectors of socio- economic development of the Arctic Zone of Republic of Sakha (Yakutia)). *Innovatsii*, (11 (241)). (Кондратьева В.И., Степанова Н.А., Трубина А.В., Луковцева А.С. (2018) О стратегических векторах социально- экономического развития Арктической зоны Республики Саха (Якутия) *Инновации*, (11 (241)).

residents of the Bulunsky District and the Yakutian Arctic. According to the order of the Government of the Russian Federation of May 8, 2009 No. 631-r "on approval of the list of places of traditional residence and traditional economic activities of the Indigenous peoples of the Russian Federation and the list of their traditional economic activities"⁴³, the Republic of Sakha is one place considered "of traditional residence and traditional economic activities of the Indigenous peoples of Russia". Traditional economic activities are culturally rooted since the first inhabitants arrived to the region and most of them have survived throughout different historical periods.

IV.D.I) Agriculture

Agriculture in the Republic of Sakha is strongly conditioned by climatic conditions and there are only two main agricultural centres which are located in the fertile soils of Western Siberia. Households in the North import fruits and vegetables from other regions at a high price as developing agriculture in these settlements and villages is almost impossible. The high costs of transportation lead to a low demand and marketability of such products in the Arctic regions.

IV.D.II) Animal breeding

People from the Bulunsky District are mainly cattle breeders (a few in Kyusyur for personal subsistence) and horse breeders, which is gaining importance. Unlike in Soviet times, and as previously mentioned, farming of fur animals (such as the Arctic and the Blue foxes) is no longer practiced in the region. Domestic reindeer herding was extensively practiced during the Soviet era. Nowadays, there are only a few herds in the region (situated in Khara-Ulakh, Borogon and Kyusyur). The overall number of domestic reindeers is currently decreasing⁴⁴.

IV.D.III) Hunting

Hunting is one of main traditional activities of Indigenous peoples of the Russian Arctic. It is both a source of subsistence and food for people in the Bulunsky area. However, the products obtained from the hunt in Northern areas are also sold and distributed in bigger urban centers and other regions of the Republic

43 Order of the Government of the Russian Federation of May 8, 2009 No. 631-r On approval of the list of places of traditional residence and traditional economic activities of the Indigenous peoples of the Russian Federation and the list of their traditional economic activities (Распоряжение Правительства РФ от 8 мая 2009 г. № 631-р Об утверждении перечня мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов РФ и перечня видов их традиционной хозяйственной деятельности).

44 Territorial Body of Federal State Statistics Service for Republic of Sakha (Yakutia) (2019) Статистический ежегодник Республики Саха (Якутия): Стат. сборник. [Statistical Yearbook of Republic of Sakha (Yakutia): statistical compilation]. Yakutsk.

of Sakha.

Consumable wild fauna is quite scarce in the district: there are moose (in the Southern part of district), wild reindeer, snow sheep, white hare, and several bird species (geese - *Anser caerulescens*-, ducks - *Sibirionetta formosa*- and ptarmigans - *Lagopus muta*-). Local people also hunt wolves and Arctic foxes, and at a smaller scale: sables - *Martes zibellina*-, stoat - *Mustela ermine*-, least weasel - *Mustela nivalis*- and wolverine - *Gulo gulo*-.

In order to hunt, people require a permission or licence for a specific animal(s) emitted by the government. However, hunting in order to ensure the preservation of the traditional way of life and to carry-out traditional economic activities can be conducted without such permission by (1) Indigenous small-numbered peoples (SNIP), (2) their communes, and (3) people, who are not SNIP but are permanent residents in the traditional indigenous habitats and for whom the hunting is a basis of subsistence⁴⁵. Hunting can be practiced in public hunting lands and lands of hunting providers (which are private). In the latter case, one must obtain authorisation from a hunting provider in addition to a license.

The amount of wild animals that can be hunted in a year/season are defined by the regional government in quotas. These are shared among lands: lands of hunting providers, public hunting lands of districts, and separate quotas for the research purposes. The quota varies each year and depends on population and distribution in the area, and other factors. Quotas for public lands are distributed by administration, and hunting providers distribute quotas themselves.

Unions of people (also known as "Indigenous communes"), municipal and private establishments, and individual entrepreneurs can become hunting providers. However, industrial (or commercial) hunting is almost exclusively conducted by hunting providers.

A particularity of such activity is the strong dependence on seasonality: each species is hunted in a specific time of the year. Hunting seasons are clearly defined by the federal⁴⁶ and regional⁴⁷ legislation.

45 Federal Law from 24.07.2009 N 209-FZ "On Hunting and on the Preservation of Hunting Resources and on Amending Certain Legislative Acts of the Russian Federation" (Федеральный закон от 24.07.2009 N 209-ФЗ "Об охоте и о сохранении охотничьих ресурсов и о внесении изменений в отдельные законодательные акты Российской Федерации").

46 Order of the Ministry of Nature of Russia from 16.11.2010 N 512 "On the approval of the hunting rules" (Приказ Минприроды России от 16.11.2010 N 512 "Об утверждении Правил охоты").

47 Decree of the President of the Republic of Sakha (Yakutia) from 27.07.2012 N 1569 "On determining the types of permitted hunting and parameters for hunting in the hunting grounds of the Republic of Sakha (Yakutia) (Указ Президента Республики Саха (Якутия) от 27.07.2012 N 1569 "Об определении видов разрешенной охоты и параметров осуществления охоты в охотничьих угодьях Республики Саха (Якутия)").

Below, the list of hunting seasons and quotas for 2019:

Species	Spring	Summer-Autumn-Winter	Quotas
Water-birds ⁴⁸	24-26 May (Geese)	22 August – 20 October	20 units per person in both seasons
	1-7 June (He-ducks, geese, loons, grebes)		60 (spring), 80 (summer) units per person per season
Ptarmigans	N.A.	August, 22 – April, 20	No limit
Moose (Adult male)	N.A.	1 October – 15 December (September, 1-30)	24 units shared among 3 hunting providers, and 10 units for public lands
Wild reindeer (Lena- Olenyok population)	N.A.	1 August – 15 March	1125 units shared among 14 hunting providers, and 70 units for public lands
Snow sheep	N.A.	1 August – 30 November	12 units for one hunting provider, and 21 unit for public lands
White hare	N.A.	15 September – 29 February	20 units per person in a season
Wolf	N.A.	15 September – 29 February	No limit
Sable	N.A.	15 October – 29 February	540 units gives to 4 hunting providers, none for the public
Stoat			50 units per person per season
Little weasel			No limit
Wolverine			1 unit per person per season
Arctic fox	N.A.	1 October – 1 April	No limit

⁴⁸ Decree of the President of the Republic of Sakha (Yakutia) from 03.06.2016 N 1184 "On amendments to the Decree of the President of the Republic of Sakha (Yakutia) from 27.07.2016 N 1569" (Указ Президента Республики Саха (Якутия) от 03.06.2016 N 1184 "О внесении изменений в Указ Президента Республики Саха (Якутия) от 27.07.2016 N 1569").

IV.D.IV) Picking berries, mushrooms and wild herbs⁴⁹

Another culturally and biologically important resource for Arctic residents are berries. In the North, it is estimated that there is a landmass of about 308 million hectares containing berries. They are mainly gathered at a household scale. Such is also the case of wild-herbs gathering although there are some food processing companies which also gather and sell them to other regions. However, there are no industrial-scale harvesting of wild-herbs. According to the information from the Ministry, nearly 60 tons of wild-herbs were gathered in 2017 (in 1986 – more than 470 tons).

Due to the fact that products of wild-herbs are in demand in the Republic of Sakha and abroad, it is expected that this type of harvesting and processing activity will boost local entrepreneurship and self-employment in the North. Some of the main obstacles for the progress of this activity are: the insufficient development of infrastructure; the absence of a specialized collection points and the lack of qualified specialists in northern settlements. In order to contribute with the production, it is planned to open a centre of wild-herb collecting and primary processing in Arctic settlements, with the subsequent transportation of the products to Yakutsk.

⁴⁹ Strategy for socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) for the period until 2035: Supporting Materials. "Appendix No. 1. A comprehensive analysis of the current socio-economic development of the Arctic territory of the Republic of Sakha (Yakutia) for the period 2010-2017." Yakutsk, 2020) (Проект стратегии социально-экономического развития Арктической зоны Республики Саха (Якутия) на период до 2035 года: обосновывающие материалы. «Приложение № 1. Комплексный анализ текущего социально-экономического развития арктической территории Республики Саха (Якутия) за период 2010-2017 гг.» Якутск, 2020).

IV.D.V) Fishing

(The information here provided is applicable only in the Bulunsky District. In other sectors of the Lena river, other water bodies of the Republic of Sakha and Russia regulate the activity and can lead to differences. The main complexity for regulating such activity is the fact that each place and fish species have their own specificities in terms of legal regulation)

Fishing is the main economic activity of the inhabitants of the Bulunsky District. Bykovsky is an exclusively fishing-oriented settlement and its continuity strongly relies on fisheries activities. Fish is caught in the internal waters (such as rivers, streams, lakes, and islands on the Lena Delta). The main commercial fishes in the region are whitefishes: omul (*Coregonus migratorius*), muksun (*Coregonus muksun*), chir (*Salvelinus alpinus*), nelma (*Stedonus nelma*), vendace (*Coregonus sardinella*), whitefish (*Coregonus pidschian*), peled (*Coregonus peled*) and Siberian sturgeon (*Acipenser baerii*). Fishing Siberian Sturgeon is forbidden in Russia, with an exception: it is allowed in the Lena River⁵⁰. Fishing for sturgeon is allowed only with a permission (license) in a designated area.

This brief does not include the prohibitions and limitations concerning fishing tools, equipment and ships, and size of fishes.

Type of fishing, purpose (Why?) ⁵¹	Industrial fishing (entrepreneurial activity)	Amateur fishing (hobby, recreation, sports, leisure, personal consumption)	Fishing for the purposes of conducting traditional livelihood and traditional activities of Indigenous small-numbered peoples ⁵²	Fishing for cultural and educational purposes	Fishing for research purposes and for the controlling	Fishing for purposes of aquaculture (fish farming)	Coastal fishing
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⁵⁰ Order of the Ministry of Nature of Russia from 24.03.2020 N 162 "On approval of the List of fauna objects listed in the Red Book of the Russian Federation" (Приказ Минприроды России от 24.03.2020 N 162 "Об утверждении Перечня объектов животного мира, занесенных в Красную книгу Российской Федерации").

⁵¹ Federal Law from 20.12.2004 N 166-FZ "On fishing and conservation of aquatic biological resources" (Федеральный закон от 20.12.2004 N 166-ФЗ "О рыболовстве и сохранении водных биологических ресурсов").

⁵² Order of the State Fishery Committee of the Russian Federation from 11.04.2008 N 315 "On approval of the Procedure for fishing for ensuring the traditional way of life and the implementation of traditional economic activities of the Indigenous peoples of the North, Siberia and the Far East of the Russian Federation" (Приказ Госкомрыболовства России от 11.04.2008 N 315 "Об утверждении Порядка осуществления рыболовства в целях обеспечения традиционного образа жизни и осуществления традиционной хозяйственной деятельности коренных малочисленных народов Севера, Сибири и Дальнего Востока Российской Федерации").

Who?	Private legal entities, municipal entities, unions of people, private entrepreneurs	Individuals and organisations	Indigenous small-numbered peoples and their unions (commune)	Educational, research and cultural organizations (e.g: zoo, museum)	Research organisations, controlling bodies	Not practiced in Bulunsky
Where?	Only in fishing grounds (sites) assigned for this purpose for a particular fishing entity (individual) with a permission (license)	In the fishing grounds of common use; In special territories assigned for these purposes; In the fishing grounds for industrial fishing with a permission (agreement)	In the districts of traditional dwelling of these people. With or without a fishing site	Anywhere if needed		
How much?	Defined by assigned quota (weight per year)	Defined depending on each area and fish species (number per person per day)	Defined by assigned quota (weight per person/union per year)	As much as needed but not too much. For omul there are quotas		
Forbidden ⁵³	In the Neelov Bay; In the Tiksi Bay; In the Lena Delta (North of Stolb Island and along entire delta, and 500 m around it); Along the eastern coast of the Bykovsky Peninsula and Tiksi Bay, and 5 km into the sea -	In the Neelov Bay; To catch a Siberian sturgeon in water bodies outside special fishing sites; To catch taimen, lenok and grayling - from May 25 to June 25. Forbidden to use nets during spawning periods (from May 25 to June 25 and from September 25 to October 25)	In places and times where industrial and amateur fishing is forbidden, unless exception is applicable; To catch fish species that are defined as rare or threatened. Exception: possible with a special permission; In fishing sites of other people/organisations without their permission (agreement)	Not applicable		

⁵³ Order of the Ministry of Agriculture of Russia from 03.09.2014 N 348 "On approval of fishing rules for the East Siberian fisheries basin" (Приказ Минсельхоза России от 03.09.2014 N 348 "Об утверждении правил рыболовства для Восточно-Сибирского рыбохозяйственного бассейна").

	from July 1 until ice freezing. Exceptions: Fishing for vendace in Bykovsky channel; Traditional fishing on fishing grounds allocated for this purpose	In fishing sites of other people/organisations without their permission (agreement)			
Who defines quotas?	Regional government			Federal government	

Chapter 4 provided input on the special characteristics of Tiksi and Bykovsky in terms of bio-physical, social and cultural conditions. It was here judged that not having this information could hamper the choice of a methodology which would remain both suitable for the site-specific characteristics and main research questions. This is why, the following chapter will focus on the methodological strategy chosen for this research. By exploring the general theoretical bases of qualitative approaches, it will be demonstrated why an inductive and reflexive approach – as conceived here – is the best option to inquire about issues related to perception, social representations, experiences, attributions and meaning. Finally, it will also integrate some of the main challenges associated to conducting this research.

CHAPTER V: COLLECTING DATA

This chapter presents the methodological approach used in this research. It starts with an overview of the qualitative grounded theory and the description of the two main variations of this theory which were proposed by Charmaz and Paillé. This section will then outline technical specificities for collecting data in the fieldwork and the strategies implemented to cope with the major challenges. This includes language barriers, translation and transcription, implement reflexivity as a necessary step for establishing the relationship between the researcher and the participants, among others.

V.A) METHODOLOGICAL APPROACH

This research adopts a qualitative methodological strategy. Qualitative approaches aim at understanding a particular reality which is studied from its particular aspects as the result of a historical process of construction and perceived according the logic and feelings of its protagonists, that is, from a subjective perspective (Pérez Serrano, 2001a).

Based in an inductive and reflexive approach, it was desired to develop a flexible research design that allows exploring issues related to “meaning”, but also to obtain further information about social representations, experiences, perception and attributions. Social representations are here conceived as Moscovici (1984) did: “they should be seen as a specific way of understanding and communicating what we know already.” They are phenomena which are associated to the unique way of understanding and communicating of a particular social group which create both reality and common meaning. According to Urbina & Martínez (2006), the perception is the first cognitive process of the human being: it is the specific and personal vision of the world that each person has, mixed with the fantasy that each subject possesses and the egocentric character of the personal vision and experience. As well as the influence of the social structure, the cultural context and the language which is at the origin of basic collective rules. Capel (1973) suggests that human perception shapes the image of the real environment, which directly influences their behavior and the resulting relationship with nature.

Using a qualitative approach was identified as the most appropriate for this research's objectives since it allows capturing information related to the social interactions from which specific meanings arise (Blumer 1969). These meanings are, in this particular case, strongly related to the relationship that is established between the representations of the inhabitants from Yakutsk, Tiksi and Bykovsky. It is focused on the processes unchained by climate change and permafrost thaw in their connection to their daily experiences. Such a posture enabled capturing, through locals' narratives, the "plurality of other people's voices that inhabit in one's own voice, that is, how the others are present in one's own statements" (Arfuch 2002). This allowed, in other words, to reconstruct a wide diversity of experiences around permafrost thaw and climate change and their implications through individual narratives. The inductive logic here used provides flexibility and openness to the implementation of the research. Consequently, creates the space required to identify new complexities and interrelationships relevant to the contexts under study (Gallart 1992). Unlike quantitative methods, the theoretical framework used for this research does not intend to operationalize variables nor formulate initial hypotheses that relate variables. Instead, it is here proposed to focus on conceptual axes which will allow to formulate provisional hypotheses that require being revised back and forth throughout the entire research process. However, at some stages of the research, quantitative data will be also used in order to complement the understanding of demographical composition and migration patterns in the region. A wide variety of data collection techniques will be used, such as observation, interviews, and document analysis.

The first stage of the methodological strategy included elaborating a non-exhaustive bibliographic review (see Table 1 below). This process took place between the first six months of this PhD research. The purpose was to obtain a bigger picture of the current state of scientific knowledge with regards to the social and economic impacts of permafrost thaw in Arctic regions, and whenever literature allowed it, in the Russian Arctic. These two broad categories served as initial guiding concepts. The final document included information obtained from books, reports and articles which addressed these topics from different disciplinary perspectives such as economy, geography, history, psychology, anthropology, sociology, etc. For each of the sources, a common structure was respected: a summary followed by a brief description of the most important information contained in it, and finished with the answers to the following question "to what extent can it help the project?". This question tried to identify concrete elements that could represent a scientific contribution for both the Nunataryuk Project and my own dissertation.

More specifically, I tried to capture innovative and relevant topics, notions or theoretical approaches contained in the reviewed literature. I also tried to find associated study cases in other Arctic regions that could contribute to delineate the current general state of knowledge of a certain domain. Some literature was included into the final document mainly because it was not pertinent to my research or because of a personal disagreement with the theoretical approaches there presented. This exercise was extremely helpful to find information gaps in terms of scientific research. This step also helped me refine my own research questions. In addition to this introductory stage, three new thematically organized resumes were written in order to make the bibliography more fruitful for my dissertation and general understanding.

The sampling strategy was carried out according to the theoretical sampling guideline originally proposed by from Glaser and Strauss (1967), where the samples are usually not pre-specified, but instead evolve throughout the fieldwork proceedings. The selection of cases and stakeholders, as well as the final amount of interviewees has been defined during the field sessions. Snowball sampling allowed meeting a first series of informants which also lead to meeting new (similar or different) informants. The description and analysis of the narratives nurtured comparison between the different groups of stakeholders.

Beyond the potential of identifying the existing differences between different groups of stakeholders, it was intended to find shared points of view and similarities until the theoretical saturation was attained. The selection of stakeholders to interview sought to find cases which were representatives for the analysis of the particular phenomena at stake (permafrost thaw and climate change). Therefore, the definition of samples did not follow statistical criteria but rather theoretical purposes. Through the comparison of answers between each group of stakeholders, some emerging patterns were identified and preliminary conclusions were obtained. Thus, the evidence based on several cases can be considered to be more solid and convincing, and consequently increase the validity of the theories proposed.

It should be noted that there is no predefined criterion to determine an exact number of cases that should be included into this research, but it is here considered that theoretical saturation enables achieving greater replication and reliability. From these samples, it is intended to obtain an analytical generalization of theoretical propositions, that is, from a particular set of results, new theories will be expanded and finally generalized (Yin, 2018).

This research seeks to capture and analyze the social processes involved in constructing meaning: meanings that each of the stakeholders attribute to the past and current configuration of their lives and livelihoods in the Russian North, as well as the meaning attributed to changes entailed by climate change and permafrost thaw. The description of the social reality where they live, facilitates the interpretation of the complexities associated to climate change and permafrost thaw phenomena that impact them at an individual and at a community scale.

This research was integrally conducted between November 2017 and September 2021. Table 1 below presents the main activities carried out per year and intensity (being XXX the maximum and X the minimum). Most of the stages, were processes that required going back and forth and therefore were not exclusive from one unique period of the PhD. For example, new inquiries and information gaps emerging from the analysis required going back to the initially collected literature information. Additional literature was actively incorporated throughout the three years.

Activity	First year	Second year	Third year	Fourth year
Bibliographic review	XXX	X	X	
Fieldwork	XX	XX		
Interviews	XXX	XXX		
Writing	X	X	XXX	XXXX
Correction	X	XX	XXX	XXXX

Table 1: Schedule of this research.

V.A.I) Grounded theory

Within qualitative methods, grounded theory appeared as the best option to integrate as it is a systemic method that provides different and flexible strategies for conducting qualitative research (Chamaz and Bryant, 2016). According to Atkinson et al (2003:150) "Grounded theory is not a description of a kind of theory. Rather it represents a general way of generating theory (or even, more generically, a way of having ideas on the basis of empirical research)." It is intended to collect and analyze qualitative data trying to remain faithful to the understandings, interpretations, perspectives and perceptions of the people studied on their own terms as expressed through their actions and their words in the narratives collected during the fieldworks.

The particular interest for applying this methodology relays on the possibility of generating abstract concepts while identifying the concrete relationships existing between them. The creators of this theory initially aimed at collecting and analyzing qualitative data remaining faithful to the understanding, interpretations, intentions and perspectives of the people studied, as expressed in their actions and words (Clarke, 2007), which is key for providing a more globally comprehension of the complexities associated to permafrost thaw and climate change's impacts in the Russian Coastal Arctic communities of Tiksi and Bykovsky. According to Atkinson et al (2003) "Grounded theory is not a description of a kind of theory. Rather it represents a general way of generating theory (or even more generically, a way of having ideas on the basis of empirical research)."

Initially articulated by Barney G. Glaser and Anselm L. Strauss (1967), grounded theory (GT) appeared as a methodology that intended to separate from the dominant positivist paradigm in sciences at the time. Positivist methods considered the researcher to be an unbiased and passive observer that collected facts without participating in their elaboration. Moreover, the objective external world was separated from the scientist and its methodologies (Charmaz, 2006).

Glaser and Strauss initially studied social and psychological processes within a particular and delimited social framework (for example, people with a chronic illness). For them, grounded theory aimed at explaining the studied process in new theoretical terms, as well developing the theoretical properties of the categories. It should also explain the conditions that lead processes to emerge and vary and address its consequences. This way they would be able to construct abstract theoretical explanations of social processes (Charmaz, 2006). GT used repetitive comparative methods and their starting point was inductive qualitative data. One characteristic of this method is the use of analytic codes and categories that emerge from the gathered data. Memo-writing are important in categories elaboration as they may specify the properties and relationships between categories as well as identified gaps. Through the process of gathering data and analyzing it back and forth along the research process, they considered that researchers would be able to increase the explanatory power of their emerging theories. Unlike other methodologies, grounded theory focuses on concepts that are relevant for the study case while reducing researcher's data worry and doubts (Glaser, 2007). Researcher plays a key role in trying to raise the wide diversity of perspectives among participants (Glaser & Strauss, 1965) to an abstract level of conceptualization in order to disclose hidden or latent patterns. Following the authors logic, a completed grounded theory had to meet the following criteria: being close to data, be useful, provide conceptual density and

durability over time, be modifiable, and having a strong explanatory power (Glaser, 1978, 1992; Glaser & Strauss, 1967).

In other words, a finished grounded theory should be capable of explaining a particular studied process in a theoretical way. Glaser and Strauss's strategies and interest for extracting theories from qualitative data was rapidly spread throughout different disciplines and professions.

Since the emergence of this qualitative method, some discrepancies aroused between Glaser and Strauss. Each of them proposed different interpretations of grounded theory (Charmaz, 2000). Glaser considered that in grounded theory, categories should emerge from data analysis and that the final purpose of it was to discover. He had a more empiricist interpretation of this methodology and imbued it with rigorous coding methods which were a reflect of the positivist influence he obtained with Paul Lazarsfeld at the Columbia University (Charmaz, 2006).

On the other hand, Strauss - influenced by the pragmatist approach of the University of Chicago (Blumer, 1986; Mead, 1934) - considered that the main purpose of grounded theory was the study of action. Social meanings were intrinsically related to the use of language and therefore could only be manifested in concrete action. Pragmatism assumes that society, reality, and self are constructed through dynamic interactions and thus rely on language and communication. Strauss was also influenced by symbolic interactionism which considers that people do not respond mechanically to stimuli, but instead are capable of reflecting about their own actions before action. He assumed that processes were fundamental to human existence; yet, humans were capable of creating new structures through engaging themselves in different processes (Charmaz, 2006). Strauss reviewed his previous collaboration and developed the method towards other directions with Juliet M. Corbin (Corbin & Strauss, 1990; Strauss & Corbin, 1990, 1998). Their new interpretation of grounded theory replaced the emphasis of comparative methods by technical procedures in order to make it more accessible to researchers from applied fields. However, the formulaic character was strongly criticized. Glaser considered that Strauss was now forcing data instead of allowing it emerge from the data analysis as originally articulated in their collaboration. For him, categories and properties could only emerge from the repetitive comparison processes along the research (Clarke, 2007).

Within the wide diversity of applications of grounded theory in qualitative research, some serious rifts occurred. Different researchers will focus on different aspects of the methodology according to their backgrounds, beliefs, values and needs. Some scholars abandoned the positivist elements

of the grounded theory proposed by both Glaser's and Strauss and Corbin's versions of the method (see Bryant, 2002, 2003; Charmaz, 2000, 2002, 2007; Clarke, 2003, 2005). Researchers from different disciplines currently use different grounded theory tools and guidelines such as coding, memo-writing, comparative methods, etc according to their necessities.

Paillé's (1994) work intended to be a method of data analysis and not an entire methodology that directs the way researchers conduct qualitative research. He aimed at responding to the question "What to do with the data and how to analyze it?" (Paillé, 1994). Unlike the original versions of grounded theory, for him, was not to create a theory (a result) but to focus on the process of analysis of the data in order to understand the meaning of an event and to represent the different multiscale interactions and processes related to it in a diagram (Paillé, 2009). This would contribute to surpass the merely descriptive analysis of a phenomenon. He replaced the multiple coding stages (Strauss and Corbin, 1990; 1998) with a series of successive steps that integrate an iterative process.

Traditional grounded theory considered that collecting and analyzing data should be implemented separately in one occasion and should be followed by the next step. For Paillé (1994) these steps should occur simultaneously: analysis takes place while collecting data. After each series of two or three interviews or observation periods should be followed by transcription and consequent analysis. This will contribute to guide the direction and focus of the following interviews.

Traditional grounded theory identifies three main stages for data analysis: 'Initial coding, intermediate phase, and final development (Heath and Cowley, 2004). Charmaz's (2006) CGT also begins with initial coding, continues with focused coding (intermediate phase), and finishes with a theoretical coding (final development). Paillé identified six successive steps (see Figure 52 below) when conducting a grounded theory analysis. These can also be divided into three stages: codification and categorization (initial coding), linking categories and integration (intermediate phase), conceptualization and theorization (final development). In grounded theory strategies, the researcher maintains a close interaction with the data and the analyses throughout the entire process. For Paillé, both steps are intrinsically related and therefore, it is impossible to think about them as separate actions with a chronological order. The researcher should implement them simultaneously, or in one same movement.

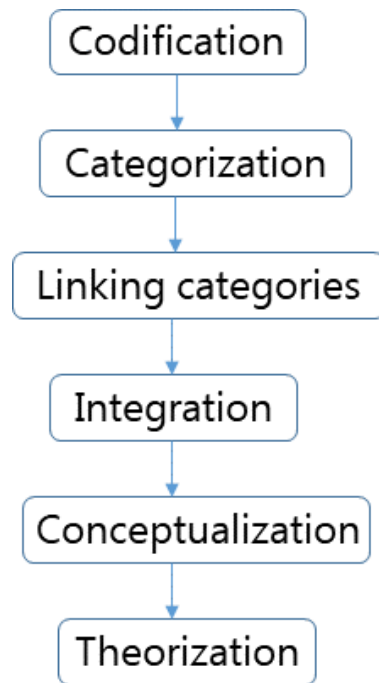


Figure 52: Paillé's (1994) steps of Grounded Theory Analysis

Kathy Charmaz, a former student from both Glaser and Strauss at UCSF introduced a more constructivist reformulation of the grounded theory. She explicitly argued that the original works from Glaser and Strauss were inherently positivist. Charmaz (2000, p. 531) pointed out that they "assume an external reality that researchers can discover and record: Glaser through discovering data, coding it and adopting comparative methods step by step; Strauss and Corbin through their analytic questions, hypotheses and methodological applications."

In her constructivist grounded theory (CGT), she adopted the grounded theory strategies as a set of guiding principles and practices instead of formulaic prescriptions or procedures to be followed (Charmaz, 2006). The initial work of Glaser and Strauss affirmed that new theories emerge from data separate from the scientific agent. Contrarily to this idea, she considers that researchers too are part of the worlds they study and the data they collect. This occurs within historical processes, social structures and interactions. The main difference is that CGT considers the personal background and experiences of both researchers and participants. This approach also fosters identifying how actions and meanings are interrelated to broader discourses and social structures (Charmaz & Bryant, 2016). Moreover, theoretical interpretations, according to her, can provide an interpretative portrayal, but under no case, an objective nor an exact picture of it (Charmaz, 1995, 2000). Finally, she highlights that the studied people's implicit meanings, experiential views and the scientific grounded theories

obtained, are in reality, forms of reconstructing the reality.

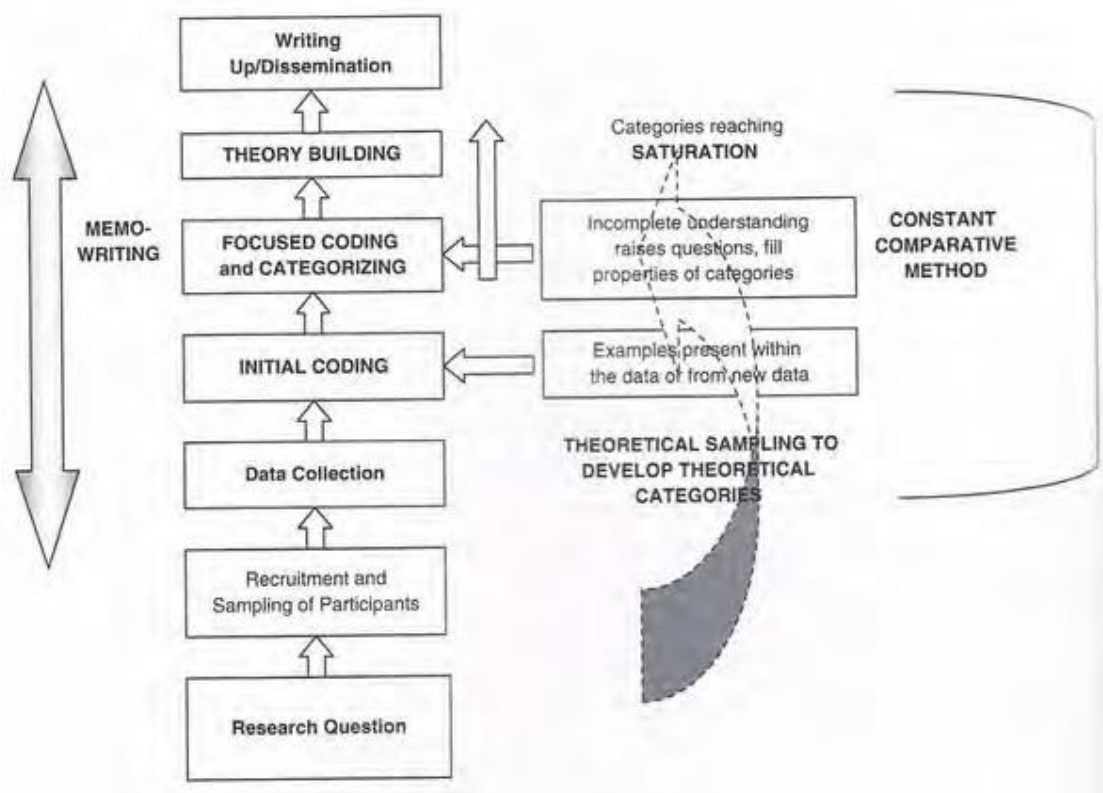


Figure 53: Visual representation of grounded theory. Source: Tweed & Charmaz (2012)

A previous step was added to my research project before implementing Charmaz's constructivist strategy: the bibliography review (described in section V.1).

V.B) STRATEGIES IMPLEMENTED IN THIS RESEARCH

Among the previously mentioned approaches, Charmaz's constructivism appears to be the most suitable for achieving the goals of this research and contributes to the sequential organization of the process. This research also implemented a narrative research approach in an attempt to understand the nature of the relationships and processes related to permafrost thaw and climate change, using local narratives as a starting point.

Before explaining each step of this research in detail, it is necessary to address one of the main topics that shaped the development of this research: the use of language. Languages are an entry channel for discovering the particular way in which people perceive, describe and understand their experiences and the world they live in. The previously described qualitative approach uses local narratives to explore and analyze human experiences. Clandinin and Clain (2008) affirm "studying and understanding experiences narratively, researchers recognize the

centrality of relationships, the relationships among participants and researchers, and the relationships of experiences studied through and over time and in unique places and multilayered contexts. Amidst these relationships, participants relate and live through stories that speak of and to their experiences of living." Through narratives, interviewees are capable of characterizing their worlds and experiences by pointing out what happened, to who, when, where and why. In this sense, Schostak (2005) considers that each event is characterized by specific structural features: this is, *dramatis personae*, system practices and material resources. Moreover, words give people the possibility to refer to their needs, their aspirations, their concerns and priorities.

Lack of knowledge of the Russian language during the first fieldwork hampered communication with local respondents and colleagues. As this was essentially a cross-language collaborative research study (Temple, 2002; Temple & Young, 2004) by Russian and French researchers, the language barriers inhibited communication and exchanges of knowledge. Another complication was that this required transforming life-as-told narratives in the source language (Russian) into life-as-told-as-translated in the target language (English, in this case) and then to life-as-interpreted-from-translation. In order to reduce the cultural textual gap due to not speaking Russian during the first fieldwork (2018), and having only basic notions of it during the second one (2019), real-time translations were included in the research process. Prior to data collection, during both fieldworks, interpreters took the time to translate the interview frameworks from English to Russian. During this process, some informal meetings were arranged between the researcher(s) and the interpreter(s) in order to dispel any possible doubt about terminology or interpretation of questions. During the interviews, questions and answers were translated and interpreted simultaneously in order to enable a more fluid conversation between researchers and interviewees. Before starting each interview, the researcher(s) introduced the purpose of the Nunataryuk project, as well as the specific goals of the interviews. The benefits of their participation in terms of scientific outputs were also outlined and confidentiality of narratives provided was guaranteed. Before starting, their right to refuse to answer a question or to be recorded was also emphasized.

In both fieldworks, interviews were conducted using snowball sampling procedures where an initial sample of key informants was listed and contacted. New respondents were contacted following their suggestions. The chosen samples did not aim to represent the population statistically, but instead were intended to capture the diversity of experiences relating to permafrost thaw in the Sakha Republic, from the perspective of its capital city and two coastal Arctic settlements (see Table

3 below).

Interviews in Yakutsk (first fieldwork) were predominantly conducted by Jean-Paul Vanderlinden, a local interpreter (Anna Svinoboeva) and myself. After Jean-Paul's departure, I continued interviewing other participants (see Table 2 below) with the help of the interpreter. I also got in contact with a couple who lived in Tiksi for a couple of years and who expressed willingness to participate (even if it was by email). Their responses were in Russian and were translated into English. Despite the difference in methodology, their narratives were included in the data analysis. On three occasions, I interviewed local stakeholders on my own. They spoke English and accepted to participate. In order to reduce misunderstanding, they asked to see the Russian translation of questions included on the printed framework page.



 RUSSIAN TEAM	 FRENCH TEAM
<ul style="list-style-type: none">• Inga NIKULKINA Professor of <u>Economics</u>, NEFU• Vyacheslav SHADRIN <u>Researcher in Indigenous Studies</u>, RAS• Anna SVINOBOEVA <u>Student</u>, NEFU	<ul style="list-style-type: none">• Jean-Paul VANDERLINDEN Professor of Ecological Economics and Environmental Studies, Director, CEARC• Natalia DOLOISIO PhD Candidate in <u>Territory Dvpt</u>, CEARC

Table 2: Members of the Russian/French team during fieldwork conducted in Yakutsk in 2018.

The implementation of the second fieldwork, as well as the members of the French and Russian teams varied in comparison to the first one (see Table 3 below). Interviews in Tiksi were conducted principally in small groups of three (the interviewee, one French member and an interpreter), although in some cases there were more than two members of the French/Russian team present. An authority from the Taimylyr Administration suggested us to limit to the minimum the number of people present during interviews, as this could be particularly intimidating for locals, especially for Indigenous Peoples. Doubts or information gaps emerging during the interviews were usually tackled by asking more questions about that topic.

Due to the harsh conditions of the trip (it was a four-hour-boat trip in the middle of the night), locals considered safer to bring only two male members to Bykovsky: Viacheslav Shadrin) and Mateo Cordier (coordinator from the French team). The rest of the team (Inga Nikulkina, Lena

Grigorieva, Pavel Garasyuta, Magali Vullierme and myself) stayed in Tiksi conducting interviews with local residents (see Table 2 below). From the fieldwork in Yakutsk, a total of 24 interviews were collected and translated to English. During the trip to Tiksi and Bykovsky, a total of 34 (from which 7 were collected in Bykovsky). In Tiksi, focal groups were voluntarily proposed by locals who manifested feeling more comfortable doing it in groups. Two groups of 4 interviewees each were arranged. Group work provokes layered reflexivity, as participants constantly interact with other's perspectives and points of view, either by assimilation or by differentiation. From these active exchanges, new data emerges.



 RUSSIAN TEAM	 FRENCH TEAM
<ul style="list-style-type: none"> • Inga NIKULKINA Professor of <u>Economics</u>, NEFU • Vyacheslav SHADRIN Researcher in <u>Indigenous Studies</u>, RAS • Lena GRIGORIEVA Senior <u>Lecturer</u> in <u>Foreign Languages</u>, NEFU • Pavel GARASYUTA Translator, Freelance 	<ul style="list-style-type: none"> • Mateo CORDIER Professor of <u>Economics</u>, CEARC • Magali VULLIERME Post-Doct. in <u>Political Sciences</u>, CEARC/IRSEM • Natalia DOLOISIO PhD Candidate in <u>Territory Dvpt</u>, CEARC

Table 3: Members of the Russian/French team during fieldwork in Tiksi and Bykovsky in 2019.

The main contact in Bykovsky was an authority from the settlement who introduced the rest of the interviewees and found a host family for the two nights and three days spent there. On this occasion, interview conditions were slightly different. Several times, relatives of the main participant intervened during the interviews, providing their point of view as well on the topic.

In Yakutsk, three different interview frameworks were created (see appendix to chapter V) in order to address different categories of stakeholders: these categories were created by considering occupational criteria first, and geographical criteria afterwards:

governmental authorities or people working in/representing research institutions;

inhabitants from non-coastal areas of Sakha Republic (including Yakutsk);

people living in Tiksi.

The first category of people increased our understanding of how the regional governmental and research structures interpret and address issues related to permafrost thaw. It was also the intention to access institutional synergies for coordinated action. The last two categories were to identify the different perceptions of climate change and permafrost thaw in two different geographical contexts (inland vs coastal, respectively). Each framework consisted of semi-direct questions accompanied by complementary prompts. Rather than having a rigid question-followed-by-answer model, the aim was to have an exchange more like a fluid discussion.

In Tiksi and Bykovsky, a single interview framework was created with a view to including the experiences of anyone living in the Bulunsky District (see appendix to chapter V). This broader category considered the high mobility of people living in Northern settlements. For this reason, it was possible to find natives from rural settlements living in Tiksi and Bykovsky whose experiences were extremely valuable. In all cases, names were anonymized, thus conserving generic identifiers.

Data collected in both fieldworks were recorded with the oral consent of interviewees. During the time in Yakutsk, I personally started transcribing the recorded interviews into English. Doing so allowed me to raise any doubts about previous interviews with the interpreter (either due to problems with the sound quality of the audio files or to a limited comprehension of the events described in the interviews). Translations excluded colloquialisms, catch words and idiomatic sentences to facilitate reading. However, other important elements that provided additional information in the interviews, such as laughs, mumbles, silences, sighs, among others, were included in the transcripts and translations.

Interviews from the second fieldwork, were partially transcribed by the interpreters while they were in Tiksi. The remaining interviews were transcribed and translated (especially those where participants spoke in Sakha) in Paris by a Sakha interpreter. When time allowed, some interviews which were initially translated only into Russian, were translated into English as well. Additionally, verbatim translation into English was done of several official complementary documents including laws, reports and census information.

FIELDWORK CONDUCTED IN YAKUTSK		
Categories of interviewees	Details	Total
Representatives of ethnic minorities	-Office of the Northern Arctic People’s Culture -Institute for Humanitarian Research and Indigenous Issues -Ex-representative of the Indigenous People in Parliament	24
Educational authorities	-Senior Authorities from the North Eastern Federal University of Yakutsk	
Governmental authorities	-Minister for the Protection of Nature	
Cultural institutions	-Personnel from the Mammoth Museum	
Research institutions	-The Melnikov Permafrost Institute -Office of the Arctic -Researchers in the medical field	
Students	-Journalism student from Tomponsky District -Law student from Yakutsk -History student from Tiksi -Financial economics student from Anabarsky District -Students from Tiksi (2) -Financial economics student from Vilyuysky District	
Traditional activities	-Reindeer herder -Seamstress	
Other occupations	-Entrepreneur from Momsy District -Biologist from Kazachie (Ustiansky District) -Power supply worker from Siktyakh (Bulunsky District)	
FIELDWORK CONDUCTED IN TIKSI AND BYKOVSKY		
Categories of interviewees	Details	Total
Authorities	-Head of Bulunsky -Vice Head of Bulunsky -Head of Taimylyr -Head of Human Resources in the Bulunsky Administration -Head of the Inspectorate of the Environmental supervision of the Republic of Sakha -Minister of Environment, nature management and forestry -Department of Social development, youth policy and sports	34
Pensioners	-From Tiksi (working as a doorkeeper) -From Tiksi (ex-Head of a family farm in Taimylyr) -From Bykovsky (2)	
Administration workers	-Deputy Director of the School of Bykovsky -Specialist in housing, utility services and energy -Workers at the administration of the Bulunsky District -Worker in the Financial Department of the Education Department of the Bulunsky District -Lawyer -Director of the Port -Accountant	
Traditional activities	-Specialist in agriculture (ex-reindeer herder) -Veterinarian & member of a family enterprise farming reindeer -Head of a family enterprise breeding horses	

	-Fishermen	
Other occupations	-Head of the Center of culture and sports -Laborer in the construction sector -Freestyle wrestling coach -Technician at the cinema -Kindergarten teacher (Bykovsky) -Electric meter technician -Workers at the library (Tiksi)	

Table 4: Summary of the interviewees consulted during the fieldwork conducted in Yakutsk (2018) and in Tiksi and Bykovsky (2019)

During the interviews, triangulation was implemented in order to compare and contrast the information provided by each of the interviewees on permafrost thaw and climate change. This step helped my understanding of the processes and experiences from the point of view of the local population. This was particularly useful as I am not local and I conducted my two fieldworks with a limited knowledge of the Russian language. Therefore, the task of revealing meanings meant dealing with additional cultural and linguistic barriers. Despite the possible variations in terminology and meaning derived from live translations, these were extremely helpful as they made the exchanges between researchers and participants more fluid. During the second fieldwork (especially in Bykovsky) some of the interviewees switched from Russian to Sakha (the most widespread local indigenous language in the Republic of Sakha) which was fluently spoken by only one of our interpreters (Viacheslav Shadrin). Some Sakha words did not have a literal translation in neither Russian nor English and required a description. In some cases, capturing the essential meaning of a respondent's phrase required activating processes of differentiation and contrast with my previous knowledge. Some other complexities involved in understanding what locals meant lay in the spelling and accentuation of some words: for example, "ледник" (read "liednik" in Russian) literally means "glacier". However, depending on the emphasis in the word, it can also refer to "the underground ice of the ice-rich permafrost (also known as "Yedoma"). For such cases, contextual interpretation by a native speaker is essential. After the second fieldwork, our Yakut translator, Marina Antonova, created a system of notes appearing on the left side of the interview transcripts, where she clarified this type of terminological specificities linked to tone, sense and meaning of certain words/expressions. This was an invaluable help that contributed to achieving a deeper understanding.

V.C) CHALLENGES OF UNDERSTANDING

Language is a means of social interaction that provides people with the possibility of expressing, evoking and constructing meaning while integrating their own social and cultural contexts into

socially and symbolically mediated contexts (Herder et al, 1966; Humoldt, 1988, Taylor, 1985) This is why languages based in values, play a key role in identity consolidation processes (Kogler, 2007)

This research was conducted acknowledging that it is, under no circumstances, exempt from the cultural and social backgrounds that shaped researchers' particular perspective and orientation towards the topic of interest (Kogler, 2007). Moreover, participants are not neutral either and also filter the information provided according to their interests, fears, concerns as well as the power relationship with the researcher. Taking this into consideration, in addition to the linguistic barriers, it is accepted that what respondents meant or experienced and the construct elaborated in my mind, may never entirely coincide. This is why, methodological reflexivity is considered to be necessary to address the actions and expressions of our respondents along the entire research process. Particular attention was also paid to avoiding reproducing or reinforcing any possible power relationship between the interviewers and the participants. This is why, capturing, interpreting and explaining the meanings and intentions contained in local narratives remains one of the biggest challenges in this type of qualitative cross-language research study.

According to Bourdieu (1999) "the interview can be considered as a form of spiritual exercise that aims to obtain, through self-forgetfulness, a true conversion of the glance that we direct at others, in the ordinary circumstances of life." In order to do so, several communicational strategies were implemented. Establishing a non-confrontational verbal and non-verbal communication (Bourdieu, 1999) with our interviewees was the main guideline. At the beginning of each interview, I explained in detail the purpose of our research and the possible interest for them in participating in this project. The intention was to establish an active yet methodical listening relationship with the interviewees, in order to capture the singularities of each story, both the unique specificities and the generality, with a delicate balance between a non-directive laissez-faire approach and an interventionist interview (Bourdieu, 1999). It was also considered necessary to look beyond the individual's experience and place the respondents in the context of the world they live in and interact with so that a broader understanding of their experiences and ideas might be obtained. As an example of such an exercise, in Chapter 7, I present the mental map (Figure 55) that was produced following the first fieldwork which was extremely useful in depicting the multidimensional relationships at stake when they refer to permafrost thawing and climate change.

As a team, we acknowledge that ethnicity, culture, age and gender are elements that could create

social distance initially between the researchers and participants. In Russia, respect for hierarchical positions is essential and applies in the context of interviews. In this sense, governmental authorities were introduced by Inga Nikulkina (leader of the Russian team) and were then jointly interviewed by the member of the French team with the most authority (in Yakutsk, this was Jean-Paul Vanderlinden, whilst in Tiksi and Bykovsky, it was Mateo Cordier).

Similarly, while in Yakutsk, young people showed clearly that they were more comfortable when I interviewed them alone or in the company of our interpreter (a young local NEFU student). Some interviewees (especially young ones living in Yakutsk), said before starting the interview that "they were not specialists on the topic" or that "they did not know much about permafrost". This could be an indicator of pre-existing power relationships or possibly we were perceived as intimidating which caused discomfort or shyness. In this type of situation, we stressed that every experience was invaluable and could help us better understand local perceptions of permafrost thaw and climate change.

To reduce any negative feelings in our interviewees, we tried to create a friendly space where natural discussions with local population could emerge. To do so, we consistently tried to match our verbal and nonverbal communication and create a subtle sense of familiarity with the participants. Showing curiosity about their lives visibly increased a sense of comfort in locals and motivated them to share their ideas with us. We were also careful with the tone and content of the questions. We avoided asking inappropriate questions (mainly related to political affairs) or imposing an "outsider's" perception of problems related to climate change or permafrost thaw. Additionally, it was proposed to hold the interviews in public places. In Yakutsk, most of the interviews were conducted at a local coffee chain. Authorities and representatives of institutions were met in their place of work after taking an appointment. In Tiksi, interviews were conducted at the main administrative building on the kind suggestion of the Head of Bulunsky to use the available meeting rooms. In Bykovsky, interviews were mainly conducted at interviewees' houses as both Viacheslav and Mateo were always accompanied by the local authority who was in charge of introducing them to the local participants.

BOX 7: Mammoth tusk gathering – the challenge of addressing sensitive local topics

One of the most challenging topics to analyze and describe, was the gathering of mammoth tusks (see Section VIII.A.2 of chapter VIII). This is a sensitive topic regionally and locally producing deep ideological fragmentation in northern communities due to the cultural implications of this activity (see Chapter 7). Although this activity has been practiced since ancient times, according to locals, it has been boosted by climate change, particularly in northern coastal communities. The sensitivity of this topic required a holistic perception of this practice. This could be an opportunity for people to identify themselves with gatherers, but it could also increase the social stigma or perpetuate clichés about them if preconceptions are applied.

V.C.I) Memo notes

Another important element that helped to contextualize the interviews and other exchanges with locals were memo notes. They give an additional level of narrative as they combine information provided by the participant with interviewer observation and interpretation and trigger the process of theorizing. They helped in filling out codes and identifying gaps in them (Charmaz, 2001). These notes were mainly taken during the interviews in order to capture additional non-verbal communication or external characteristics of the interview (who was present, which changes took place in the process, descriptive information about the location of the interviews, physical attitude of the interviewees, and any ideas exchanged informally before/after the interviews).

This was also a constructive exercise to write down my thoughts to avoid forgetting and losing useful information. Going back and forth, I compared the data from my interviews with my notes at different stages of my research. In some cases, they helped to identify emerging patterns.

V.IV) SOME KEY TERMINOLOGICAL CONSIDERATIONS

As previously stated, language played a central role in this research. In addition to the previous considerations, some additional theoretical specificities concerning the terminological use in this research need to be addressed.

It is assumed here that concepts can only exist within a particular system of meaning and significance shared by a social group and that interactions between and within these systems are

key in shaping the way and the extent to which a specific concept will be used. It is therefore accepted that the scientific and local participants may have one or several meaning(s) for climate change and permafrost thaw and may consequently differ in connotations, uses and implications. For the purpose of this research, the intention was to find the juxtaposition points between the two. Although interviewees may not refer to "climate change" or "permafrost thaw" in the same way the scientific community does, they used other associated concepts and showed a detailed understanding and conceptualization of these processes. They often provided explicit explanations of the nature of such relationships. This information is extremely valuable as it enabled local concerns and needs in face of permafrost thaw and climate change to be contextualized and characterized.

To understand the social dimensions of climate change and permafrost thaw, new actors, dynamics, and methodological challenges need to be introduced into the already complex and dynamic physical world (McCarthy et al, 2014). For this reason, mechanical or deterministic approaches are to be avoided so that our understanding of the social realities and complex human dynamics associated with climate change and permafrost thaw in these coastal settlements is not clouded. This research considers not only the participants themselves, but also the relationships with the cultural, physical and economic dimensions, assuming that the interaction between humans and their environment cannot be conceived in a reductive way or by merely isolating concepts (Morin and Kern, 1993)

The notion of "local" frequently emerged in the narratives of our participants. It was used as both singular and plural adjectives to refer to a particular portion of the population (see Table 2 below). This research, therefore, respects their logic and reproduces this term during the analysis process. However, it is not used in the sense that our interviewees' lives or experiences are circumscribed by restricted horizons or boundaries (Ingold, 2015), but the term "locality" is based on subtle yet constitutive elements of a shared identity, such as mobility, customs and kinship ties, which emerge in their daily lives as a broad and physically fuzzily delimited "here" (see Chapters 8 section VIII.A). This explains why "locals", according to participants, include not only small-numbered indigenous peoples of the North, but also anyone born in Tiksi, Bykovsky or neighboring settlements who shares the lifestyle and interactions with their places. In interview #12, the word "local" was implicitly used to describe a group of people with certain characteristics, in opposition to another.

Interview #4 (conducted in Tiksi)	
<p>"Мне 36 полных лет. Родилась в Тикси. Училась в Хара-Улахе. Окончила и приехала сюда работать в 2003 году в Управление образования и живу, соответственно. Местная, так сказать."</p>	<p>I'm 36 years old. I was born in Tiksi. I studied in Khara-Ulakh. I graduated and came here to work in 2003 at the Department of Education and live, respectively. I am local, so to speak.</p>
Interview #9 (conducted in Tiksi)	
<p>"Я сама местная, но ездила работать."</p>	<p>I myself am a local, but went to work.</p>
Interview #12 (conducted in Tiksi)	
<p>"Да. Им будет сложнее. Или кто приехал сюда – не уроженцы, не местные – а кто- то, кто приехал."</p>	<p>Yes. It will be more difficult for them. And for those who came here – who are not natives, nor locals.</p>
Interview #13 (conducted in Tiksi)	
<p>"Я местная, эвенка, коренная. Здешняя. Родилась. Детство прошла всё в стадах. Росла там. Училась в Кюсюрской школе. Закончила. И закончила техникум, сельхозтехникум, ветеринарное отделение. И потом закончила тоже кооперативный техникум, техникум торговли."</p>	<p>I am local, Evenki, Indigenous. I was born here. During childhood I was in the herds. I grew up there. I studied in the school of Kyusyur from which I graduated. And I graduated from the agricultural college, the veterinary department. And then I also graduated from a cooperative technical school of trade.</p>
Interview #15 (conducted in Tiksi)	
<p>"Мясо и рыбу я никогда не покупаю. Потому что я человек местный. "</p>	<p>I never buy meat and fish. Because I am a local person.</p>
Interview #24 (conducted in Bykovsky)	
<p>"Местные тоже овощи вообще не едят почти. Не привыкли. И не входило у них это в рацион."</p>	<p>Locals don't eat too much vegetables. They are not accustomed to them. They have never been the part of the food ration.</p>

Interview #27 (conducted in Bykovsky)	
<p>“Я думаю, с одной стороны, конечно, это хорошо, что новые животные появляются. Потому что это может быть дополнительным доходом для местного населения.”</p>	<p>I think, on the one hand, of course, it is good that new animals appear. Because it can be an additional income for the local population.</p>

Table 5: Quotes extracted from interviews referring to the notion of “local” (original quotes in Russian on the left / translations into English on the right).

It is proposed to address climate change and permafrost thaw as multidimensional, relational, historical, heterogeneous and widespread processes. They are multidimensional and relational because their influence over inhabitants and groups of inhabitants is strongly correlated with their own relative position in the complex system. They are historical because they have a temporal trajectory in that they are constantly fluctuating and evolving over time (Bergesio, 2019). Moreover, both processes can only be perceived through their physical manifestations that each person is capable of perceiving during their lifetime. They are heterogeneous because both processes are included in and affected by several dynamics. Finally, it is possible to think about them as widespread processes not only because they influence broad swathes of territory, but because each social group is heterogeneous and is impacted differently. The particular social, economic, geographical and historical context shapes the type and extent of the impacts of climate change and permafrost thaw.

Despite the analytical difficulty of integrating the previously described characteristics into the writing process, we claim that dimensions are inter-connected and, therefore, must be interpreted holistically. Omitting these linkages could lead to oversimplifications that could reduce the explanatory power of the analysis (Bergesio, 2019).

The results obtained from the data analysis (see Chapters 8 and 9) are presented under separate titles for the sole purpose of addressing in detail each element/process/ relationship contained in local narratives. This artificial separation is not to reflect the deepest nature of the information nor to create a fragmented understanding of it. It aims to facilitate comprehension by the reader of the multiple and simultaneous processes mentioned by local inhabitants of Tiksi and Bykovsky when evaluating their situation in the face of climate change and permafrost thaw.

Lastly, by providing rich site-specific information about life and livelihoods in Tiksi and Bykovsky, enunciated as “relevant” by the population, it is intended to create bridges to facilitate the application of information to decision and policy making in the future (McCarthy et al, 2014).

This chapter presents the main theoretical bases on which the selection of the methodology for this research was made. By adapting the constructivist vision of the grounded theory, as conceived by Kathy Charmaz, it is possible to develop a structured and organized approach to research, without being too rigid. This stimulated a process of self-reflection in which I, as a researcher, acknowledge that I am not neutral when it comes to the reality I am trying to understand, and therefore I should try to identify and communicate any preconceptions or ideas resulting from the social structures and interactions I take part in. In order to complete the methodological approach, chapter VI provides a detailed description of the collection, codification, integration, analysis and theorization about the data.

CHAPTER VI: DATA ANALYSIS

This chapter describes the strategies implemented for collecting, coding, integrating, analyzing and theorizing about the data obtained during my two fieldworks in Yakutsk, Tiksi and Bykovsky (2018 and 2019 respectively). Although Strauss (Strauss & Corbin, 1990, 1998) and Charmaz's approaches (Charmaz, 2000, 2006) presented several similarities in their conception and implementation, this research was conducted by putting particular emphasize on the latest's authorrecommendations.

VI.A) INTRODUCTION

In continuity with the previous chapter, this sector provides an in-depth description of this research process, from gathering data, to theorizing and elaborating the main conclusions of this dissertation. Data was integrally collected between June 2018 and August 2019, and included both face-to-face interviews as extant texts. 2020 was dedicated to analyze data and theorizing.

VI.B) DATA GATHERING

Before moving into data gathering and before travelling to Yakutsk (2018), I elaborated a draft mental stakeholders' map in order to identify the potential sectors of the society who may feel affected by permafrost thaw and climate change in the Republic of Sakha. This contributed to create broad families of stakeholders that we wanted to meet during this first fieldwork. With the collaboration of our Russian colleagues, this draft version was then fleshed out. Following the snowball sampling, it was possible to meet new participants. In most cases, after the interview came to an end, interviewees would immediately contact by phone new potential participants.

Gathering data aimed at seeing the changing world as local participants from Yakutsk, Tiksi and Bykovsky do in order to obtain a better understanding of the processes and dimensions at stake due to modifications in climate and permafrost.

According to Glaser (2002), "All is data." However, the chosen methodology for addressing the particular research question/s is crucial as it will shape the type of information that we are capable to gather, and therefore, the interpretations we can make of it. Some of the most frequently used tools for gathering data by grounded theorists include ethnographic methods, textual analysis and

intense interviewing (Charmaz, 2006). For the particular purpose of this research, intensive interviewing appeared to be the most suitable tool to inquiry into coastal Russian Arctic communities' perceptions and experiences concerning changes in climate and permafrost. Moreover, it is an open-ended method, which perfectly fits with the constructivist grounded theory approach used for this research.

One written interview was also included: a couple who have lived in Tiksi until last year contacted me by email indicating their interest in participating and willing to answer the interviews by email and in Russian. Despite the procedural differences, it was intended to include their narratives into the corpus.

The initial questions have been shaped by the previous literature review elaborated during the first semester of my PhD. It contributed to identify key concepts related to this particular region in Russia and for this topic in particular, as well as to recognize important information that I was initially overlooking. It also enhanced relevant information gaps that could be potentially addressed during the research process. Unlike positivists approaches, it was not intended to force any initial idea or theory into the data, but to let emerging data refine the research questions.

According to the specific research questions and interests for each fieldwork, several open-ended interview frameworks were elaborated:

- **three for the 2018 fieldwork in Yakutsk**
- **and one for Tiksi and Bykovsky**

Snowball sampling was used in both opportunities and facilitated having immediate access to a wide diversity of stakeholders. This allowed me to collect enough information about the local and regional context, as well as capturing diverse experiences and degrees of concern about the effects of permafrost thaw and climate change. The purpose of this research was not to obtain generalizability but to fit emerging theory with the gathered data.

Charmaz (2006) considers that the researcher should aim at establishing rapport with the participants. Taking into consideration the pre-existing linguistic barriers, trying to establish a deeper connection with my interviewees and trying to interpret their narratives without falling into simplifications, became essential. Firstly, as a concrete demonstration of respect towards them.

Secondly, because in a comfortable environment of exchanges increases the chances that establish

conversations where people feel in security to share their feelings and deeper meanings with me.

The initial research question that gave me a sense of direction in the course of my first fieldwork was: "How do people living in Yakutia, experience permafrost thaw and climate change?". The initial scoping fieldwork conducted in the capital city of the Republic of Sakha in 2018, introduced new information about which are the main stakeholders concerned and how different, yet complimentary, points of view co-exist among the population in the capital city of Yakutia. In a succeeding stage, coding allowed me to unveil the diverse processes (physical and cultural) unchained by permafrost thaw and climate change, what meanings do they attribute to these, and which actions are considered to be legitimate. Delineating the context in which such processes and actions occur was also important for this research as it helps the researcher and the readers contextualize why locals perceive what they do. Such process also required delving into taken for granted assumptions within participants. For example, inquiring about some taken-for-granted aspects during the interviews gave me more visibility about:

- **The logical order of processes and events;**
- **The causal relationships between them;**
- **The feedback loops between processes and events as a result of permafrost thaw and climate change;**
- **Which adaptive measures are considered as legitimate and desired by local population**

The main purpose of using semi-structured interviews was to make our participants reflect on their daily life events and hear about them within the local frame. This type of information is essential to interpret and reconstruct their reality as experienced and understood by them. From the interviews conducted during the first fieldwork, I obtained an overview of the situation concerning permafrost thaw at a regional scale- as most interviewees were native from different regions of the Republic of Sakha but lived in Yakutsk - while introducing new concepts and specificities to the research.

One year later, during the second fieldwork conducted in Tiksi and Bykovsky, we gathered more focused information. The main purpose was to better understand how the specific geographical conditions and relative situation of each of these settlements (being Arctic and coastal) influenced the way their inhabitants perceive changes in permafrost and climate. This would also allow to compare the narratives from both fieldworks and to identify the main similarities/differences

between the predominant emerging trends. This way, conceptual gaps would be filled and new relationships between the regional and the local situation could emerge.

Sample questions were mainly used as a guide to:

- **frame conversations;**
- **direct them towards our particular processes of interest;**
- **avoid treating sensitive topics (politics, militaries, etc)**

Using sample questions contributed to complement the information that each participant provided and could therefore be asked slightly differently in order to adapt to each interview's context. In most of the cases, the pace of the conversations allowed delving deeper into the topics. Although the dynamic and particular way of implementation of the interview frameworks slightly differ between the interviewees, not forcing participants' responses was adopted - since the very beginning of the fieldwork - as a commonly shared guideline for all the members of the teams. The nature of the interviews also varied according to the specific way in which each participant addressed topics. For example, during the fieldwork in Yakutsk, a law student repeatedly tried in this discourse to diminish the role of permafrost for the inhabitants from the city, and openly manifested not understanding why all the questions were focalized on this topic. In such occasion, I decided to explain the interest that this particular topic had for both the scientific and local community. However, even in these situations, it was important not to force participants' points of views or forms of understanding. Moreover, during the entire research process, I paid particular attention to avoid introducing my own thoughts or terminologies into their narratives.

Researchers' active and attentive participation in the data collecting process can positively influence the interviewing dynamics and contributes to gather valuable information from participants. Listening to the recorded interviews after the fieldwork, while going back and forth into my memo notes, was an effective mean to rebuild what our interviewees were feeling and non-verbally communicating during the conversation. Memo notes contained useful information about the setting, scene and the participants' attitude before, during and in some occasions, after the interviews as well. These two steps were essential to avoid guessing or assuming what they meant. Also to remember more easily the person in question when coding and analyzing the data in Paris.

Additionally, some extant texts were also included as a complement to the interviews. More specifically, reports and census data were used in order to provide with statistical and legal

information as well as relevant results obtained from local researchers concerning migration and economy, among others. Legal information was key to fully cover the implications of the problems that locals mentioned, for example, concerning fishing activities in Bykovsky or mammoth tusks gathering. During the interviewing process where live translations are required, the speed to process huge amounts of information provided by participants, does not always leave enough time for the researcher to elaborate all the pertinent questions to obtain the complete vision of the situations or processes they are talking about. In such cases, this type of documents actively contributes to fill the information gaps created during interviewing. Contrasting both types of information revealed an evident congruence between extant documents and my first-hand narratives, confirming their complementarity.

VI.C) CODING

An excel documents with basic information (length of the audio file, who was interviewed, the location, etc) was created for each fieldwork in order to guarantee a better management of the interviews. This also facilitated the manipulation of each file in the Atlas.ti software (Friese, 2019) which was subsequently used to code and interpret the corpuses of interviews.

The first stage of this process involved creating codes that allowed organizing thematically the information obtained. This allowed me moving forward to an analytic interpretation of the gathered information. The importance of codes relies in the fact that they show action while introducing concrete examples and dilemmas associated to each studied process. One of the main challenges associated to this stage, was finding the most appropriate terms to englobe ideas according to locals' perspectives. This required active efforts to reduce the influence of my own preconceptions about the experiences and processes captured during my interviews. Initial coding, as proposed by Charmaz (2006), has the potential to obtain a higher level of familiarity with the studied phenomena and the possible experiences associated to them, not as experienced or preconceived by the researcher, but from the participants' points of view.

These codes allowed identifying in the participants' narratives some – until now - invisible relationships between concepts, ideas and processes. Some codes were not directly linked to climate change nor accelerated permafrost thawing but provided valuable information about the general context in which these processes occur and are mentally constructed by local inhabitants. This included topics such as the nostalgia feeling associated to the Soviet era, or the future perspectives

for northern settlements, among others.

Coding allowed me to understand what is happening as well as my interviewees' standpoints. This process was particularly relevant for two reasons:

- because this unchained the theoretical integration of my data
- coding brought into my research new and more precise questions which were extremely helpful for targeting the research questions of my second fieldwork.

Language, once again, required particular attention. When creating codes, and in order to avoid using preexisting categories, I went back to the Russian transcriptions of the interviews, to pull the exact words interviewees used with their most precise translation in English, to stay as close as possible to the original sense, meaning and purpose of their ideas. For example, the Russian word "naled" which means ice-field. Locals' specific concepts and words reflected in some cases, assumptions, connotations and framed actions. Such was the case, for example, of "traditional knowledge threatened" or "buildings/houses detrimental". Both codes contain information about particular processes that frame inhabitants' action.

Codes included both gerunds (which reflect enacted processes taking place) and static words/concepts. The mix of both would allow, in these particular cases, to start rebuilding connections and interactions. This would also facilitate the theorizing process by clearing the diverse existing relationships between individuals, events and experiences.

Codes remained simple, precise and open in order to capture the wide diversity of experiences associated to each process and discover the multiple forms of linkage between the identified elements. Each line often referred to multiple codes simultaneously, which also revealed since an early stage, the complexity and interrelationships of the processes associated to permafrost and climate in the region.

Along the several and reiterative stages of careful coding, rewording some codes was necessary to improve the fit and relevance. The main purpose of this research is to capture and communicate the local reality in the most reliable way. Additionally, the theoretical analysis of these codes aims at revealing the main processes and stakeholders, and render their interconnectedness explicit. This step was essential to unveil how both the material and physical dimensions are related to

permafrost thaw and climate change in the Republic of Sakha.

The transcriptions from each of the two fieldworks were treated, coded and analyzed as independent hermeneutic units in Atlas.ti 8. The purpose of each of the two fieldworks differed, basically in terms of the width of the regions studied: while the first one focused in the experiences captured by inhabitants living in the capital city of the Republic of Sakha, the second one focused in the particularities of permafrost thaw and climate change as perceived in the coastal settlements of Tiksi and Bykovsky. For this purpose, the interview frameworks were adapted to the context and the purpose of each of them. However, in both occasions, a similar logical structure and concepts/words were used in order to address the same processes yet from different perspectives. This also facilitated integrating the analysis and obtaining a broader overview of the regional and local situation, while developing new theoretical categories that made the research questions move forward.

Some of the codes from the data obtained during the first fieldwork, reappeared in the second fieldwork's data, although they simultaneously included a deeper and more local-scale type of information. For example, in Yakutsk, there was only one global code named "permafrost" which included a wide diversity of feelings, experiences and indirect associations to this word. While from Tiksi and Bykovsky, two clearly different codes associated to permafrost emerged (as a reflect of the formulation of two different questions addressing this idea): "permafrost definitions" and "permafrost thaw". The former one confronted the varied forms of understanding permafrost in local narratives, while the latter one englobed particular experiences and derived processes associated to the thawing permafrost.

The results of this exhaustive work are included in the Chapters 7, 8 and 9. The main outcomes of the analysis of the narratives from Yakutsk are included in chapter 7, while chapters 8 and 9 are mainly focused on the data obtained in Tiksi and Bykovsky.

VI.C.I) First codification

The first stage included line-by-line coding which revealed more information about the wide diversity of processes associated to permafrost thawing and climate change as perceived by local stakeholders from different regions of the Republic of Sakha, how they are evolving and which are their main consequences.

The hermeneutic unit from Yakutsk contained 46 codes in total. These were later reorganized under the form of 6 broader and integrative thematic “families of codes” (see table 6 below). The different relationships existing between codes and the thematic families were then graphically represented under the form of a mental map (see Figure 55). Once again, with the purpose not to introduce exogenous concepts into the analysis, chosen words were repeatedly contrasted to the data. This mental map illustrates the existing relationships between the different processes, stakeholders and elements revealed by interviews. This was particularly useful as the main goal of the trip to Yakutsk was to obtain a brief overview of the situation concerning permafrost thaw and climate change at a regional scale, using as an entry point the narratives from people native from different corners of the Republic of Sakha and different professions who were living in Yakutsk in June 2018.

IMPACTS	COLLECTIVE ACTION	OPPORTUNITIES
Negative impacts on natural resources	Governance needed	Emerging opportunities
Negative impacts on infrastructure	Knowledge related issues	
Negative impacts on health and mental well-being		

Table 6: Six thematic families of codes that synthesize and reassemble information contained in the codes emerging from the narratives in Yakutsk (also see Chapter 7).

The information gathered in Tiksi and Bykovsky was analyzed as one single hermeneutic unit as we only used one interview framework for the inhabitants from both settlements. This also aimed at giving the respondents enough space to define their space boundaries as conceived by them, and not to limit them to our spatial separations which could be felt as “artificial” in contrast to a high mobility reality in northern settlements.

This hermeneutic unit contained 110 codes in total. Families of codes were not created: firstly, because the objectives of this fieldwork slightly differed from the previous one. This time the goal was to collect locally pertinent and site-specific information from Tiksi and Bykovsky, as the general overview was already obtained. Additionally, the amount of information was such, that it would have hindered the creation of such relational network.

VI.C.II) Second codification

The second stage included relating and comparing data from the two hermeneutic units and introduce as a result, new focused codes. Comparing statements from participants' narratives within the same fieldwork and later on, between fieldworks, allowed for the capturing of subtleties and to the contrasting of the different modalities of experiencing changes related to permafrost and climate. Simultaneously, I started selecting manually the most prominent codes after processing and comparing those already existing from Yakutsk and those from Tiksi and Bykovsky. The purpose was to confront, to integrate or to maintain them separated. These helped me to identify the most frequently mentioned notions, ideas and processes contained in codes, as well as to integrate more detailed data. This also provided me additional information to delineate the dimensions touched by permafrost and climate. As a result, I was able to unveil the main trends and standpoints from local inhabitants concerning these two phenomena. New categories emerged and were regrouped while trying to connect them with my initial research questions.

The principle categories that emerged from the overall codification and analysis of narratives were:

- **Interactions between climate change and permafrost thaw**
- **Permafrost thaw impacting the material dimension**
- **Permafrost thaw impacting the cultural and symbolic dimensions**
- **Defining agency as locally conceived**
- **Identifying adaptive strategies**
- **Determining future perspectives**

They were inductively obtained from our gathered data and responded to both the regional (the Republic of Sakha) and local situation (Tiksi and Bykovsky). The definition of these categories aimed at capturing the essence of ongoing processes and reveal the different views, meanings and levels of concern that inhabitants attributed to each of them. They do not represent a contradiction, but instead should be interpreted as different complimentary elements of one reality which is perceived as experiencing deep transformations.

VI.C.III) Theoretical sampling

Theoretical sampling aims to obtain rich data that elucidates the categories and is an important step to move forward to developing theory (Charmaz, 2006). By sampling my theoretical categories, it was possible to capture and englobe a wide diversity of local experiences and associations related to permafrost thaw in the Republic of Sakha. This contributed to construct new tentative hypotheses which were studied and reinforced with additional inquiry until obtaining a more solid theory that would fit my narratives. This is where a key finding for my research emerged: in fact, impacts of permafrost thaw and climate change exceed the limits of the merely material or physical dimensions. This research revealed that these dimensions both impact relevant cultural and symbolic aspects of lives and livelihoods in the Republic of Sakha. Such effects take on even greater dimensions in northern coastal settlements like Tiksi and Bykovsky. The specificities associated to such theories will be developed in the conclusions section.

Having the opportunity to attend to the summer school focused on Arctic issues at the North Eastern Federal University in Yakutsk during the entire month of August 2019 (right after finishing conducting the fieldwork in Tiksi and Bykovsky), was extremely useful to collect more technical information about the Republic of Sakha that could shed light on my latest data. In fact, narratives were an effective tool to capture important daily life events and describing general trends in terms of mobility, employment, climate, etc. Attending to the courses included in the Summer School provided me with extra technical, historical, geographical and statistical information as well as the possibility to inquire the speakers (who were local scientists, authorities and professors). This was an invaluable information which served to fill the empty gaps that appeared during the interviews. During the last stage of my research, I also collected legal and statistical documents which clarified some key points of my narratives. It was possible to make visible the effects of new changes in their environment over certain elements/activities/stakeholders which were identified as "directly impacted". Emerging questions were therefore compared to this new data. By contrasting both types of information, I finally obtained a broader picture of the situation concerning, and could delve into the practical and legal challenges of mammoth tusks gathering activities, among others.

Although the qualitative analysis of narratives revealed the existence of major guiding similarities between respondents in the Republic of Sakha - which after theoretical sampling

became new categories -, it is also important to provide further details about those narratives which withdrew from the prominent trends as they also contained relevant information for the overall analysis and purpose of this research. During the two fieldworks, three participants in total explicitly manifested that changes in permafrost and climate are either:

- **not perceivable**
- **or irrelevant at a local scale**

These included one student from Yakutsk (interviews during the first fieldwork), a fisherman from Bykovsky and a worker at the library from Tiksi (both interviewed during the second fieldwork).

The student acknowledged that permafrost is a “symbol of the region” but continually reiterated that changes on permafrost are irrelevant for people’s lives and livelihoods in the city of Yakutsk:

INTERVIEW 14 B (first fieldwork): “Again, yeah. Like I said at first, people in our city and in our Republic are not usually thinking about permafrost. We don’t care. We only care about winter and I guess people from villages must care about weather in winter because sometimes they get food for themselves by fishing or hunting and they need to understand at which time they can go outside and how to get dressed. So, about permafrost nobody cares, we don’t think about this (...) No, I don’t see changes on permafrost. I just try to explain. When I was born, and probably my parents and great grandparents were born, every time permafrost was there in the same place. So we can’t see changes on permafrost. We can only see one change, climatic system in the Arctic and in our Republic. It will be much hotter in the winter but for example, when I was a child, 15 years ago, I am sure that winter was much colder than now, for example -50 was typical weather in Yakutsk in winter but now in winter we can have -40/-45 maximum.”

Overall, he diminished permafrost’s role in their changing world. However, in his discourse he also manifested that most of the problems related to roads’ conditions are related to permafrost. He does accept that thawing permafrost produce a reduction of bearing capacity and therefore destructs the piles of buildings in the city. However, he also associated it to the lack of technical maintenance. He specified that there is a new area inside the capital city where they are implementing a new technology better adapted to permafrost.

On the other hand, both the respondent from Bykovsky and Tiksi denied perceiving significant changes in permafrost or climate at the beginning of the exchanges. The fisherman from Bykovsky initially referred to coastal erosion as a natural phenomenon linked to wind and water, but not directly to permafrost. He also considers that the speed of such process did not vary. He stated:

INTERVIEW 28 QUOTE 22-1 S (second fieldwork): “[Coastal erosion] always happened. It depends on the water coming and wind blowing. The water comes and washes the coast, with the wind it digs the ground, and the ground falls. This [process] always existed (...) No. Nothing is getting faster. In any case, everything happens as it should. The coast has weak spots. For example, the ice [wedges]. You see the bottom of the coast? If pointed there, it will break faster. As soon as the ice melts, the top of the coast falls. The unfrozen sides, the sides with soil are soaking. That’s how it is. The place we are living is like this (shows). On the hill like this, there is sand, ice nearby, then sand, then ice again – like humps. That is why it’s breaking. When being washed, the ground side is soaking, and something like a stream is created. It is strongly washing away the interior, and it falls both coasts. All coasts are like this. The same when you are digging the cellar (...) What could happen? – Nothing will happen. What sort of threat can happen? – only if a big tsunami will wash it all off. (both laugh). Otherwise, it will all stand as it is.”

Although he interrelated specific forms of permafrost (ice wedges) to coastal erosion, for him it does not have a major role. Moreover, he affirms that climate is not changing, that there is not such a thing and climate works cyclically.

The worker at the library from Tiksi initially affirmed not identifying major changes in climate as “(...) most periods go by, a period of cold - two years can be cold, two years can be then very warm. As in the summer, as in the winter. Yes, there is such a cycle. And so, perhaps, the polar night became smaller, shorter. Yes, yes, shorter.” Moments after, she added:

INTERVIEW 14 QUOTE 62 AI: "(...) Although there is a cyclical pattern - yes; I say that there are no changes; but still, if you look at the plants - yes, there is more of them growing. It used to be not so much in the 90s, in the 80s... At first, we thought that [because] the military people were settling in, it became too many people here, and therefore it became less [vegetation]... People are pulling out everything [plants] - you know. And there were, kinda, fewer dwarf birches growing at that time, same for the flowers too. And now all people had left, there is a small population, but ... Maybe it's because of this [population decline] or because of the weather [changes], but in any way, there are a lot of dwarf birches [nowadays]."

These three participants mentioned and described specific processes that were catalogued as "unchained by permafrost and/or climate change" by other respondents. Such cases required moving forth and back through the data contained in their narratives as, a priori, constituted a new emerging category that differed from the predominant trends. I expanded on this category through careful revision of their narratives and arrived to the conclusion that although they deliberately downplayed the role of changes in climate and permafrost, they were capable in their discourses, to address and interrelate the same previously mentioned changes associated by the rest of participants. All in all, there appears a computability between the changes observed by interviewees, for example, reduction in bearing capacity, coastal erosion, changes in flora. However, the difference lies in the point of reference from which each of them analyzes the entire sequence of processes. This is why, I concluded that they did not should be kept nor treated as separate analytical units or categories.

These variations in the narratives could be explained by:

- **a difference in terms of the logical order of events;**
- **a difference in the way they define and catalogue something as "the cause of" something else;**
- **or all simply because they do not consider attributable the entire responsibility to only one phenomenon (permafrost thaw or climate change).**

These draft hypotheses should also consider some elements as: experiences of life, age, profession, among others. Understanding the role that both permafrost and climate have in the life of local inhabitants will also shape the urgency with which they consider necessary to take action and adapt.

Theoretical sampling facilitated identifying these specific forms of variations that did not fit the other range of experiences. Although obtaining a precise diagnosis of the causes of such emerging differences would require asking more questions to these same interviewees, after analyzing and comparing data all over again, I was able to obtain a better understanding of the subtle implications and therefore, constituted a more solid analytical theory.

This complex process integrated into my initial questions and interests, started providing a more solid structure to this research:

- **Firstly, how material and cultural impacts of permafrost thaw and climate change interact and become the two sides of a coin (associated to my initial question “what is happening in the Republic of Sakha?”)**
- **Secondly, how do the historical processes shape today northern population’s agency and possibilities to adapt to emerging impacts (“what do they do?”)**
- **Thirdly, which are the future perspectives of people living in northern settlements like Tiksi and Bykovsky, taking into consideration the implications of a changing world they are living in (“what do they want for their future?”)**

The result of this reiterative theoretical process helped me obtain a broader and more generalizable form of understanding. In this sense, the results of this research could represent an important scientific contribution to study the situation concerning permafrost and climate change in other alike Russian Arctic coastal settlements. This exercise could lead to important findings in terms of similarities and/or specificities, and could lead to identify broader trends at a coastal Russian Arctic region scale.

VI.D) INTRODUCING STAKEHOLDERS

For the purpose of the first fieldwork (conducted in Yakutsk), it was prioritized to meet and interview a wide diversity of stakeholders in order to capture the experiences and perspectives associated to permafrost thaw and climate change. While for the second one, it was initially desired to meet people who lived or was born in Tiksi and Bykovsky. However, once the interviews started, we realized that high mobility in the region would require to broaden our target participants. We included inhabitants from any village or settlements from the Bulunsky District. As described in chapter 4, the idea of moving from one village/settlement to another in this region is culturally rooted and therefore, completely normal.

In spite of the fact that no particular efforts have been made to obtain equality in the number of female and male interviewees, such parity was overall obtained.

In Yakutsk, three interview frameworks were created to address three broad categories of participants that we expected to meet:

- **governmental authorities or people working in/representing research institutions;**
- **inhabitants from non-coastal areas of Sakha Republic and**
- **people who lived or was born in Tiksi:**

While the first category emphasized the occupational situation of each interviewee, the two latter ones focused in the geographical criteria. Within these broad categories, it was important to meet as many inhabitants as possible.

In Tiksi and Bykovsky, this initial delimitation between local stakeholders was not established and everyone was interviewed using the same questions and prompts. Although we did not register the specific age of each of our participants, we paid particular attention to including young people in Tiksi and Bykovsky (defined as those below 30 years old), in order to capture the essential differences of perception of permafrost thaw, climate change, and general living conditions in such settlements, in contraposition to people who lived there during the Soviet times. This would also lead to gaps in terms of ambitions and desires for their future (e.g., do all the sectors of the population consider out-migrating as a solution? If not, who are the main concerned by this trend?).

Authorities did not represent a group of particular interest because formal information from regional authorities was already obtained during the trip to Yakutsk. In Tiksi and Bykovsky, we had the possibility to encounter a bigger proportion of people living from traditional activities (fishing, hunting, animal breeding/herding). This was closely related to the fact that these are the main economic activities in the Bulunsky District. In Tiksi, an important percentage of the interviewees hold an administrative position at the main building where the majority of the interviews were conducted. This included lawyers, economists, being head of some department, accountant, etc. Visiting the local library also introduced us several workers at this institution.

In Bykovsky, due to the local structures and livelihoods, we interviewed local fishermen, workers

at the kindergarten (teachers and the director), a specialist in housing and utilities services, etc. In both settlements, we were introduced to pensioners.

VI.E) BRINGING RESULTS BACK TO PARTICIPANTS

As a closing stage, it was planned to return to Yakutsk in November 2020 in order to present the main results of this three-year-research with local stakeholders. The main purpose of such a trip is to verify the pertinence and precision of my categories and theories with what local stakeholders experience and perceive in a daily basis. In other words, I seek for confirmation from my participants. The current health crisis is preventing me to conduct this work before finalizing my PhD thesis. Yet it is still budgeted for. This will be an opportunity to refine and adjust the outcomes of this research to the reality as reconstructed in locals' narratives. This is particularly relevant if we consider that one of the final purposes of such exercise is to elaborate a brief guideline document including scientific recommendations to improve the bases of decision-making in the Republic of Sakha concerning climate change and permafrost thaw. These will be based in the results and the feedbacks from the local community.

This is, not only a way to reward the invaluable collaboration and contributions from our Russian colleagues and interviewees during the three years of research. But also, a concrete way to attend local stakeholders' requests, especially as local authorities repeatedly manifested the necessity of synthetic and technical scientific inputs to accelerate decision-making in the regional political sphere.

Chapter VI provided a description of each of the steps integrated into the qualitative methodological approach that was here implemented. The last part of this thesis concerns the presentation of the analysis of the narratives obtained during the two fieldworks conducted between 2018 and 2019 in the Republic of Sakha. It will be presented into the form of three chapters (VII, VIII and IX) and will englobe different layers of understanding that emerged from the analysis. Chapter VII will provide a regional overview of the situation concerning permafrost thaw and climate change. More specifically, it will present the results of the qualitative analysis of the interviews conducted in 2018 in the city of Yakutsk. This will contribute to obtain a first level of understanding concerning the local perception of these processes as experienced in different points of the Republic.

CHAPTER VII: DIMENSIONS AT RISK ASSOCIATED WITH PERMAFROST THAW & CLIMATE CHANGE IN THE REPUBLIC OF SAKHA

This chapter contains the results of the scoping fieldwork conducted in the capital city of Yakutsk between June and July 2018. Face-to-face interviews allowed us to gather valuable information on how people from different regions of the Republic of Sakha living in Yakutsk perceive and interpret changes related to permafrost thaw and climate change. This stage was particularly relevant for my dissertation for several reasons: firstly, because the narratives collected provided me with a broader overview of the current situation in the Republic of Sakha concerning permafrost thaw, climate change and the implications. Secondly, because the analysis of these narratives reveals that both processes trigger complementary and, on some occasions, similar processes at regional and local scales. Finally, meeting residents from different corners of the Republic of Sakha guided me to the main regional stakeholders who are involved in topics associated with permafrost thaw and climate change in the republic.

VII.A) A REGIONAL OVERVIEW OF PERMAFROST THAW & CLIMATE CHANGE IN THE REPUBLIC OF SAKHA

Scientific research, as well as observations and knowledge gleaned from Arctic residents provide detailed information about the ongoing multiple transformations of the Arctic region (Nuttall, 2018). These changes are giving rise to new, inter-related processes and stressors which, in turn, are creating new risk patterns for the inhabitants of the Republic of Sakha. The aim of the scoping fieldwork conducted in Yakutsk in June 2018 was to obtain a regional overview of permafrost thaw and climate change in the Republic of Sakha (Russian Federation). Identifying new risks mentioned in narratives could be a starting point to better understand the opportunities for, and implications of, possible adaptive solutions.



*Figure 54: Map of the city of Yakutsk in the Republic of Sakha and other republics of the Russian Arctic.
Source: self-created*

VII.B) RISKS, PERCEPTION & CULTURE

Analysis of the narratives concerning the situation in the Republic of Sakha centered on risks. The concept of risk is defined according to Aven & Renn (2009): "Risk equals the two-dimensional combination of events/consequences and associated uncertainties (will the events occur, what are the consequences)." It is important to specify that when considering permafrost thaw, the risk "event" under scrutiny is the increased thawing of the permafrost, and/or, the reduction of the permafrost surface (either continuous or discontinuous). When climate change is mentioned, the risk events are the associated causes and consequences of it. This scoping fieldwork focused on the interpretation of local perceptions of these events, their causes and consequences. This allowed us to obtain further information about how permafrost thaw is associated with different causal statements, statements of salience and their justifications (Vanderlinden et al., 2017). In fact, "risk issues" (see Renn, 2008, pp. 133 and 134) can have different forms: they can be perceived materially as daily living conditions under threat, but also non-materially (well-being, culture, values, etc.) which can also be threatened.

The material consequences of permafrost thaw have been widely documented. However, in

order to appraise a risk, all dimensions of the concern should be included (Renn, 2008, p. 74). For this research, interpretation of the perceptions of a specific risk is part of the concern assessment. Climate change exerts pressure on cultural dimensions such as beliefs, ritual practices, art forms, identity, community cohesion and the sense of place (Adger et al., 2013; Quinn et al., 2015; Crate et al., 2017). Understanding local communities' perceptions of cultural changes is particularly relevant, especially if we consider that non-material processes and resources enable people to lead meaningful and dignified lives. Because of climate change, some of these elements are now at risk, and therefore require special attention (Adger et al., 2013).

Risk perception is considered to be a cultural construct (García Acosta, 2005; Vanderlinden et al., 2017). Therefore, the notion of risk is a complex intellectual construct between the members of a society (Douglas & Wildavsky, 1982). Cultural aspects shape the way societies perceive risks and, therefore, influence the responses to the new risk patterns associated with climate change and permafrost thaw.

Throughout their history, Northern communities living in the Russian Arctic have developed a precise understanding and sense of place which cannot be separated from the extreme climatic conditions and presence of permafrost. Integrating their definitions, perceptions and assessment of risks provides an overview of the adaptive measures that they judge acceptable and needed. Last but not least, integrating the cultural dimensions broadens the understanding of different responses to similar environmental changes within communities. Acknowledging all these elements implies putting the cultural aspects at the core of any research project dealing with the social effects of climate change.

With this in mind, this chapter explores the diversity of perceptions of climate change and permafrost thaw between the respondents from different regions of the Republic of Sakha living in the capital city of Yakutsk. Achieving this goal relies on collecting and analyzing the narratives gathered during the fieldwork.

Narratives play a key role in this essentially qualitative research. Through narratives, humans are capable of reconstructing fragmented observations, particular experiences, realities and meanings (McComas & Shanahan, 1999). In this sense, people use narratives to attribute meaning and value to social and environmental events. Analysis of the narratives of residents from the Republic of Sakha provide insight into the way permafrost thaw and climate changes are perceived and the implications they have for northern communities. Additionally, this

reveals the differences between the norms, definitions and expectations of the scientific community and those of local stakeholders. Clarifying these differences can be an effective means of improving the communication between those most concerned and researchers (Kane et al., 2014).

To understand the outcomes of this chapter, the particularities of the chosen methodology are presented. The body of translated interviews was first transcribed and then qualitatively analyzed using Atlas.ti 8 (Frieze, 2019). A mental map (Figure 55) in the form of a network has been created after multiple types of connections between codes were established. This was particularly useful to visualize the main topics emerging from narratives. To increase the accuracy of this analysis, codes were created that respect the order and words used by participants. Finally, broader categories were created that group codes according to 6 different levels of previously identified actions or concerns:

- **Impacts on natural resources**
- **Impacts on infrastructure**
- **Impacts on health and mental well-being**
- **Governance needed**
- **Knowledge-related issues**
- **Opportunities**

VII.C) INITIAL THEMATIC CODING RESULTS

During interviews, people were keen to tell us about their life experiences to do with permafrost, climate and their environment. It is important to highlight that everyone was familiar with the terms “permafrost”, “permafrost thaw” and “climate change”, terms used in our questions and prompts. After outlining the questionnaires in English, Jean Paul Vanderlinden and I met the Russian-English translator to determine if the words chosen had an equivalent translation in Russian and were familiar to local residents. This was important to reduce the possibility of misinterpretation during the interviews. We also verified that the translations preserved the intention of the original English.

Differences in types and levels of concern expressed in our interviews can be interpreted as the reflection of the different characteristics or contexts of the participants, for example, places of origin: big cities, villages or small settlements; coastal or non-coastal areas; urban or rural areas, among others. Living conditions vary greatly between these cases and the spheres perceived as being affected by climate change or permafrost thaw are inevitably influenced. Gender too

can shape local perception of changes. This is particularly relevant as activities and livelihoods are strongly gender-oriented according to local tradition: while women spend more time on domestic activities, men are usually more involved in traditional activities (fishing, hunting and herding), and therefore, spend more time in direct contact with nature. Practicing a particular traditional activity increases the level of precision of the respondent's knowledge. On the other hand, it is observed that people with higher mobility, especially those travelling between regions, were capable of pointing out a wider variety of examples of how changes in permafrost and climate affect local livelihoods and traditions.

The only topic on which there were divergent views between respondents was the relevance of permafrost. Two interviewees said that this topic is not important for residents of the Republic of Sakha. In three narratives, the presence of permafrost is not denied or unknown, but for them, there are other bigger priorities: for example, climate (see quote #9) or the seismic conditions (see quote #10).

All in all, the overall body of narratives maintained a particular logic and presented no contradictions. Narratives complemented each other, expanding the knowledge about local stakeholders' perceptions of the multidimensional changes they are currently experiencing. Residents are fully aware of the complex chain of modifications and new risk patterns that have recently emerged as a result of permafrost thaw and climate change in the Republic of Sakha. An in-depth qualitative analysis of the narratives underscored some of the main topics that emerged from conversations with the respondents. Seven main categories emerged. A table containing some of the most representative quotes (27 in total) for each of the aforementioned categories was created (see table 7 below) in a first stage. These categories encompass the main topics derived from questions concerning permafrost thaw and climate change in the region and summarize the main concerns of the local inhabitants.

(1) Samples associating changes with both permafrost thaw and climate change	Interviewee	Quote #
<p>"It (permafrost) affects reindeer herders because before we were moving along the coastline. Now the climate has changed, big bushes have appeared and it has become really hard to herd the deer. (...)</p> <p>Because the soil has changed, the lakes are</p>	<p>Reindeer herder from Kolimskoie</p>	<p>1</p>

<p>disappearing, there are landslides, insects have appeared, polar bears have started to move around, everything has changed. The birds, the water, the nature, the soil and the weather of course. It appears that the weather affects many things, the routes taken by of birds and animals have changed and there are also migrations, animal diseases.”</p>		
<p>“Another challenge for our people is the catastrophic flooding observed in recent years. Why does this happen? Many reasons. More meltwater. More rain. Another reason: maybe because the deltas of these rivers now are not dug and that’s why water can’t flow. But hydrologists say that one of the main reasons for the new floods in the northern rivers is the amount of water which gets accumulated in the surface (more than 30%) due to melting permafrost. Then, it comes to the rivers and this is another challenge of permafrost melt.”</p>	<p>Representative of the Institute for Humanitarian Research and Indigenous Issues</p>	<p>2</p>
<p>“Actually, there was an article maybe a month ago. They found a huge glacier that broke away from the shore and the main reason I read in the article was because of permafrost, the weather is getting hotter and today is close to 19°C – a week ago it was -2°C. When I was studying there (Tiksi), the weather was not like that. Maybe we got a few days which were very hot in the middle of July and afterwards it was always very foggy and under 2 degrees. I was really surprised by the news.</p>	<p>Student #2 from Tiksi</p>	<p>3</p>
<p>“People living in Tiksi are concerned about climate change and permafrost thaw. (...) For example, I know that students of the Arctic Gymnasium (High School) conduct their own research to identify changes in</p>	<p>Student #3 from Tiksi</p>	<p>4</p>

<p>climatic conditions. (...) Changes in permafrost affected the flora and fauna most severely. New plants are appearing in the tundra, which are more common in the western and southern regions of Yakutia. The animal world has changed habitat. (...)</p> <p>Local hunters also agree with the fishermen and believe that animals traditionally being hunted (deer, arctic foxes) have changed their habitat and moved further away from old places."</p>		
(2) Samples associating changes solely with permafrost thaw	Interviewee	Quote #
<p>"...in the houses built on permafrost, the permafrost will soon melt and the building will be destroyed so we need another place to build the houses. Such cases are in villages (...) The special areas for fishermen are being eroded and they need to move their houses in order to survive. And even technology cannot move that."</p>	<p>Seamstress from Saskylakh</p>	<p>5</p>
<p>"...earlier, 2 or maybe 3 centuries ago, we had epidemics such as the black death. The people and the cattle were buried in some places but we don't know exactly where. Now the permafrost is melting and they (dead bodies) are appearing during the autumn or they come to the water, rivers, lakes. However, we don't have any diseases or epidemics in Yakutia yet, but the example of Yamal shows us that this is one of the big problems for us and the future."</p>	<p>Representative of the Institute for Humanitarian Research and Indigenous Issues</p>	<p>6</p>
<p>"I think yes (people are concerned about permafrost) because permafrost thaw begins the erosion process. People start losing their houses which are destroyed. And in the tundra, it creates holes."</p>	<p>Biologist from Kazachie</p>	<p>7</p>

<p>"Permafrost affects badly our buildings and on summer buildings that were built on permafrost, when it melts, they are just going down and the walls are being destroyed because of the movement. In Yakutia, the technology should be special for building houses on permafrost and the materials must be of high quality. I would like to say for roads as well."</p>	<p>Student from Yakutsk</p>	<p>8</p>
<p>(3) Samples identifying a weak relevance of permafrost</p>	<p>Interviewee</p>	<p>Quote #</p>
<p>"...people in our city and in our Republic don't usually think about permafrost. We don't care. We only care about winter and I guess people from villages must care about the weather in winter because sometimes they get food for themselves by fishing or hunting and they need to understand when they can go outside and how to get dressed. So, nobody cares about permafrost, we don't think about this."</p>	<p>Law student from Yakutsk</p>	<p>9</p>
<p>"...most people don't want to know about the conditions of permafrost (...) People are interested in knowing about the conditions of the land under Tiksi because there are seismic movements."</p>	<p>Student #1 from Tiksi</p>	<p>10</p>
<p>"I can't say whether it (permafrost) is important or not, because permafrost is part of our lives. The entire territory of Yakutia is covered by permafrost and our traditional lifestyle is connected with this, it depends on it."</p>	<p>Representative of the Institute for Humanitarian Research and Indigenous Issues</p>	<p>11</p>
<p>(4) Samples identifying a strong relevance of permafrost</p>	<p>Interviewee</p>	<p>Quote #</p>

<p>"Our culture, or circumpolar civilizations, is based on these territories where there is permafrost or a cold climate. And that is why each change to permafrost or our climate has an impact on our culture. We started to feel these changes a very long time ago (...) when reindeer herders or fishermen come to a place, they have like a storage place. They put their meat and fish one or two meters deep, but now this is disappearing because the permafrost is melting. All these places are destroyed. However, we still try to make them, but they will be destroyed every time."</p>	<p>Former representative of the Indigenous People in the Parliament</p>	<p>12</p>
<p>"I cannot speak on behalf of the whole population of Sakha Republic, but for our district it is definitely very important because our entire life is related to it (...) I think that all our life depends on the permafrost so we wouldn't exist without it. We get food from the reindeer, so if there are no reindeer we cannot survive, and we also obtain fish."</p>	<p>Seamstress from Saskylakh</p>	<p>13</p>
<p>"First of all, it (permafrost) is a visiting card, an image of Yakutia. Secondly, permafrost is really cold and people who live in the cold have a long life expectancy. And thirdly, it's our culture."</p>	<p>Young entrepreneur from Momsky District</p>	<p>14</p>
<p>"That (permafrost) is our outstanding special point and that is why we are in a unique place in the world. In earlier times, people just got used to living in such conditions and dislike the heat."</p>	<p>Financial Economics student from Anabarsky District</p>	<p>15</p>
<p>(5) Samples asserting that traditional knowledge and occupations are being threatened by changes in their environment</p>	<p>Interviewee</p>	<p>Quote #</p>
<p>"...because the ground is moving, changing, that's why we have to change our migration routes."</p>	<p>Representative of the Institute</p>	<p>16</p>

<p>Sometimes we don't know what the best route is because everything has become unpredictable.</p> <p>Normally we could predict the weather for one month, for seasons, years! Using these predictions, we could choose routes for more comfort. Now we can't do it because we don't know what is happening. All of our traditional knowledge about the weather is being destroyed. You can say the same about each of our traditional occupations, fishing, hunting too. Not only infrastructure."</p> <p>"...the young generation is not interested in our traditional occupations like reindeer herding, hunting, fishing, because they understand that they are not comfortable: "they don't give us enough profit for our life", but this is the base of our traditional lifestyle and knowledge! If these young people find one tusk, the price of this tusk is more than the money from one-year's work as a reindeer herder or hunter. This is why we can now say that our traditional occupations – reindeer herding, fishing and hunting – are in crisis because people involved in these are very old. They are over 50. If we sustain this situation for a long time, it means we might lose these traditions."</p>	for Humanitarian Research and Indigenous Issues	
<p>"After school, children come to Yakutsk and do not come back. They stay in Yakutsk. That's negative.</p> <p>Traditional reindeer herders and fishermen are disappearing."</p>	Biologist from Kazachie	17
<p>"...all our life is regulated by the official laws, orders and others decrees, for example, period of the year when we can catch fish. But these laws were for the</p>	Former representative of the	18

<p>past, now everything has changed and people are losing their harvest (...) And the procedure for changing this regulation is very hard, very bureaucratic. The fish spawning time has changed and all the laws and directives regulated this but now everything has changed and people can't do anything. And if they go to fish during the real spawning time, this might be considered illegal (...) Three years ago, people raised the question of traps for wolves because wolf traps are banned, but now wolves are becoming an epidemic for us. This is a big challenge because every year they take 5-10 thousand reindeer from us"</p>	<p>Indigenous People in the Parliament</p>	
<p>(6) Samples identifying a need for further action</p>	<p>Interviewee</p>	<p>Quote #</p>
<p>"We started to feel these (climatic) changes a very long time ago. In 1995, at the meeting of reindeer herders in the Itum Kalinsky region, we spoke about it. And we spoke about the need to change the migration routes of the reindeer herders because some changes have been observed. This is why the melting of permafrost has a major impact on our traditional lifestyle. Today it is a reality and every year, on the northern river, Alezeya, there are floods. This is the result of changing permafrost. Not long ago, the members of the local parliament were interested in this question, and at the beginning of June they organized parliamentary discussions about the impact of climate change on the traditional lifestyles and traditional occupations of indigenous peoples in the North. Now, scientific expert groups and authorities examine the system</p>	<p>Former representative of the Indigenous People in the Parliament</p>	<p>19</p>

<p>to make research on this process in order to face this challenge and think about the changes we need. (...) Many changes...We have never paid too much attention to this but now it is urgent. (...) (People) always try to adapt to these changes just as they happen. And they try to raise these questions with their officials to fight against wolves and bears, to help them in flood situations, etc. When we speak about this during parliamentary discussions, I say we don't have a normal program or plan on how to mitigate this, we only act with the results, not to mitigate or to prevent, only after something happens (...) We must do something to prevent it. We must adapt. We must understand where we are going. All these global questions are for all mankind, we must all work on them."</p>		
<p>"People living on the coast feel climate change. For example, the winters are very short and almost windless. Strong winds no longer reach the maximum level, as they did 10 years ago. The summers have become mild, the temperature has increased. The reservoirs of ice have changed in the autumn. (...) we can say that the permafrost is really melting and this can only worry the inhabitants of Tiksi. Something has to be done."</p>	<p>Student from Tiksi #3</p>	<p>20</p>
<p>"Yes, there are several conflicts. It is commonly known that where there it is legal to obtain (mammoth tusks) there is also illegal trade. And the point is that the tusks are going to China. It is the imperfection of the laws that regulate how to obtain these tusks. I hope for your next visit, everything will be clearer."</p>	<p>Guide from the Museum of the Mammoth</p>	<p>21</p>

(7) Samples identifying key potential stakeholders associated with the implementation of responses related to permafrost thaw and climate change impacts	Interviewee	Quote #
<p>"The influence of climate on the population is not an issue for the Ministry for Nature Protection. It thinks you should look at the research done by the Institute of Health. You should get in contact with the Ministry of International Relations of our region because it is in charge of the research related to health, ecology, life etc.."</p>	<p>Minister of Nature Protection</p>	<p>22</p>
<p>Now it is the Federal Authorities (responsible for fixing quotas and dates). It's very hard to change because they are for the whole Russian territory. They don't think that maybe each territory is different. And the procedure for changing this regulation is very hard, very bureaucratic. The spawning time for fish has changed and all the laws and directives regulated this, but now everything has changed and people can't do anything. And if they go to fish during the real spawning time, they might be considered illegal. We need to think about regional conditions. For example, three years ago, people raised the question of traps for wolves because you know wolf traps are banned, but now wolves have started to become an epidemic for us. This is a big challenge because every year they take 5 or 10 thousand reindeer from us. This question was only raised when we brought experts from the European Union to this Arctic area four years ago, and they prepared a special document to start treating this problem. However, you see that it is</p>	<p>Former representative of the Indigenous People in the Parliament</p>	<p>23</p>

not only a federal responsibility but also an international responsibility!"		
"Roads cannot be of very good quality because in spring or summer you can take very good roads but then, in winter they can be broken because winters are too cold. We need new methods but it is very expensive. And for me, honestly, the government doesn't pay attention to roads in Yakutia. As you know, our city is very small so I think that the government can try to create some new methods in our city"	Law student from Yakutsk	24
"I think the main actor must be the government: federal, local, regional government. They must implement special programs on how to mitigate the effects of this climate change or melting permafrost. But we must understand that all that I say is measured by the results. We must think how to prevent and how to support (people from Yakutia)."	Representative of the Institute for Humanitarian Research and Indigenous Issues	25
"I think that the industrialists will cope with the problems (of permafrost thaw) because they do all their business on the permafrost. In permafrost there is oil, natural resources, precious resources, the entire periodic table is there, and of course there are so many people interested in the Arctic in terms of business."	Seamstress	26
"Most people don't want to know about the conditions of permafrost. This is a topic for scientists."	Student from Tiksi #1	27

Table 7: sample quotes representative of the 7 central initial results that were identified: awareness of permafrost thaw (1) linking it to climate change and (2) not linking it to climate change; judgment on the (3) weak and (4) strong relevance of permafrost thaw; (5) expression of the threat to traditional activities represented by permafrost thaw; (6) need for further action; and (7) key stakeholders for implementing adaptive measures related to climate and permafrost

This cross-cutting analysis identified six overarching integrative categories ("a" to "f" below) (plus an extra one) and brought together the different concerns expressed during the interviews (see codes of the mental map). These were organized into thematic groups. A first general theme refers to "impacts" ("a" to "c" below). The stakeholders interviewed identified several negative impacts of permafrost thaw on the physical elements of their environment, including:

a) Impacts on natural resources: rivers, soils, mammoth tusks, flora, fauna, etc. They consider these to be closely related to the maintenance of their traditional occupations such as herding, fishing and hunting.

"It [permafrost] affects reindeer herders because before, we were moving along the coastline. Now the climate has changed, big bushes have appeared and it has become really hard to herd the deer. (...) Because the soil has changed, the lakes are disappearing, there are landslides, insects have appeared, polar bears have started to move around, everything has changed. The birds, the water, the nature, the soil and the weather of course. It appears that the weather affects many things, the routes taken by birds and animals have changed and there are also migrations, animal diseases." (quote #1, for more examples see sample quotes #3, 4, 7, 12, 13 in Table A2)

b) Impacts on infrastructure (roads, buildings and pipelines) which reduce the transportation possibilities of people, goods and supplies between different settlements/villages/towns in the Sakha Republic.

"Another challenge for our people is the catastrophic flooding observed in recent years. Why does this happen? Many reasons. More meltwater. More rain. Another reason: maybe because the deltas of these rivers now are not dug and that's why water can't flow. But hydrologists say that one of the main reasons for the new floods in the northern rivers is the amount of water which accumulates at the surface (more than 30%) due to melting permafrost. Then, it comes to the rivers and this is another challenge of permafrost melt." (quote #2, for more examples see sample quotes #5, 7 in Table A2)

"Permafrost badly affects our buildings and in summer, buildings that were built on permafrost are just going down when it melts and the movement is destroying the walls. In the Republic of Sakha, the technology should be special for building houses on permafrost and the materials must be of high quality. I would like to say for roads as well." (quote #8, for more examples see sample quotes #5, 7 in Table A2)

Interviewees also identified other non-material impacts that dignify their lives and livelihoods including health, mental well-being, identity and a sense of belonging:

c) Impacts on health and mental well-being, taking a holistic approach to health and its relationship to ecosystem integrity under climate change. Permafrost thaw has the double impact of reducing the ability to act (a) because of potential health-related physical weaknesses and (b) because of stress.

"...earlier, 2 or maybe 3 centuries ago, we had epidemics such as the black death. The people and the cattle were buried in some places but we don't know exactly where. Now the permafrost is melting and they (the dead bodies) are reappearing in the autumn or they come to the water, rivers, lakes. However, we don't have any diseases or epidemics in the Republic of Sakha yet, but the example of Yamal shows us that this is one of the big problems for us in the future." (quote #6, for more examples see sample quotes #2, 5, 11, 12, 13, 14, 15 in Table A2)

A second theme concerns issues related to collective action and refers to:

d) Knowledge-related issues: These refer, on the one hand, to how the new risk patterns affect their traditional knowledge systems and, on the other hand, to the need for scientific participation and research on permafrost thaw and climate change processes.

"...because the ground is moving, changing, that's why we have to change our migration routes. Sometimes we don't know what the best route is because everything has become unpredictable. Normally, we could predict the weather for one month, for seasons, years! Using these predictions, we could choose routes for more comfort. Now, we can't do it because we don't know what's happening. All of our traditional knowledge about the weather is being destroyed." (quote #16)

"Most people don't want to know about the conditions of permafrost. This is a topic for scientists." (quote #26; for more examples see sample quotes 1, 4, 8, 12, 13, 15, 16 in Table A2)

e) Governance needed: Multidimensional and multi-scale changes in the environment have created governance gaps that interviewees say need to be identified, treated and filled by authorities. More specifically, they emphasized the need for new, better adapted norms/regulations.

"...all our life is regulated by official laws, orders and other decrees, for example, the period of the year when we can catch fish. But these laws were for the past, now everything has changed and people are losing their harvest (...) And the procedure for changing this regulation is very

hard, very bureaucratic. The fish spawning time has changed and all the laws and directives regulated this but now everything has changed and people can't do anything. And if they go to fish during the real spawning time, this might be considered illegal (...) Three years ago, people raised the question of traps for wolves because wolf traps are banned, but now wolves are becoming an epidemic for us. This is a big challenge because every year they take 5–10 thousand reindeer from us" (quote #18 in Table A2)

f) An additional category, entitled "Opportunity", was included. Throughout the interviews, people expressed concern about the negative character of perceived changes while only one opportunity was identified: the commercial opportunities that an increase in the number of mammoth tusks, that sell at impressively high prices in the Asian markets, represents for local inhabitants. However, this is not entirely positive, as it was identified as an activity that goes against the traditional beliefs of the indigenous people. With this in mind, one representative of the people of the North said:

"In the minds of traditional Northern people, the mammoth is the God of the underworld. It was taboo to pick and collect its bones. We believe that if, for example, we take this bone or tusk, it opens the door to the underworld. And it will bring us many troubles. It is one of the strongest taboos in our culture. Sometimes, however, some people try to sell them (...) and now we see that collecting mammoth bones is one of the biggest businesses in the North and many people get involved in this business. I see big changes in our traditional life or traditional worldview, because it destroys our traditional beliefs and the connections between older and younger generations. I can say that we are losing our traditional ecological worldview because if you can pick the land and collect these bones, it means that you have stopped believing in our traditions. "

VII.C.I) On causality, values at risk and uncertainty

The causal statements associated with these multidimensional impacts were further analyzed while trying to stick closely to the respondents' stories of permafrost thaw. In doing so, five categories of operators linking permafrost thaw to its perceived origin and impacts were identified: "threatens," "is the cause of", "is associated with," "requires," and "is part of." "Threatens", "is part of" and "is the cause of" are unidirectional operators. "Associated with" and "requires" are bidirectional which is quite unusual for the latter. These relationships, as observed in the interviews, are mapped in Fig. 1.

Impacts are identified along causal chains which find their origin in permafrost thaw. A fine

distinction is made in our corpus between “is the cause of” and “threatens”. Actual observations are required to register the respondent's explicit causal statements (here associated with the “is the cause of” operator). These observations are expressed as verbs describing (undesired) impacts. A number of permafrost thaw risks have already been identified and their causal origin is, in the respondents' eyes, quite clear. These impacts and associated causal statements are erosion, floods and forced displacement; mammoth tusk poaching, cultural erosion; damage to pipelines and buildings; and changes in the migration routes of wild and domestic animals. The “threatens” operator refers to causal statements loaded with uncertainty associated with objects/values at risk, either directly or indirectly, including cemeteries, health, water quality, underground storage, infrastructures, hunting, reindeer herding, fishing, flora and fauna, and roads (see Fig. 1).

The “associated with” and “requires” bidirectional operators show that the respondents believe that the impacts of permafrost thaw are part of complex interrelated phenomena. Some of these could be expected, such as associating a threat to flora and fauna with a threat to reindeer herding. Some indicate a grasp of climate change and its specific place in the changes observed. For instance, climate change is jointly associated with permafrost thaw and the future. It also links a threat to cultural heritage (cemeteries) and health through potential diseases. The “requires” operator reflects a call to action in the respondents' narratives. Most of these solutions refer to some sort of collective action whether through state institutions, science, regulation or administrative responsibility.

Finally, the “is part of” operator captures causal statements where an initial impact on part of a greater ensemble has an impact on this greater ensemble. This operator is particularly important here as it captures multiple impacts in the form of threats to hunting, fishing and migratory routes that threaten the greater ensemble of local culture.

VII.C.II) Furthering the analysis of the “requires” operator - looking for risk-mitigation options through collective action

In order to cope with the new non-linear changes and impacts, respondents explicitly mention the need for action and identified the government and the scientific community as being responsible for developing adaptive measures on permafrost and climate change

“[...] we can say that the permafrost is really melting and this can only worry the inhabitants of Tiksi. Something has to be done.” (quote #20, for more examples see sample quotes #19, and 21 in Table A2)

"Roads cannot be of very good quality because in spring or summer, you can take very good roads but then, in winter they can be broken because the winters are too cold. We need new methods but it is very expensive. And for me, honestly, the government doesn't pay attention to roads in the Republic of Sakha. As you know, our city is very small so I think that the government can try to create some new methods in our city" (quote #24 for more examples see sample quotes #23, 25, 26 and 27 in Table A2)

They also mention the need to update the norms and laws, as, in some cases, they are no longer adapted to the current changing environment (see sample quote #17 above). Finally, they also highlight the importance of defining administrative responsibility for certain new resources resulting from changes to permafrost such as mammoth tusks, as they are being found more frequently. In this respect, a representative of the Melnikov Permafrost Institute said:

"In Yakutia now, there have been long discussions with Moscow and the central part of Russia concerning the status of the mammoth tusks. Is it a national resource or not? The issue is raised because all national resources are subject to a special law. They all belong to the central federation, not to the local governments. The Yakutsk Academy for Sciences has a Department of Mammoth Fauna that is working on these issues (...) It is very chaotic and unknown, but very important to make a point on the permafrost economy in coastal areas and climate impacts." From the analysis of this operator, it is possible to infer that collective action is essentially conceived as something that can only be achieved through the intervention of "superior external" actors. In this respect, the notion of agency could, a priori, be related to vertical and hierarchical relationships. This confirms some of the findings in Kennedy et al. (2018), including a case study from Sakha Republic. In this case study, agency, or the lack thereof, is identified as limiting local adaptation to climate change.

VII.C.III) Furthering the analysis of the "is part of" operator: when material impacts threaten culture

The unidirectional operator, "is part of", reflects how changes might lead to physical and material impacts but also represent a threat to cultural dimensions, including the three main traditional activities practiced in Sakha Republic: hunting, fishing and reindeer herding. These are not only economic activities but are also strongly linked to the identity and the worldviews of indigenous people.

"...because the ground is moving, changing, that's why we have to change our migration routes.

Sometimes we don't know what the best route is because everything has become unpredictable. Normally we could predict the weather for one month, for seasons, years! Using these predictions, we could choose routes for more comfort. Now we can't do it because we don't know what is happening. All of our traditional knowledge about the weather is being destroyed. You can say the same about each of our traditional occupations, fishing, hunting too. Not only infrastructure.” (excerpt of quote 16 in Table A2)

The increasingly unpredictable environmental and climatic conditions put these traditional occupations at risk of disappearance, and with it, the loss or degradation of their traditional knowledge and culture.

A deeper analysis of the elements mentioned by respondents appearing in the mental map also reveals an interconnection between the physical and the cultural dimensions

“We started to feel these (climatic) changes a very long time ago. In 1995, at a meeting of reindeer herders in the Itum Kalinsky region, we spoke about it. And we spoke about the need to change the migration routes of the reindeer herders because some changes have been observed. This is why the melting of permafrost has a major impact on our traditional lifestyle.” (excerpt of quote #19, see sample quotes #16 and 19 in Table A2)

More specifically, physical changes represent a threat to their culture. This is the case of forced displacements, the destruction of underground caves traditionally used by reindeer herders and hunters during migrations, the erosion of places of cultural value such as cemeteries, and the shorter duration of winter roads on which several communities depend to obtain goods and supplies.

VII.C.IV) What was learned in terms of permafrost thaw risk perception

As stated in the introduction and methodology sections, accessing perceptions was possible through the local residents' narratives, more specifically, by identifying different categories of claims: evidence claims, causal statements; salience claims; statements indicating what matters to the respondent; and normative claims, in the form of statements judging the moral dimensions of a risk issue (Touili et al., 2014; Vanderlinden et al., 2017).

Another major finding is that the causalities attributed to permafrost thaw and climate change in the interviewees' narratives are aligned with the scientific knowledge: climate change is causing annual and seasonal average temperatures changes (especially, warmer temperatures), it affects permafrost and in turn, affects things of interest to humans. This is an element that needs to be taken into consideration, especially when considering risk mitigation of permafrost

thaw: this could mean that there is no need for external knowledge-centered interventions as the respondents know in great detail what is going on.

Furthermore, our results indicate that their knowledge and associated causal statements go beyond simple linear causal relationships. Our respondents specify quite precisely the nature of the associations which we did not expect. The various operators that were identified indicate/reveal intervention points. For instance, the "threatens" or "requires" operators point to a quite precise intervention in the causal chain. Alternatively, the "is part of" operator points to larger scale interventions with multiple benefits. These results indicate the complementary nature of scientific knowledge (elucidating the nature of causalities) and layperson narratives (embedding these causalities in everyday observations). The complex fabric of life in a changing environment is better ascertained through local narration and may allow for better identification of salient issues. Individuals in the Sakha Republic perceive permafrost thaw within that context. They understand the many dimensions of what is involved. Their perceptions may inform scientists and policymakers alike.

The salience claims observed also inform us on the specifics of permafrost thaw and associated knowledge systems. Our respondents share the interest of scientists in infrastructure, biological and non-biological resources and associated economic dimensions (see introduction). Yet they also express interest in their culture, their minority status and their cultural reliance on a quite unique environment. When considering the current scientific interest in permafrost thaw (see introduction), there seems to be a discrepancy between what scientists find salient (material dimensions) and what our respondents find salient (a mix of material and non-material concerns). Again, this illustrates the importance of accessing local perceptions when considering risk issues associated with permafrost thaw. The complementarity of scientific knowledge and locals' perception includes improving the identification of what matters, to whom, and why.

Finally, our respondents' narratives include risk mitigation. This emphasizes the fact that when laypersons perceive permafrost thaw risks, they connect them to mitigation options. As our respondents appraise the risk situation, they simultaneously imagine potential permafrost thaw risk mitigation avenues. On this dimension, our respondents seem to hold quite a monolithic view: intervention should originate and be conducted from the outside world. This result allows us to ascertain a supplementary dimension of permafrost thaw risk perception analysis. Respondents' narratives refer not only to permafrost thaw, but also to who they are in the face

of permafrost thaw, and how they construe their ability to face the associated risks. This final result is of critical importance, as action will be needed, and these actions will call for local agency. Our results point to a genuine need for further research into the determinants of local agency in the Republic of Sakha.

VII.D) SYNTHESIS

Using a series of interviews and coding them thematically, how inhabitants of the Republic of Sakha describe their understanding of permafrost thaw and climate change was explored. During this process, key elements were uncovered, including a high level of awareness of permafrost thaw, a salient issue in the Republic of Sakha, and its impacts; an explicit understanding of the complex causal webs behind permafrost thaw; and the expressed need for potential mitigation strategies that seems to reflect an agency deficit and a reliance on external authorities.

Analysis of their narratives also demonstrated the intermeshing of ordinary life experiences, the interconnection of material and cultural impacts and the need to consider these simultaneously in order to understand precisely how permafrost thaw is affecting the Republic of Sakha. Ordinary life and everyday concerns, both practical and symbolic, from personal to local, regional and national levels are interconnected and, according to our respondents, should remain so. The material and cultural dimensions of permafrost thaw are two sides of a single coin and are strongly interrelated. The analysis of narratives demonstrated that, for locals, geo-physical processes triggered by changes in climate and permafrost undoubtedly transform the landscape and alter ecological patterns. But these transformations exceed the physical and material dimensions and exert supplementary pressure on northern culture. Physical degradation (manifested in different forms: such as thawing cemeteries, increased numbers of mammoth tusks appearing from the permafrost or forced displacements, among others) threatens their symbolic representations, the material practices and the emotional ties that they have developed with that specific land. For locals living in the North, their land is filled with memories, life experiences, and contributes to a site-specific way of interpreting and evaluating events. Forced restructuring of their cultural features caused by climate change and permafrost thaw might lead to temporary or irreversible internal fragmentation and socio-cultural rupture.

In this sense, one of the biggest challenges of conducting research in this part of Siberia is maintaining the interconnectedness in both material and cultural dimensions. This is even more

important as the results of this first fieldwork demonstrate that science is perceived by local residents as a central source of solutions to permafrost thaw and its associated impacts. Science-based solutions have legitimacy with our respondents. I argue that maintaining close association with material and cultural dimensions while conducting research and elaborating policies may help with their legitimacy. This is why translating these results into concrete public measures appears to be a necessity in the face of accelerated changes.

Our results successfully map out permafrost thaw and its impacts at a regional scale, using the narratives of people from different locations from the Republic of Sakha as an entry point. Furthering this analysis beyond the capital city would facilitate a much-needed finer analysis of the implications of permafrost thaw and climate change in smaller Arctic settlements. In this sense, during the fieldwork conducted in 2019 in Tiksi and Bykovsky, it was possible to delve into the local expressions of climate change and permafrost thaw in coastal settlements of the Bulunsky District. The detailed information provided by respondents permit the specific mechanisms to be reconstructed that affect their natural environment, their relationship with it, and the non-material dimensions of their lives and livelihoods.

Chapter VII aimed to introduce a first level of understanding of permafrost thaw and climate change in the Republic of Sakha. The qualitative analysis of the narratives gathered during the first fieldwork allowed the impacts of these processes to be addressed at a regional scale. This was facilitated by the fact that a wide variety of interviewees encountered were born and lived in different regions of the Republic of Sakha. Their multiple backgrounds and experiences undoubtedly enriched the level of understanding of the regional implications. Because of this, it was deemed necessary to obtain relevant local information in the settlements of Tiksi and Bykovsky and compare then to the results previously obtained in Yakutsk. Chapter VIII will reduce the scope of the analysis and will integrate the most outstanding elements that were present in local narratives about permafrost thaw and climate change.

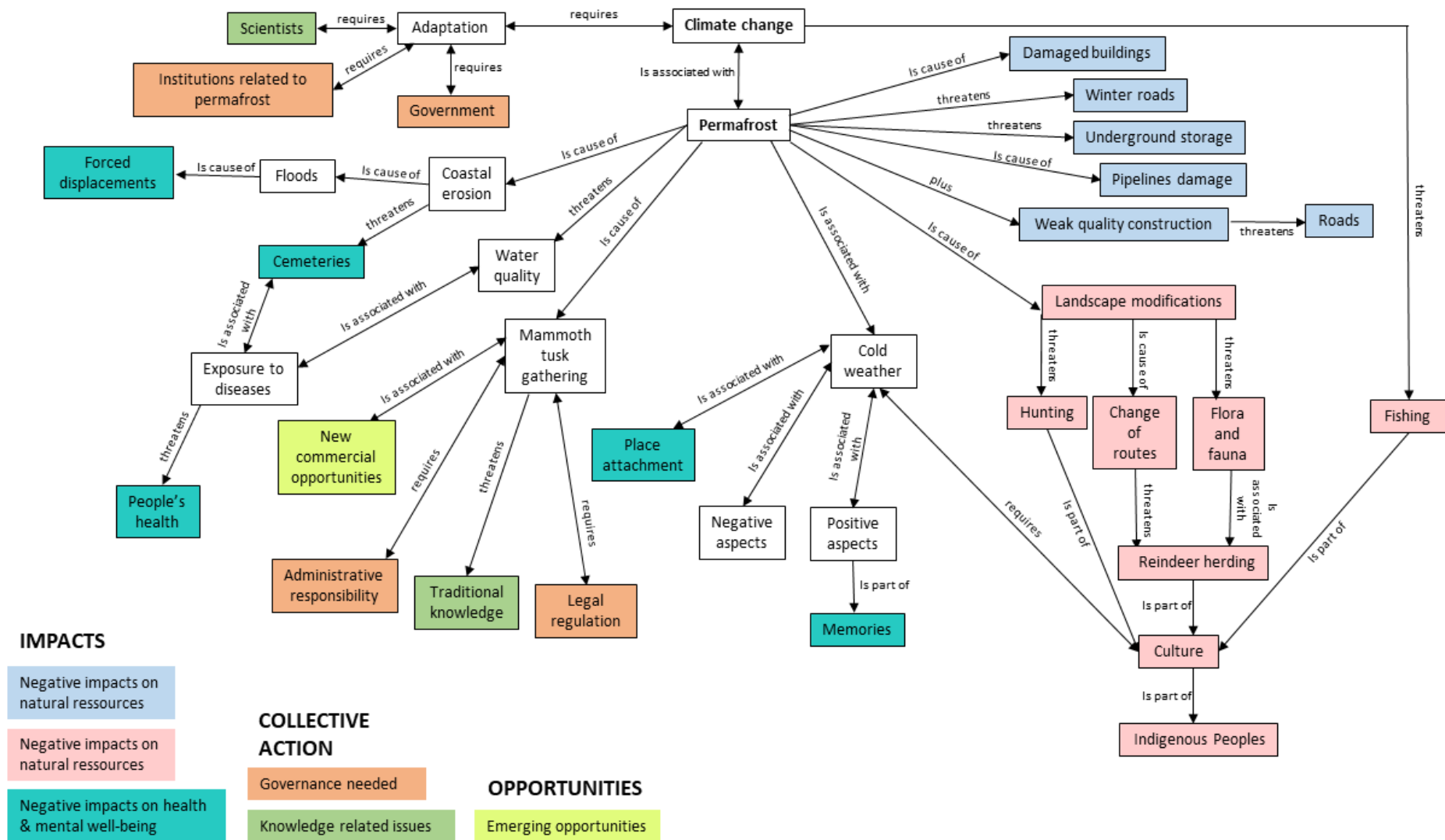


Figure 55: Mental map showing the relationship between the issues associated with permafrost thaw, organized along the 6 broad categories described in the text and using the operators also described in the text.

CHAPTER VIII: LOCAL RISK PERCEPTIONS IN THE RUSSIAN COASTAL SETTLEMENTS OF TIKSI & BYKOVSKY IN THE CONTEXT OF CLIMATE CHANGE AND PERMAFROST THAW

Following the first fieldwork in Yakutsk, which provided valuable insight into climate change and permafrost thaw at a regional scale, further information was sought on local impacts and concerns in the northern settlements of Tiksi and Bykovsky (Bulunsky District). Using the narratives of people living in Tiksi and Bykovsky as an entry point, this chapter presents the main aspects of their lives and livelihoods currently at risk due to rapid changes in their natural environment. These will be analyzed in the context of climate change and permafrost thaw. For this purpose, I first highlight the key elements that shape the way locals perceive their reality and describe them. I propose to then analyze the pre-existing and new social challenges that northern residents face in terms of culture and identity and their interplay with climate change and permafrost thaw. Finally, the main physical manifestations of changes in the natural environment, as perceived by locals, are briefly described. This chapter thus focuses on results that will be equally discussed in the following chapter.

VIII.A) LIFE IN NORTHERN SETTLEMENTS: PUTTING LOCAL UTTERANCES IN PERSPECTIVE

This chapter puts a special emphasis on local narratives. Although the main aim of the semi-direct interviews was to obtain a broader understanding of how residents from Tiksi and Bykovsky perceive changes related to climate change and permafrost thaw, the interviewees were given wide scope to talk about anything they considered relevant or important to them. The intention was to be open to how interviewees formulate concepts, describe relationships and attribute priorities to events and concerns. For this reason, and to better understand the local perception of events, I begin this chapter by describing some site-specificities that the inhabitants of Tiksi and Bykovsky consider when evaluating their current reality and describing their main concerns in face of simultaneous and multidimensional changes. It is important to highlight that Russian legislation, by definition, excludes Sakha people from the category of “small-numbered indigenous peoples”. However, local respondents did not refer to this exclusion directly. Therefore, the analysis of the impacts and extent of climate change and permafrost thaw was

undertaken at a community level. Moreover, the purpose of this research was to respect people's identities and how they perceive themselves. However, this does not imply neglecting the differentiated impacts and interpretations of each social groups. But these differences were considered and analyzed with the words enunciated by respondents.

Although the interviews focus on modifications caused by climate change and permafrost thaw, respondents highlighted other simultaneous threats to their culture, identity, and livelihoods. Although the plan was to impose a hierarchical order on information in this chapter, narratives revealed that challenges concerning culture, development and local economies are perceived as equally relevant and urgent for residents from northern settlements. It is therefore proposed to describe the main cultural and identity challenges highlighted by locals followed by an outline of the different manifestations of changes in nature. In most cases, interviewees referred to these changes while simultaneously describing how they – directly or indirectly- accentuated socio-cultural and economic threats in their communities. To understand the extent and implications of climate change and permafrost thaw on these Russian northern communities the natural and the socio-cultural dimensions need to be analysed simultaneously.

In local narratives, the word "change" was used to refer to a wide and complex series of multidimensional modifications occurring in their environment which create a feeling of uncertainty in the community. Changes are perceived and described through the lens of personal experiences as well as a socio-cultural evaluation. Life in northern settlements like Tiksi and Bykovsky is deeply influenced by their national and regional history and respondents often characterize and evaluate current changes in relation to the Soviet era. Also, a person's background strongly conditions the degree of contact between that person and the natural environment. People who practice traditional activities and spend longer periods of time in the nature are quicker to perceive transformations in the tundra. For example, an environmental inspector in Tiksi said that working in nature allows him to perceive changes more rapidly than his relatives who live in Yakutsk:

INTERVIEW 5 QUOTE 33-1 S: "Well, I already talked about that. About villages that begin to crumble, about animals. I personally saw it myself. My relatives cannot see this. They are sitting at home, and most of them are sitting there in Yakutsk (...) As I drive, they don't drive, they sit at

home. And sitting at home you will not feel this, unfortunately. It is necessary to ride, to see."

When identifying their principle challenges and concerns, respondents in Tiksi and Bykovsky are strongly influenced by historical processes, identity issues and shared visions of livability. In this sense, when discussing current quality of life, they rapidly referred to the past, suggesting that, for them, the past and the present co-exist. Although different significations may be attributed to the notion of "olden times", it was frequently used as a synonym for "Soviet Union times". In their narratives, especially for people from Tiksi, the word "nostalgia" was repeatedly used to describe how they feel about what this region used to be during Soviet times, but no longer is. Their attachment to this frame of reference reveals that the evaluation of their lives in the present is still deeply marked by the legacy of the Soviet Union. In other words, the present cannot be understood without taking local history into consideration.

In a local context where villages do not have health infrastructures, administrative services, or transport infrastructures connecting them with bigger cities (especially with Yakutsk), Tiksi is perceived as a prosperous center inside the Bulunsky District. In comparison with neighboring rural settlements, Tiksi is considered by villagers to provide better job opportunities, education and services. Nonetheless, living in Tiksi also presents challenges, especially in terms of housing situation which is complex and has deteriorated since the Soviet breakup. People abandoned apartments registered under their names and left to go to other regions in Russia or other countries (for example, Ukraine) to overcome the consequent crisis. Consequently, these apartments cannot be used, provoking, some people claim, an increase in apartment prices in Tiksi.

On the other hand, Bykovsky currently appears to be relatively more stable, as the Artel Artika (see chapter IV, page 147) continues its fishing activities and provides jobs to the majority of the men living there. Locals express a strong attachment to fishing activities and to the Artel which many claim are the two elements sustaining life in the settlement.

When asked about the current socio-economic situation, positivity seems to prevail over negativity, unlike in the recent past characterized by crisis. In fact, perestroika (meaning "reform" in Russian) appeared in local narratives as a tipping point for the economic crisis. Many respondents observe subtle signs of potential development in Tiksi. Development is seen as an

increase in the number of cargos coming to Tiksi, better salaries and bigger purchasing power, and more money being invested to repair infrastructure. One environmental protection inspector highlighted that fishermen are now able to hire “«хамначыт»” (“a person working for another person” in Sakha), as indicator of economic progress in the region. A man living in Tiksi said that people are gradually returning to the village, giving impetus to some trade development. Entrepreneurship is growing and more cultural events are organised in the settlements.

Another important element that shapes the way locals perceive, evaluate and describe changes is the way they appropriate and move within the territory which they consider as their “own place”. Mobility is an important part of the Sakha Republic population’s pace of living. It has allowed communities to adapt to harsh climate conditions, cope with unstable socio-economic conditions and has therefore shaped their sense of place. Mobility also plays a key role in “compensating for the shortfall of a wide range of goods and services, from clothing to health care and education” (Bolotova et al, 2017). Mobility was also shaped by historical processes which include forced replacement processes and sedentarization policies of nomadic groups in this region, especially during the Soviet era (Habeck, 2016). New settlements were created to develop specific economic activities (fishing, hunting, herding) and to distribute these products to the Russian territory. Another legacy of Soviet times is higher wages in Arctic Districts and earlier retirement (as one year of working experience counts for two in some professions). These benefits encouraged newcomers to settle in the North.

Nowadays, even for those who do not live a nomadic lifestyle, most aspects of daily life imply some degree of mobility. People experience short-term daily mobility (commuting to work - collective farms, herding, or going to visit relatives, for example); seasonal mobility (going fishing, hunting or traveling to obtain health assistance in bigger cities) and long-term mobility which turns into migration when people move to a new city for higher education or better job opportunities. Mobility within one family is quite common, with members from the same household living in close, yet different settlements. Daily trips to the countryside is also common among locals: going to the riverbank, campsites and the tundra for leisure activities. High local mobility is experienced at a regional scale (Bolotova, et al., 2017).

Interviews revealed that boundaries of “one’s own place” are flexible and vary among

respondents. Similarly, boundaries between their settlements and the natural environment became fuzzy in the narratives. In fact, an increase of locals' motility and mobility enlarges the mental notion of "here" that locals have. The concept of "motility" used here is defined by Vincent Kaufmann (Flamm & Kaufmann, 2006; Kaufmann et al, 2004) as: "the capacity of entities to be mobile in social and geographical space, or as the way in which entities access and appropriate the capacity for socio-spatial mobility according to their circumstances" (Kaufmann et al, 2004). Following this criteria, it was observed that "here" frequently meant "in the Bulunsky District" rather than "in our settlement". The most motile respondents even refer to a "here" that includes Yakutsk.

Similarly, various meanings and interpretations of the term "remote" appeared in local narratives. For example, some used it with negative connotations: as a measure of distance to Yakutsk (the capital city of Sakha Republic) or as a synonym for lack of development of infrastructure (crucial to maintain patterns of motility and mobility). For elders, remoteness might also be an inconvenient when medical assistance is required urgently:

INTERVIEW 33 QUOTE 17 K: "In the hospital, we do not have enough specialists. At the end of the year I got sick, I had a stroke. I was laying in the hospital. Sanaviation took me to Yakutsk through the blizzard. I am so grateful to the doctors that they saved me. And so there are not enough specialists at all. When we need to undergo an examination, we have to fly to Yakutsk again to be examined."

However, remoteness is not only seen as a form of "enclosure". For some, it is perceived as a positive attribute of the region, for example, for those who seek to preserve the wilderness of nature.

INTERVIEW 5 QUOTE 4-1 S: "Currently, it seems to me that the main thing is to preserve the pristine [nature], the diversity of the animal world. Protect them from the industrial influence and from tourism. We are now saved by our remoteness [inaccessibility and remoteness] a little knowledge of scientists and tourism. This saved us so far. But now there is a development and there is a danger in this. With development comes (an abrupt thought). Airports will increase, cargo flows, Moscow - everything will appear. The environment will be affected."

Mental construction by locals of space boundaries as well as their motility and mobility undoubtedly shape the way they characterize and attribute specific significance to events. In fact, locals perceive and describe changes as affecting larger territories than merely those formally bounded by Tiksi and Bykovsky. In continuity with this line of thought, the results of the analysis of local narratives on climate change and permafrost thaw are presented as a single broad spatial unit and not as two separate settlements. The only exception is the description of coastal erosion, as this topic was addressed differently by locals in the two communities. The different geophysical conditions of Tiksi and Bykovsky influence the magnitude of this process in each settlement.

VIII.A.I) Current cultural challenges

Several elements arise from local analysis of the current social situation and the main challenges experienced in northern settlements. First of all, it is important to highlight that most interviewees were not born in Tiksi or Bykovsky but in neighboring settlements (such as Taimylyr or Kyusyur); other districts (Ust-Aldansky district), other settlements from the Bulunsky District that have closed (like Sagastyr, ex-Soviet fishing settlement) and a minority from further territories such as Azerbaijan.

Also, the demographical compositions of Tiksi and Bykovsky differ. The former has more diversity of nationalities among its inhabitants (Russians being the most predominant ethnic group, followed by Yakuts, Evenki, Even and Ukrainians), while the latter is an Evenki settlement with a small proportion of Yakut, Even and Russian inhabitants (Russian Census, 2010).

Despite this variety of nationalities in both settlements, there is general agreement among locals on one of the main concerns: the “mental” switch of the younger generations that no longer adhere to the traditional lifestyle. They have lost their ties to traditional activities and knowledge, and therefore, the number of people engaged in these activities has dropped sharply in recent years, representing a threat to cultural preservation.

INTERVIEW 28 QUOTE 16-27 S: “They [the ancestors] were people who were in the nature, right? – and you are here in the settlement, you sit in the warmth. That is very different. Like this, for example, the reindeer herding disappeared in Taimylyr. The nomadic reindeer herders don’t have children: everybody went to the settlement, and they became inhabitants of settlements. Before,

when we were studying at school, we were studying with reindeer herder boys, boys who had reindeers. They were teasing us at school by lassoing us. They are skilled in it: while you were running, they could catch your leg with a lasso and dropping you to the ground. Catching your lower leg, for example. They were thinking of us as of the reindeers, now I realise. They have it in their blood. All these people died – people of the same age as me. Modern young people don't even want to go out. They might have something too. There's something in their minds. But everyone fell to the fish. They thought that the fish is easy; they say: "reindeer herding is difficult" – they don't want to be in the wilderness."

Accordingly, the average age of reindeer herders has increased to between 50 and 55 years (see interview 21 quote 5-6 appendix to chapter VIII). Young people are no longer attracted to animal herding, fishing or hunting. Despite local efforts to teach indigenous languages in schools and to incorporate indigenous festivities in the calendar, many are unwilling to continue traditional activities which are physically demanding but now have additional difficulties due to changes in the environment.

INTERVIEW 28 QUOTE 34-4 S: "Teachers are doing a good job: they started to teach their languages. Children started to speak Evenki, know the dances. The real [cultural] revitalization has happened. And more than this cannot be done – you cannot outpace it. You only have to follow this pace in order to not to lose it. By learning the language and so on."

Elders consider young people to be incapable of living as their ancestors did in the past. Some families for not immersing them in traditional activities from a young age (see interview 21 quote 6-8 appendix to chapter VIII).

Others believe that globalization and access to Internet triggered this "change of mind" (see interview 28 quote 16-3 below), and a move towards "modern" paradigms and non-traditional economic activities, such as tourism (see interview 5 quote 9-15 below).

INTERVIEW 28 QUOTE 16-3 S: "Modern weathermen are looking at the Internet. They only follow what Internet tells – they are unable to use their heads. We forgot the [methods] of our ancestors; you cannot say: "pretty much like this".

INTERVIEW 5 QUOTE 9-15 S: "People have already begun [to find out] that one can make money differently. For instance, a lot of private hotels appeared. When you were visiting [before] in Tiksi there were probably only 1-2 hotels? And now, wherever you spit, in every house, there are several hotels. People began to engage in tourism. But this tourism is so ... wild. they are chatting somewhere on the Internet and invite people (...) As you can see, people started somehow trying to do something, weasel their ways out. The influence of the Internet has greatly increased."

Notwithstanding, some others see that technology has the potential to attract youth to traditional crafts. For example, in the era of the telecommunications, when people are able to keep in touch with their families during trips, this could have a positive emotional impact and reduce the stress of seasonal trips (see interview 21 quote 5-9 appendix to chapter VIII). Also, affordable technology that allows reindeer to be followed via satellite could introduce positive changes for herding activities although it is still inaccessible for most locals.

In Bykovsky, the situation concerning traditional crafts is slightly different. The Artel "Kholkhoz Arktika" is still the main source of employment for locals and the entire community depends exclusively on fishing activities (see interview 27 quote 4-5 below). During the interviews, some elders referred to Artel as an active promoter of traditional activities in Bykovsky, as they hire (and therefore retain) young people in the settlement. However, because of its key role in the settlements, the socio-economic situation could easily deteriorate if the Artel undergoes a crisis or closes its doors.

INTERVIEW 27 QUOTE 4-5 Ya: "Here, it turns out, the main organization is the collective farm "Kolkhoz Arctic", where the bulk of the population is engaged in fishing. This is our village-forming enterprise. More than 200 people from our locality are employed there. It includes women and children, and men, and pensioners. And so, I believe that the most important thing here is traditional fishing."

A new, financially attractive economic activity has gained importance in Northern Yakutia: the gathering⁵⁴ of mammoth fossils (and other paleontological remains). More analysis is needed to understand the motivations and implications for people living from this activity as well as the

⁵⁴ In Russian legislation, this activity is referred to as "собирать остатки" – 'gather the remains'. This is why the people who practice this activity are called "gatherers" (rather than "hunters", "tuskers" or "poachers").

potential impacts on traditional crafts and worldviews. A short legal overview is presented in Box 8 below, to explain the rights and constraints in force for those exerting this activity.

BOX 8: Mammoth fossil gathering in the Republic of Sakha

Mammoth fossils – carcasses, bones, tusks etc. of Pleistocene mammals (mammoth, woolly rhinoceros, cave lion, horses, canines etc.) – are a special natural resource. Gathering of these is regulated by both Federal and Republican legislation concerning subsoil resources. The Federal Subsoil Law establishes that a license must be granted to gather mineralogical, paleontological and other geological collectible materials from the subsoil (issued by the Ministry of Industry and Geology of the Republic of Sakha for 3 to 5 years). However, if a license is not obtained, an employment contract (including a fixed-term employment contract for seasonal work) can be agreed with an entity or entrepreneur that already has a license. The legal gaps in the Federal Subsoil Law are regulated by the Republic of Sakha legislation on Subsoil Resources and “Regulations of use and disposition of special natural resource – fossil remains of mammoth fauna”. The regional government regulates licensing, trade, and the transportation of these fossils. Any other fossils (mammoth tusks or remains of mammoth fauna) that are not limited by Russian and the Republic of Sakha legislation, do not have a scientific or museum value. If they are not purchased by the Government of the Republic of Sakha or Russia, they can be used at the owner’s discretion. The government has a priority right of purchase of unique remains (e.g. exceptionally valuable tusks). In such cases, the gatherer gets remuneration for the piece. This activity is considered legal only if the following rules are respected:

- Possession of a license for gathering (Art. 6, 10.1, 11 of the Federal Subsoil Law)
- One license permits the gathering of only one sample (Order of the Ministry of Natural Resources of Russia No. 711)
- Mining or other special works (such as water-pumping) are not being conducted (Order of the Ministry of Natural Resources of Russia No. 711)
- Gathering is for research or educational purposes (Order of the Ministry of Natural Resources of Russia No. 711)

-The license holder has to annually submit reports on paleontological materials collected, in accordance with the conditions of the license (Art. 22 of the Federal Subsoil Law)

-Gathering is not in Specially Protected Natural Territories. (e.g. Natural Resource Reserve of Lena-Delta of the Bulunsky District) (Art. 9, 24, 28 Federal Law on "Specially Protected Natural Territories")

-If materials of scientific or cultural value are found, work must stop and a report must be made to the government (Art. 33 of the Federal Subsoil Law)

-The gathered valuable objects must not be damaged or their value decreased (Art. 243 Criminal Code of Russia)

-No damage or pollution of the environment (Federal Law on "Environmental Protection")

However, various legal violations occur easily among gatherers:

1) Not having a license; or having one but gathering pieces in a non-designated territory (Art. 7.3 of Administrative Code of Russia)

2) Using water pumps to obtain mammoth fauna, a violation of authorised conditions of water bodies (Art. 7.6 Administrative Code of Russia) or violating the water protection regime, which may lead to pollution or other harmful phenomena (Art. 8.13 Administrative Code of Russia)

3) Collecting mammoth fossils in protected natural territories (Art. 8.39 Administrative Code)

4) Practicing the activity in the border zone (100 km along the Arctic coastline and the Arctic Islands) without a formal permit (Art. 18.2 Administrative Code)

5) Carrying out entrepreneurial activity without formal registration or a mandatory license (Art. 171 Criminal Code of Russia)

6) Destruction or damage of objects of cultural value to the people (Art. 243 Criminal Code of Russia)

Despite this clear and well-defined legal framework, implementation of these rules is not always

straightforward. In fact, some points of the laws might pose some difficulties to gatherers during their activities, such as the “one license, one sample” rule. Knowing that mammoths most likely lived in large groups, as modern elephants do, when one sample is found, it is highly likely that there are more samples in the surrounding soils. If this gatherer has only one license but finds several carcasses or tusks, this person has to find someone else who has more licenses in order to declare these samples to authorities (as required by law). This particular case is considered and regulated by the law. But a similar situation arises when gatherers want to declare pieces gathered in non-designated territories. In this case, they need to find someone with a valid license for the territory where the gatherer found the sample which sometimes is challenging.

Media also play an important role in creating the image and crystalizing the myths around gatherers (See “The investigation of Eduard Petrov- Skeleton Island - Russia 24⁵⁵”). The broadcasting of documentaries or articles about tusk gatherers without providing detailed information might contribute to the negative perception that some inhabitants have about them. Sometimes, problems with illegality might have to do with what a trader does with the samples rather than the gatherer. In other cases, “illegality” in trading these pieces might have more to do with problems with filling in the forms or following the administrative steps rather than the nature or purpose of the action itself. Biased documentaries or news about tusk gatherers reinforce social stigmatization of this group of people in the Republic of Sakha. To avoid reinforcing social stigmas, it is essential to consider the multiplicity of factors at stake for tusk gatherers, as well as the consequences. There is a narrow line between legality and illegality and falling into the second category might have serious consequences for gatherers in terms of social condemnation.

Moreover, gathering remains and crafts-making have been practiced by indigenous people for centuries (although at a smaller scale). This activity was quite developed during the Empire era when indigenous people gathered fossils for explorers or scientific expeditions. These samples were then sent to Europe or around the world. Nowadays, some still do this, selling these remains, which represents a source of income for them. In addition, indigenous people (including small-numbered indigenous peoples) can gather these remains while conducting their traditional

⁵⁵ This documentary was financed and produced by a Federal OFFICIAL TV-Channel. Throughout the program, pejorative adjectives were used to refer to tusk gatherers: “bad people”, “criminals”, “contraband”, “illegal”, “greedy”, “alcoholics”. Following the release of this documentary, people in Yakutia organized a public protest. Among the protesters were tuskers, craftsmen, and others claiming the untrustworthiness of this documentary and affirming that their activities are totally legal.

economic activities in specific designated areas. Laws stipulate that they can do it to gain extra income, for the protection of their indigenous rights or to limit uncontrolled and illegal gathering in the hard-to-reach lands of the Republic of Sakha.

During the interviews conducted in Tiksi and Bykovsky, some respondents said that gathering mammoth fossils might represent a threat to indigenous peoples' culture and traditional lifestyle.

INTERVIEW 27 QUOTE 31-5 Ya: "Well, I think that this does not affect me personally in any way. But it affects the lifestyle of the northern people. Previously, mammoth bones were never mined. For the older generation, this is a very big sin - if you take something from the earth. You can get food, you can get furs, you can get berries. Because man and nature are interconnected: you give to nature and nature gives you. But the fact that the remains lie in the ground. buried. - The remains can not be touched according to our beliefs."

As previously mentioned in Chapter 7, the older generations in local communities see gathering carcasses buried under the soil as dangerous and an attack on their traditional beliefs. Shamanic worldviews of indigenous people from Siberia do not differentiate between human and nonhuman worlds (Brightman et al., 2012). Gathering the remains of mammoths is considered by some as opening the door connecting humans with the underworld and may bring misfortune to the family of the tusk gatherer. Even nowadays, gatherers try to reconcile with their traditions, and after gathering samples from the soil, undertake a ritual in which they apologize for disturbing a dead soul. In exchange for what they take, they leave jewelry made of valuable beads (as they use to do in the past). In ancient Sakha culture, jewelry had a high value because it was imported from China and was a sign of wealth. However, nowadays, this activity is a source of social conflict between generations – the elders trying to preserve their traditions and the youth trying to make ends meet and adapt to the socio-economic and environmental reality they live in. The context for both generations is not the same and presents different opportunities and challenges. In the past, living exclusively from traditional activities was possible and could satisfy the needs of an entire family. Nowadays, this is no longer the case. The decline in traditional economic activities is closely related to resources available from nature. Also, accelerated permafrost thaw means that paleontological remains appear with more frequency than before. There is now a fruitful and well developed international market for

mammoth fossils which replaced the market for elephant ivory after its trade was internationally banned in 1975. The simultaneous occurrence of these three main circumstances left locals more open to switching their principle economic activities. Many locals now see in this activity a source of extra income that may help them to improve their quality of life while maintaining their traditional activities and rights.

Some respondents expressed that official efforts to preserve traditional activities in the area are not sufficient. Policies are considered to be insufficient or too restrictive, and solely aim to reduce fishing and hunting quotas for locals. Fines for illegal fishing or hunting are also perceived as an extra limitation for these sectors. One respondent suggested that more indigenous students attending university would help to increase local human resources for the community in this sphere.

Finally, but not less importantly, the external pressures that traditional crafts are currently experiencing may cause cultural distress to people living from them. The alternative of moving to bigger settlements like Tiksi might be seen as a destruction of their lifestyle and, for many, adaptation may be impossible. They live in harmony with nature and cyclical seasonality, and thus, working in office jobs is impossible for them. This incompatibility in lifestyle reminds us of the irreversible consequences that the disappearance of traditional crafts would have for these people.

VIII.A.1.1) Places & culture faced with climate change and permafrost thaw

Conducting research in the Russian Arctic demonstrates that the perception and evaluation of climate change and permafrost thaw are intrinsically linked to territory and how people interact with it. In this sense, contextualizing the historical roots of the current mobility trends in Tiksi and Bykovsky and understanding how these shape the territories considered as “their places” and “here” by respondents is essential.

The fieldwork conducted in Yakutsk, Tiksi and Bykovsky demonstrated that northern residents experience places as “much more than a point in space... [it] takes in the meanings which people assign to that landscape through the processes of living in it” (Ryden, 1993, pp. 37–38). Closely associated with this interaction with and definition of place, it was possible to identify a similar trend in their definition of “here” in their narratives. “Here” (in Russian: “тут” or “здесь”) was

frequently used by respondents to encompass those places with which, through life experiences (including traditional activities, work, visiting relatives, leisure and historical events), they have established emotional and affective ties. Because of the wide diversity of experiences, "here" could be used to refer to zones outside the strictly administrative boundaries of these settlements. This was also the case for many residents from neighboring settlements. Often, this notion is used to refer to the Bulunsky District, rather than one particular settlement⁵⁶.

INTERVIEW 21 QUOTE 19-13 K: "(...) Because, for example, if a non-local doctor comes - he will leave in a couple of years. But the local one will stay here anyway, no matter if he is from Tiksi or Bykovsky, or Kyusyur; but he will stay here anyway (...)"

People whose lifestyle is associated with higher mobility used "here" in a broader sense, for example, to include the city of Yakutsk (which they mentioned visiting regularly for different purposes). On other occasions, it was used more broadly to distinguish between "the North" or "northern settlements" and southern districts/settlements/towns. This was often the case when describing the way of life in these settlements. This word often appeared in narratives to depict a feeling rather than a specific geographical place. This feeling refers to a particular way of life, moving from place to place, interacting with other inhabitants and with the surrounding environment. When interviewees use it as an antonym for other regions, it can be assumed that this meaning is against a specific background characterized by certain experiences and ways of understanding and interacting with the natural world, including social norms, traditions and worldviews. For example, "here" was often used to describe the experiences or feelings of respondents from the tundra. This included specific forms of knowledge gained through life experiences, including understanding how the natural world works and monitoring changes in the natural environment and climate trends, among others.

Another important element that appeared to conceptually outline the northern residents' feeling of "here" is their particular sense of mobility. Mobility has a cultural dimension for residents of the Republic of Sakha (Crate, 2013) and has been a key feature since the first inhabitants arrived in this area. Their strong reliance on hunting and nomadic herding required moving around the

⁵⁶ Tiemylyr, Kyusyur, Siktyakh, Namy, Naiba, Bykovsky, Tiksi, Ust-Olenyok (Ystannakh) and Sklad (Tumat) - they are the seven settlements from the Bulunsky District.

territory to the rhythm of the seasons. Mobility patterns in the Russian Arctic have also been shaped by official state policies. For example, during the Soviet Union, populations were resettled and relocated in order to achieve collectivization which led to deep cultural transformations and to the modification of customs and lifestyles. For example, children were sent to state boarding schools and indigenous peoples were sent to work in unfamiliar regions. Under these circumstances, they were hampered from practicing their traditional subsistence activities (Crate, 2013). This altered the previous social configuration, and separation from their homelands meant having to adopt new ways of interacting with their environment. The collapse of the Soviet Union also meant that people in rural areas became economically vulnerable and moved to the city (Argounova-Low, 2007). More recently, many northern cities and towns have been founded to exploit ephemeral resources. The mobility of people and goods was supported by the now popular commercial air service (Berman, 2013). During this period of territorial reconfiguration and technological progress, Yakutsk became the central hub of the Republic and remains so. Nowadays, mobility is the common denominator between different sectors of the Republic of Sakha population, including reindeer herders, hunters, fishermen, students and people who go to visit relatives in other settlements, or who travel to the city. Yakutsk is still the central hub and residents from northern settlements like Tiksi and Bykovsky often choose to move there to find better professional opportunities, education and better financial stability.

Similarly, remoteness and sparse settlement patterns in northern regions (Berman, 2013) like the Bulunsky District hold sway over local and regional forms of mobility. Remote regions are "distant from large, urban industrial and political centers, and they are sparsely settled. Most of them contain native or indigenous populations as well as non-native immigrants with a mix of traditional and Western institutions. Typically, they have limited market economies, and they are dependent on exports of natural resources, government transfers, and subsistence activities. The costs of doing business, both public and private, are high. Important decisions affecting these areas are made in distant metropolitan centers. These remote regions lack both political autonomy and economic self-sufficiency." (Huskey & Morehouse, 1992, p.129). In this sense, mobility should be seen as a concrete means for northern residents to develop their lives and livelihoods. But also as a means of avoiding the negative impacts of climate change, permafrost thaw or an adverse socio-economic milieu. Mobility trends in northern settlements and regions

should not be overlooked as they are at the core of Yakutian culture⁵⁷. Moreover, the direction of the population flows can either curb (as after the Soviet breakup) or stimulate the development of northern settlements.

Respondents from both settlements identified impacts of climate change and permafrost thaw that go beyond the formal administrative borders and need development policies and adaptive strategies originating in interregional efforts. This is particularly relevant for people whose lives and livelihoods depend on continuing to practice traditional activities like fishing or reindeer herding. This often means moving beyond the boundaries of one settlement (for example, Kyusyur). Traditional activities are extremely important to maintain Yakutian nutritional habits to which meat and fish are essential. Reindeer herders from the area mentioned their concern about unusual changes in wild reindeer migration routes, which inhibits their access to the animals and therefore, to meat.

INTERVIEW 2 QUOTE 68-1 A: "Well, to be exact, it (permafrost thaw) affects the migration of reindeer. There ... somewhere, a swamp appeared, for example. Swamping - where the depressions, holes are. Over there. (...) If there are no reindeers nearby, you have to drive further away. <inaudible> more expenses. So we have to spend a lot to hunt reindeer in other places."

Warmer temperatures have a negative impact on reindeer health, forcing them to move to higher and colder areas during particularly hot summers.

INTERVIEW 22 QUOTE 15-8 KK: "When it is too warm they (reindeer) feel bad. They can't breathe. The [skin] is not letting [the heat] out. Because their skin is all closed. So when it is too warm (...) If it is too warm... We have tall mountains, there is snow on top. There is snow, for example. So they go there to cool down, they lay down there – mostly young reindeer do so. And so little reindeer suffer from bronchopneumonia in summer. It happens. It is not something critical, but... If it is too warm, the morbidity will increase anyway."

⁵⁷ Culture is here interpreted as "what people think, what they do, and the material products and landscapes they produce; culture is shared, learned, symbolic, cross-generational, adaptive and integrated." (Salick & Ross, 2009).

Similarly, a resident from Bykovsky pointed out that changes in availability and distribution of fish severely affect their livelihoods.

INTERVIEW 25 QUOTE 4-9 K: "(...) During the last three years the collective farm (Arktika) cannot execute the plan - there is no fish. I think that last year the plan was executed but not fully. My son is going to work during the summer fishing. He says that the plan is smaller than last year. It is because it was not executed previously. Everything turns around fish here. We eat fish, we sell fish (...)"

A wide range of explanations for abnormalities in fish and reindeer behavior and distribution emerged from local narratives and reveal that further research on these topics is required to understand the resulting socio-economic hardship. This is why I suggest that adaptive strategies and policies remain geographically flexible to enable the identification and integration of symbolically and culturally meaningful places which are not necessarily within the administrative borders, but are undergoing equal effects of permafrost thaw and climate change. Reducing "unprotected areas" can reduce unwanted effects on fundamental ecological and social relationships that characterize livelihoods in this northern settlement where the population is highly dependent on and connected with their environment.

Understanding the particular mechanisms, social processes and relations that intervene in the physical and symbolical appropriation of their places by local inhabitants and the delimitation of what they feel as "here" could facilitate the just implementation of climate and development policies as well as local acceptability. Local-oriented decision-making frameworks that consider these non-material elements would represent a significant contribution to the technical assessments of the risks that climate change and permafrost thaw pose to their places and identity (Adger et al., 2011). The spatial extent and multidimensionality of these risks require efforts at multiple levels (settlements, districts, regions, national government) while engaging with multiple stakeholders simultaneously.

Knoz (2003) considers that climate is a "nested physical structure in places that may have a significant impact on functional as well as on psychological connotations of places". Within the context of accelerated climate changes, emotional ties, symbolic representations and material practices associated with places are under threat and their meanings could be re-structured. For

example, warmer temperatures in Tiksi and Bykovsky, where extreme cold is a constitutive element of local lives and livelihoods, could result in irreversible cultural and psychological consequences as well. Narratives demonstrate that climate strongly shapes the type of activities practiced in their places and that increasing temperatures are putting traditional activities (for example, winter-fishing or “Podledka” in Russian) and knowledge (how to maintain ice-cellars⁵⁸) at risk. The particular habits and skills that inhabitants developed in these places shape the way they conceive the natural world and how they insert themselves in it. New circumstances (for example, the appearance of polar bears near their hunting grounds) increase their feeling of uncertainty and alter the whole chain of interactions. This new environmental and climatic configuration can engender the articulation of new meanings (Adger et al., 2011).

The historical and political events (for example, memories from ancestors rooted in these territories, or how Bykovsky was established and settled) that form part of the culture and have forged the current specific social configuration, would also be at stake under the forced displacement scenario. By cross-linking information gathered in interviews, it is possible to affirm that climate change and the accelerated permafrost thaw now represent a concrete threat for several aspects of local identity.

The rate of bio-physical changes suggests that official efforts should not focus on keeping places the same, but instead on creating an institutional framework that identifies, protects, and capitalizes on the cultural specificities of the settlement, its productive practices and potential economic possibilities (Albagli, 2004) within the new spatial configuration. This is valid for both future scenarios, whether the population of Bykovsky stays on the peninsula or is forced to displace to the inner continent. Elaborating strategies and policies that ignore these elements may induce a symbolic and real loss of valued cultural places that actively reinforce local identity (Lacour, 1985).

VIII.A.II) Manifestations of changes in the natural environment

In local narratives, nature appears as a permanent juxtaposition of different aspects. Climate, permafrost, flora, fauna and landscape are in constant interaction with each other in a feedback loop. The real extent and severity of the impacts of the changes, as locals suggest in their

⁵⁸ In Russian “Ледники” (“permafrost-cellars” or “ice-cellars”).

narratives, must be interpreted in relationship with the other constitutive elements of that system. In various contexts, locals used permafrost and climate change as interchangeable terms. Similarly, when locals were asked to define permafrost in their own words, many automatically addressed the process of thawing.

VIII.A.2.1) Climate

Although the questions in the interviews referred to “changes in climate”, locals addressed the topic by describing modifications in seasonal weather. Changes in weather conditions were mentioned by inhabitants from both Tiksi and Bykovsky. They included variations in temperature, snow conditions, winds and the length of the seasons (reflected in the length of the navigation season). Most of the time, changes in each of these variables were described together. However, they were described and perceived slightly differently depending on the age, place of origin and activity of the interviewee and the season of the year at issue. Younger people frequently mentioned elders of their community as reliable sources of climatic judgement, as they lived there for longer periods of time and are therefore capable of distinguishing more changes in the environment.

Despite the potential economic benefits of longer navigation seasons for some settlements; locals perceive climate change as a negative influence on the local traditional lifestyle, mainly due to the accelerated thawing of permafrost and the changes in flora and fauna distribution, which in consequence, affect other important aspects of their lives and livelihoods.

VIII.A.2.1.1) Summer becoming warmer and longer

One of the main observations of respondents from Tiksi and Bykovsky is that the summers are longer and warmer.

INTERVIEW 13 QUOTE 66 SP: “(...) In the summer, it became warmer. It is visible that it is warmer. We even notice that the weather in Tiksi is also brighter. It used to be, it’s the most, somehow less ... The summer was shorter, and now it has become a little bit longer.”

INTERVIEW 19 QUOTE 9-2 K: “K: It has become warmer. Much more.”

INTERVIEW 21 QUOTE 2-2 KK: "We have some warming: before the warmth was not so long, not for a week. Just a couple of days, three or four days, that were like summer, with a nice weather, but now it's a week. It's lasting a little bit longer."

INTERVIEW 31 QUOTE 8-3 E: "Well, of course, if you consider the so called summer and autumn, they have become longer, then, probably, in general, it has become warmer."

One local man even associated this abnormal temperature increase with the increasing blood pressure problems that his mother and many other local inhabitants have recently experienced. A local woman pointed out that the weather in Tiksi and Yakutsk is now becoming more similar. Locals identified changes over relatively short periods of time: one of them mentioned observing more accentuated changes in summer average temperatures in recent years.

INTERVIEW 20 QUOTE 7-5 CA: "In summer, for example, when I arrived 7 years ago, it was +18, +22 degrees for 3-4 days maximum. The rest of the time it was like today, +10, +8°C. Now, especially in the last two years, I noticed that it can be around +20°C for a month."

Some others detailed that, before, warm days in summer never lasted more than 3 or 4 days in total. Now, this has changed and it can be unusually warm for almost one week. This change appeared to be noticeable through different manifestations: for example, through the fact that, unlike before, kids can swim in the sea when the weather is warm (see interview 25 quote 8-5 appendix to chapter VIII).

Other indicators of warmer weather are associated with daily life events. One local woman (interview 33 quote 20 appendix to chapter VIII) pointed out that when she was a student, snow arrived in September. Now, this only happens in October. Some locals rapidly associated warmer temperatures in summer with accelerated permafrost thawing and therefore "the earth is going under the water".

INTERVIEW 23 QUOTE 4-5 B: "It is getting warmer which is not bad (laughs) but there are some disadvantages. The disadvantages? Our permafrost is thawing. That means that the earth is going under the water. The advantage that we can make... a resort here in the future (laughs) To attract tourists here and develop some activities."

In some cases, the statement referring to warmer weather in summertime was accompanied by the statement "and winter is colder".

INTERVIEW 26 QUOTE 6-1 P: "Even our summer was warm [this year] - we have never had such a summer. In three months we used to see the heat for three days and that was all. The rest of the time it was cloudy, cold - something like that. And now for almost half a month in June it was hot. Yes. Summer is warmer and winter is colder."

INTERVIEW 27 QUOTE 6-6 Y: "Summer is warmer, and winter is colder."

VIII.A.2.1.2) Winter becoming colder

Respondents from both Tiksi and Bykovsky mentioned that winter is becoming colder. It is manifested in lower average winter temperatures, stronger and longer blizzards and more days of extreme cold (called "frost" by locals).

INTERVIEW 12 QUOTE 11-4 D: In winter, for example, it's very windy and there is a frost. Earlier, there were only winds. Frosts were not so strong. And nowadays, they are very strong! Both frost and wind - it is impossible to get out. "

INTERVIEW 27 QUOTE 11-7 Y: "Winters have become very cold with a strong wind. The average temperature in winter used to be somewhere around -25/-30°C. And now it reaches the maximum of as much as -45°C, it happened up to 50°C!"

INTERVIEW 29 QUOTE 30-6 "E: The frosts started to be stronger. It was windier and warmer before. That's what they say. Winter became colder. It was warmer before."

Inhabitants from Tiksi pointed out that colder winters negatively affect their lifestyle and celebrations. It becomes hard for them to go out under these weather conditions. For example, last year, due to an unusual one-week blizzard and extremely cold weather, locals from villages and Tiksi could not gather at the Aikhal Club to celebrate New Year, as they usually do. This was the first time it occurred. Colder winters are also perceived through the necessity to wear warmer clothes than before for the same season. For example, locals mentioned having to wear "unty" which are knee-high fur shoes made of reindeer's fur. Colder temperatures became an adaptive challenge for locals, especially for the older people. Another change is with blizzards: before, they

occurred only when temperatures were between -10 and -15°C but now, locals (see interview 20 quote 2-5 appendix to chapter VIII) consider that temperatures are much lower, as low as -45°C or even -50°C, and are also accompanied by blizzards. Before, average minimal winter temperatures were never below -20/-25°C. Now, they can easily reach -30/-35°C. Locals also turned to childhood memories to compare weather conditions. One local woman from Bykovsky (see interview 26 quote 4-1 appendix to chapter VIII) said that as a child she used to play in the snowstorms during winter and it was warm. But now it is unbearably cold and she is afraid to go outside. According to the older people, blizzards used to last longer but brought with them mild temperatures (see interview 25 quote 4-17 appendix to chapter VIII). They also believe that it was snowier before. Once again, Yakutsk appears in the local narratives as a point of reference. One local said that now it can be as cold as in Yakutsk.

INTERVIEW 21 QUOTE 7-2 KK: "(...) As for the cold: it became somehow very cold during the snowstorm. It used to be a little warmer, but now it's as frosty as in Yakutsk. [It was] warm! When the wind blew, and there was a blizzard outside, it was warm. You went outside, and it was not so cold. Now, it became colder in winter: the frost is like in Yakutsk."

VIII.A.2.1.3) Changes in snow & lower average winter temperatures

Most interviewees agreed that in recent years, there has been a sharp reduction in the amount of snowfall. They affirmed that before it was snowier.

INTERVIEW 21 QUOTE 13-20 KK: "Yes. The amount of precipitations (changed). It used to be snowier. We could have snow up to our throats."

A worker from the Port of Tiksi (see interview 20 quote 2-7 appendix to chapter VIII) added that last winter's minimal temperatures were lower than they used to be in the past. Locals also perceive this reduction in snowfall through the possibility of reaching more remote places in the taiga (such as their hunting grounds) by car that before were inaccessible (see interview 22 quote 5-2 appendix to chapter VIII).

The direction of the major winds appeared to be another relevant element for northern settlements as it is also related to snow. Locals mentioned that wind direction was taken into consideration in order to strategically place buildings and houses inside the settlements. They

now consider that the prevailing wind direction has changed and consequently, snowdrifts are accumulating differently. The major winds used to have a south-westerly direction, and now north-westerly and westerly winds have been identified. Westerly winds are considered to be warmer as they blow from the land. They also said that in the past blizzards brought warm days. Now blizzards are accompanied by unusually low temperatures.

INTERVIEW 24 QUOTE 7-8 K: "I think it is changing. If you look at the village you will see that all the houses are oriented in the same direction. It is because of blizzards winds from south – west in winter. They blow from Tiksi's side, so the houses are built like this not to be driven with snow. We have been observing north-westerly and westerly winds recently. We can see that snowdrifts are not in the same places as they used to be (...) Western wind is warmer, it blows from the land."

Closely related to the previous point (VIII.A.3.1.2) the majority of interviewees declared having observed simultaneous changes in precipitations (especially in the form of snow) and a decrease in average winter temperatures. Some locals mentioned that autumn snow-cover forms later than before. In fact, first autumn snows no longer accumulate on the surface as they melt immediately after falling. In the beginning of September (around the 10th according to one inhabitant), the first autumn snows already lay on the ground. Now, at this time of year, snow falls and melts directly. Therefore, snow cover persists slightly later in the autumn (see interview 7 quote 60 appendix to chapter VIII).

A reduction in the amount of snow might influence the soil by reducing its temperature. Layers of ice-crust from thawing snow can form if there are sharp temperatures fluctuations: for example, if during the day, the sun melts the surface layer and during the night, the cold temperatures refreeze it again. In this case, the pasture will be covered by a hard crust of ice which is dangerous for reindeer and horses as they cannot graze lichens and they can injure their hooves. One man living in Tiksi narrated that an event of this type happened in the district, affecting a large herd of horses who could not get food due to the hard ice-crust on the ground (see interview 21 quote 14-2 appendix to chapter VIII).

VIII.A.2.1.4) Earlier opening & later closing of the navigation season

Longer autumns (leading to a later freeze-up of water bodies and therefore a later closing of the

navigation season) and shorter winters (associated with accelerated sea ice melting and earlier opening of the navigation season) are two sides of the same coin: manifestations of warmer weather.

These phenomena have economic and cultural impacts in northern (and more specifically, remote) settlements. As detailed in previous sections, the supply and distribution of food and basic necessities is season-dependent and therefore, any change in the length and distribution of the seasons might provoke delays. One respondent living in Tiksi mentioned that winter roads have been opening later in the past three years, hence there were delays in receiving fresh products from other regions. The delay in the freeze-up of rivers and lakes also impacts on traditional crafts. Locals perceive it as a risk for fishermen who practice "Podledka" (winter-fishing from underneath the ice followed by immediately freezing the fish). The ice which is not completely frozen can lead to severe accidents in areas where fishermen usually go (see interview 22 quote 7-4 appendix to chapter VIII). This respondent narrated having experienced five different dangerous episodes related to incomplete frozen ice. Respondents pointed out that "shuga" (a floating fragile ice that appears before the surface water freezes completely) used to appear in the end of September or first days of October in the past (see interview 25 quote 8-1 appendix to chapter VIII). Now, however, it only appears in mid-October or even in November (see interview 26 quote 8-4 appendix to chapter VIII). As a result, fishermen miss the moment of the year when the largest amount of fish migrates upstream to spawn. Although there are a few fish in the river in wintertime, autumn remains the season when most fish are caught. Longer autumns are also reflected in the fact that ships can now navigate for longer periods of time (see interview 31 quote 6-4 appendix to chapter VIII).

One respondent added that some fish, like Siberian Vendace (*Coregonus sardinella*), can act as an indicator to predict if the freeze-up will be earlier or later that year as this fish prefers lower water temperatures. If a local goes fishing and catches one of these, he knows that the water temperature is low and will therefore freeze soon.

On the other hand, locals agreed on the fact that navigation season also opens earlier. For example, one worker in the seaport of Tiksi estimated that the beginning of the navigation period in the bay of Tiksi has changed. As mentioned by a local man, this increases the total number of

days that ships can navigate and distribute merchandise.

INTERVIEW 20 QUOTE 2-10 Ch: "Last winter [in Tiksi], there was less snow, but more frost. And thus, if earlier we were starting the navigation in the bay of Tiksi around the 20th of July, now we begin on the 10-15 July."

VIII.A.2.1.5) Cyclical changes

Three respondents mentioned believing in the cyclicity of changes in climate. When asked about possible manifestations of changes in climate or permafrost, they either minimize the evidence of such changes (see interview 28 quote 12-2 below), or they mention differences compared with previous years, but downplay their impacts as they believe them to be part of a broader natural cyclic process (see interview 14 quote 54 appendix to chapter VIII).

INTERVIEW 28 QUOTE 12-2 S: "No. The climate is not changing. Anyway, in a hundred years this will repeat. It's a cyclic process – it always comes back. Nature is defending itself. Therefore, when they say "global warming" – it's a lie. Nature regulates itself. But (got interrupted) (...) After a hundred years, after 150 years, something occurs in any way. The warming will come, likewise the cooling will come too – there're such periods indeed."

This is somehow perceived as a scientific explanation to the observed changes and could diminish community stress associated with the "lack of control" over wider changes in their environment.

INTERVIEW 31 QUOTE 38-3 E: "Well, here it is. It is believed that the climate is cyclically changing. So now it's warming, then again the period of cooling will come. There is such a theory. Imagine it also exists here: it was voiced at the scientific-practical conference of schoolchildren (they did the work). They studied the temperature from here, in the village of Tiksi, they began measuring. And, it seems, such a tendency does exist - cyclicity."

Although this was not explicitly formulated in local narratives, the relief associated with being able to understand nature's behavior through causal statements could also influence their plans for the future.

VIII.A.2.1.6) No changes

Only three respondents explicitly denied observing remarkable changes in climate (see interview 8 quote 50 appendix to chapter VIII; interview 24 quote 7-2 below) or permafrost in these settlements (see interview 28 quote 24-1 below). After being asked if climate change could create new risks, this respondent ironized that the only threat would be to have a tsunami wash everything away. An interesting element is that right after saying that he does not perceive any change, the respondent from interview 24 described changes in winds and acceleration of coastal erosion (see interview 24 quote 7-28 appendix to chapter VIII). Similarly, the respondent from interview 8, said he did not observe any climate change but went on to describe in great detail the changes in snow occurring in the local mountains, a phenomenon that, according to him, has never happened before.

INTERVIEW 24 QUOTE 7-2 K: "Climate change? We don't see lots of changes here in the North. Maybe it is more noticeable in the central parts. I think it is all the same here. Winter starts in September and it finishes in June. There are just two months of summer. We don't see any dramatic changes actually.

INTERVIEW 28 QUOTE 24-1 S: "What could happen? – Nothing will happen. What sort of threat can happen? – only if a big tsunami will wash it all away (both laugh). Otherwise, it will all stand as it is. It was standing for many centuries, millions of years. It [the peninsula] will get smaller of course. It will keep getting smaller like this."

VIII.A.2.2) Permafrost

Addressing changes in permafrost conditions introduced a broad diversity of other simultaneous physical processes that locals describe with great precision. In the first interview stage, I aimed to identify the meaning and mental representations used by locals for the concept of "permafrost thaw". Several different associations and forms appeared in the narratives. Some of the respondents referred to it as a synonym for ice, or icy ground (see interview 7 quote 79; interview 8 quote 62; interview 17 quote 5-11 appendix to chapter VIII). For example: "It (permafrost) is underground, it is impossible to dig there - pits, all that. Permafrost is not particularly visible from outside."

Other respondents automatically referred to the process of permafrost thawing and associated geophysical processes taking place (see interview 19 quote 11-2 below).

INTERVIEW 19 QUOTE 11-2 K: “Well ... Frozen soil, which is permafrost, thaws and, in principle, it is quite badly affected. And in the future, if it continues [at such a pace], will still be there our buildings that stand on permafrost? Here are such questions. I think Bykovskiy and Taimylir (are affected by this). Well, Hara-Ulah, I think so. Because it is also in such a zone. In Kyusyur is not particularly noticeable. Well, and ... let's say, in Borogon. There, too, the banks collapse due to thawing.”

One man living in Tiksi pointed out that as the coastline thaws and new gullies appear, lakes can end up discharging their water into the new sinkholes that appear. Similarly, lakes can also join rivers if the erosion is deep enough into the land (see interview 17 quote 6-3 below).

INTERVIEW 17 QUOTE 6-3 T: “The coastline thaws, there is less and less ground. New gullies appear. Later, maybe some lakes will move into the sinkholes, that appear. For example, the delta of Lena is very branched, and there are many lakes on the islands. If the coastline continuously collapses, collapses far enough into the land, the lake will join the river. For example, at the beginning, a big cavity [might form]. Also, the swamp might form; many-many years will pass until it will form and silt up. Thus, the discomfort will happen there too, for example, for animals.”

Another immediately highlighted the negative impact that permafrost thaw has on different northern settlements situated close to Tiksi and Bykovsky.

Some inhabitants related permafrost thawing to changes in weather (more specifically, warmer temperatures): coasts are thawing and collapsing every year (see interview 17 quote 5-2 & interview 21 quote 8-3 appendix to chapter VIII). A woman living in Tiksi said: “The permafrost thaw. I already watched the science-movies about thawing ground ice. I watched and I think that the thawing of ground-ice affects it, the global warming. In other words, the warming affects the ground-ice.” (see interview 18 quote 5-2 appendix to chapter VIII)

One interviewee exposed permafrost thaw as a process that can be balanced naturally.

INTERVIEW 17 QUOTE 10-2 T: “(...) In order to stop the thawing, you have to freeze it. Only then

the thawing will stop. But if it stays in the same [level] (even if there's much thawing, and it remains at the same level), this thawing will continue. But maybe if the increase of temperature it will be externally stopped – maybe it will stabilize. In the nature it happens like this. For example, you hacked through the ice, made an ice-hole, then you left; it will close up. Concerning the close-up of the ice-hole. If you make an analogy with thawing: when the warming will stop, maybe it [the permafrost thaw] will close-up too."

Another small groups of respondents seemed to dismiss their capacity to judge or define permafrost, due to the fact that they are not scientists and do not conduct scientific research (see interview 24 quote 12-1; interview 20 quote 9-2 appendix to chapter VIII). This is how some locals confronted these two forms of knowledge which have an impact on the way each of them conceives processes and experiences associated with climate change and/or permafrost thaw.

Some people formulated broader and more generic statements to describe the extent of the process itself. Words such as "everything" and "all" were central to this type of statements. For example, one resident from Bykovsky said "Everything is thawing and falling apart. It can destroy all the Bulunsky District" (see interview 29 quote 58-2 appendix to chapter VIII). This was similar to another group of respondents who directly referred to the consequences of permafrost thaw. Projections for the future include apocalyptic scenarios where the word "disappear" was used repeatedly: "If it goes fast [permafrost thaw] the village will disappear." (see interview 24 quote 15-1 & interview 29 quote 26-1 appendix to chapter VIII) or "(...) and, again, if all the ground falls with us, everything - the settlements will disappear." (see interview 5 quote 6-17 appendix to chapter VIII).

The individual mental construction and explicit discursive formulation may differ between locals according to their personal experiences and frame of reference. However, the totality of the respondents - even those who explicitly deny knowing what permafrost is and those who said that scientific observations are required to identify permafrost - managed to discuss in detail the processes and diverse spheres that are directly or indirectly concerned by changes in permafrost. Locals also emphasized that permafrost thaw varies according to the geographical area. They mentioned that settlements built on permafrost (such as Kyusyur, Borogon, Naiba, and Bykovsky) have been feeling more intensely the impacts of thawing processes – such as coastal erosion (see

interview 5 quote 6-2 below & interview 18 quote 5-2 appendix to chapter VIII).

INTERVIEW 5 QUOTE 6-2 S: “We have permafrost everywhere. And the settlements are built on permafrost: Kyusyur, Borogon, Bykovskiy. Siktyakh is less prone to this. Hara-Ulah is also concerned. Here are 4 settlements - they are built on permafrost, and they are under. [the influence of permafrost thaw] Well, in short, the permafrost disappears, thaws. The shores begin to collapse. In Kyusyur, the process has also begun very strongly in recent years. In Bykovskiy - there is already half the village left. Nonsense at all. In Khara-Ulaha (Naiba), too, such disasters are already happening. And of the people who lived in Khara-Ulakh, basically, left (due to) difficulty [inaccessibility and remoteness]. It’s hard to deliver goods there.”

For this reason, people living in Naiba moved out. Accelerated geophysical processes, in addition to the remoteness make it even harder to deliver goods and live in such settlements. In contrast, Tiksi is presented as a settlement which stands on rocky ground and therefore, is not subject to permafrost thaw (see interview 1 quote 180 appendix to chapter VIII).

VIII.A.2.2.1) Coastal erosion

Coastal erosion and the collapse of the banks were two frequently mentioned processes associated with permafrost thaw, regardless of the place of origin of the interviewee. This is occurring at a rapid pace on the banks of the Delta River (see interview 17 quote 5-2 below). It is affecting different settlements in the Bulunsky district, especially those built on ice-rich permafrost. However, Bykovsky was often mentioned in local narratives as one of the most extreme cases in the district. For Bykovsky’s inhabitants, this was one of the most extensively developed topics and was identified as the main current concern as this will shape the future of the families living in the peninsula.

INTERVIEW 17 QUOTE 5-2 T: “T: Since I am living here (Tiksi) constantly, I have an opportunity to observe. In the recent years a lot has changed towards the warming. Very much: the coasts are falling, eroding. In 2016 I was travelling around the Lena Delta, there are no rocks, everything is on the permafrost. There are a lot of places where the coast collapses every year. Even here, right here (shows), if you go there you will see that every year it is collapsing: 1-1.5 meters. It is being washed away and thawing.”

In Tiksi, permafrost thaw and coastal erosion appear to be quite different because of its geomorphological conditions. Although these processes are also taking place in Tiksi, they seem to occur at a slower pace and the consequences are less visible than in Bykovsky.

A resident from Bykovsky (see interview 24 quote 22-1 appendix to chapter VIII) pointed out that the impacts of permafrost thaw on Tiksi's port are insignificant due to the fact that it is on rocky ground and only a few ships circulate annually on these waters. Therefore, economic losses would be negligible. However, he considered that permafrost thaw severely affects the land strips of the aerodrome as holes and swamps appearing require increasing technical maintenance. He also mentioned that unlike Tiksi 1, the airport is located in lowlands and if serious thawing took place, a landslide might occur.

Other explanations were expressed by locals. A worker from the port (see interview 20 quote 12-2 below) observed some degree of coastal erosion in Tiksi, but did not link it to climate change. Instead, he associated coastal erosion with precipitations (snow) that fill the rivers in spring and consequently wash away the banks.

INTERVIEW 20 QUOTE 12-2 CA: "Here, at ours, there's an ongoing erosion of banks, but I don't think it's related to global warming. It's because there's much snow – the river fills-up in the spring and washes away the bank. Why do I suppose that it's not due to global warming? – because it is being washed away when the ground is not thawing yet, and the snow is still lying, and it's cold. When there's much snow, the streams fill-up with water."

On the other hand, inhabitants from Bykovsky agree that coastal erosion is happening on the Peninsula at a fast pace and that this requires urgent treatment by authorities. Coastal erosion is associated with permafrost thawing and the influence of waves. Locals mentioned that waves exert pressure from the north and the east, especially in the "isthmus" that unites the cape to the continent. For this reason, some interviewees even stipulated that the peninsula might eventually be cut off and become an island in the future. Only one local interviewee (see interview 28 quote 12-1 appendix to chapter VIII) claimed to not have observed major changes in climate or permafrost and considers that everything is happening as it should, as he considers permafrost

thaw and changes in climates to be natural and cyclical processes.

The main challenge posed by accelerated coastal erosion is the possibility of forced displacement, which opens up different questions and reactions within the community. Firstly, because moving the settlement to a nearby area no longer seems feasible as erosion is occurring on every side of the cape and the entire peninsula is dealing with erosive processes. When a member of the team asked people living in Bykovsky about the possibility of moving the settlement further away, for example, to the start of the peninsula (near the continent), one man said that there are swamps in that area. Therefore, they would have to move very far away, beyond the landfill and swamps, more than 15 km from where they are now. Locals expressed the need for financial support from authorities to execute such a plan. However, locals do not think about moving the settlement as something immediate, but as something that will occur in 30 years or more. When enumerating the challenges that forced displacement would imply for locals, different manifestations of affective ties to this place and their lifestyle appeared in the local narratives. The constitutive elements of the reality they live in are seen, in the eyes of the people concerned, as unique and irreplaceable. Some respondents (see interview 25 quote 18-1 below) showed explicit discontent about this possibility:

INTERVIEW 25 QUOTE 18-1 K: “Of course it is not ok for us [to be replaced]. Here, we have our houses, facilities, farm units, ice-cellars. It is difficult to move all this stuff. Everyone has his own ice-cellar. This is not a catastrophe, but it is a dramatic change of daily life here.”

One of the most visible manifestations of coastal erosion in Bykovsky is the erosion of and damage to the two local cemeteries. One is situated on the west side of the peninsula facing the Laptev Sea, while the other is on the east side of the cape. In both cases, the soil is thawing and cemeteries are being eroded resulting in the appearance of coffins on the surface (see interview 23 quote 4 below; interview 24 quote 7-18 appendix to chapter VIII).

INTERVIEW 23 QUOTE 4 B: “The coast is falling off. The same thing is happening to the cemetery over there (...) There are bodies and coffins there (...) Yes, this is a real threat. If we don’t do anything now to reinforce the shore it can turn out really badly. There was a lighthouse over there – it is bending now. There are some new houses over there. If the lighthouse has already bent, it means that it can fall next year.”

Some locals affirm that about 10 meters of the coastline have been eroded in recent years. According to one respondent (see interview 25 quote 16-3 appendix to chapter VIII), it might take between 5 to 10 years for erosion to reach their houses. It is believed that in the past, Yakuts buried their relatives near the coast where they had a good view. Another version was described by a district authority who mentioned that, in the 17th century, if a Cossack killed someone then he would be buried right under the grave of the person he had killed. Therefore, when transferring graves, it is now possible to find up to three layers of graves. Despite efforts to find a solution to coffins appearing on the shoreline, locals encounter several difficulties. For example, a man living in Bykovsky (see interview 27 quote 39-1 appendix to chapter VIII) said that for two years in a row, the government designated 300 thousand rubles to collect the bodies, bury them in a mass grave and burn the old coffins. The wood is in a condition that makes them almost impossible to burn so they had to make a large bonfire for the old coffins.

Understanding the impacts of accelerated coastal erosion by local inhabitants involves paying attention to several elements concurrently. Firstly, Bykovsky was established as a fishing settlement and the majority of its population depend on this activity. Secondly, the local population is predominantly indigenous: Evenki, Even and Yakut. It is important to consider how cultural dimensions may be affected by erosion. One local man described the cultural challenge of how to handle and treat the remains of their ancestors and the wooden coffins appearing in the shoreline due to coastal erosion. According to traditional beliefs, young people should not touch the bodies and only the eldest people in the population can bury the dead. The idea is that this protects the youth in case of contagion.

INTERVIEW 27 QUOTE 37-3 Ya: "(...) no one dares to remove them because, according to our traditional beliefs, young people should not touch these human remains. They can be buried only by the elders, the oldest inhabitants. We can say that, on the one hand, if it is logical for the old to bury the dead in the old days because they already had nothing to lose. If there is any kind of disease, then they themselves can get sick and die, but at the same time the young will continue to live. But such a belief has remained and because of this, people do not do this kind of work, they are not accepted for this business. I think that this is another negative consequence of the thawing of permafrost."

This is a tangible example of how permafrost thaw, in the form of coastal erosion, exerts pressure on traditional beliefs and worldviews. Locals face the challenge of finding alternative solutions which align with their morality and with the traditional ways of the community. If locals avoid touching these remains so as to respect their traditional beliefs, this could lead to a feeling of powerlessness. On the other hand, if they decide to move the coffins, they may feel guilty or even face social condemnation. Both could cause strong cultural distress among the members of the community even if this is not detectable from the outside.

People also expressed concern about possible changes in fish availability and circulation if the isthmus disappears and the peninsula becomes an island (see interview 25 quote 29-2 appendix to chapter VIII). The accelerated erosion of the isthmus has increased local anxiety about this eventuality. Some mentioned that they perceive this possibility as a negative thing for life in Bykovsky as no one knows what other modifications could this entail. The permafrost thaw transcends the geo-physical dimension and may threaten fish stocks, the traditional food and source of employment in the settlement.

The interviewees differed in their perception of how much time remains before the peninsula is completely eroded and cut off from the continent, but they agreed that it will happen in the near future - between 50 and 100 years from now -. (see interview 29 quote 58-19; quote 58-20; quote 58-23; quote 58-24 appendix to chapter VIII)

Another visible impact of coastal erosion is the damage to hunting and fishing cabins which are usually built on the shoreline. One respondent (see interview 17 quote 8-4 appendix to chapter VIII) pointed out that some of these have already collapsed due to erosion and have been washed away. A local woman (see interview 29 quote 50-2 appendix to chapter VIII) indicated that this happened to her husband's fishing cabin due to landslides associated with erosion, obliging him to build a new one farther inland closer to the tundra.

In Bykovsky too, respondents tried to identify in the interviews what causes coastal erosion. Most associated it with permafrost thaw although other causal relationships emerged too. For example, one reindeer herder linked it to hydraulic erosion, stating that similar to the settlement of Namy, the river might wash off the shore there too (see interview 21 quote 8-5 appendix to chapter VIII).

One local woman expressed her concern about untreated garbage which she considers could accelerate the thawing process (see interview 29 quote 58-26 appendix to chapter VIII).

Ice jamming was mentioned by one resident as a cause of coastal erosion. One local woman (see interview 26 quote 49-25 appendix to chapter VIII) talked about this natural phenomenon that takes place every summer in the region. When ice starts defreezing, ice packs start to flow downstream to the sea. When the drifting river-ice is packed in big chunks, it does not melt and goes out from the river in big blocks. When they arrive at the delta, they start jamming in the Bykovsky Peninsula. Ice packs hammer the shoreline, increasing the erosion. Although this process is natural, it was suggested as a possible cause of accelerated coastal erosion.

VIII.A.2.2.2) Changes in lakes

Different and multidimensional manifestations of climate change and permafrost thaw were mentioned during the interviews. One local reindeer and horse herder, after describing variations in snow distribution, detailed some modifications in lakes and proposed two hypotheses to explain them. He affirmed that some lakes close to the river might eventually disappear if the ground that separates them is eroded. This could also happen if the water from the lake flows into the river through underground channels (see interview 22 quote 5-9 appendix to chapter VIII).

VIII.A.2.2.3) Mammoth tusks

Another frequently described manifestation of permafrost thaw is the increasing number of mammoth tusks and other remains of Pleistocene fauna appearing in the thawing shorelines of rivers and sea. Although this has always existed, locals perceived a sharp increase in recent years. An increasing number of locals have turned to gathering these remains which, as described in section VIII.A.2, have increased tensions within certain members of local communities. This activity is predominantly practiced in summer as carcasses and tusks are more exposed due to seasonal permafrost thawing. Locals have widely adopted this supplementary seasonal activity to make ends meet. Tusk gatherers are regularly contacted by resellers who have collection export licenses and registered plots for tusk gathering. If a gatherer finds remains on unregistered lands, the reseller may buy it from the gatherer and then declare having found it on his authorized plot. Before being sold, all declared remains must pass a sanitary verification process where

veterinarians check for infection. Small bones are of most interest to craftsmen. The two main causes of the appearance of these remains are warmer temperatures and permafrost thawing and coastal erosion. One resident from Tiksi said that as shorelines are now falling apart, carcasses and tusks are becoming exposed (see interview 2 quote 203-4 appendix to chapter VIII).

Another respondent emphasized the fact that weather is becoming warmer.

INTERVIEW 21 QUOTE 9-26 KK: "It gets warmer and the tusks come out, they stick out. If it wouldn't get warmer, the tusks would have been buried there I guess. So it gets warmer, and the tusks appear on the surface, so they take them out."

A resident from Bykovsky considers that permafrost thaw is the cause of the increasing appearance of bones and tusks.

INTERVIEW 27 QUOTE 31-1 Y: "Since permafrost thaws, bones and tusks come out in this way. And people are drawn for easy ruble, easy money and go."

Two respondents, an environmental protection inspector and an authority from Bulunsky District (see interview 15 quote 15-2 appendix to chapter VIII), contradicting the other interviewees, affirmed that the number of tusks and carcasses appearing has decreased. The former specified that this has been happening since 1900s but that this phenomenon is independent of permafrost thaw, while the latter denied knowledge of any link between them.

VIII.A.2.2.4) Thermokarst

Two local interviewees mentioned having observed this topographic depression in the tundra.

INTERVIEW 18 QUOTE 4-8 S: "For example, the forest has a (top) soil, that is thick like this (shows), and below that - there is already the ice. The forest formed on top of the ice-lens. And where the lakes are, I saw that the ground was detached. It is becoming heavy when the trees, bushes grow on it; and maybe because of the thawing it had detached. So it was getting down like this (shows) into the lake, with the trees (...) Yes, like sliding down from the lens. And the lens of this ice was left open. I saw a lot of such things in 2006. When I was small, I did not see such things there."

Although no one referred to it in scientific terms, they described it by using their personal

observations and vocabulary. They associated it with the thawing of permafrost. One of them described it as follows: "If this ice thaws, then the earth's crust fails. Marshy puddles form in these places." (see interview 27 quote 35-2 appendix to chapter VIII).

VIII.A.2.2.5) Naled on the crack ("trashina")

Another example of the close interaction between climate and permafrost are the "icings". One local explained that during winter, when the ice surface cracks, new holes (known as "trashina" in Russian) appear in the ground surface. Consequently, water overflows or sits on top of the ice and freezes. Locals referred to the masses of layered ice formed on the ground or on the river as a consequence of overflow events as "naled". Being white and flat makes it almost impossible for people to distinguish it. One interviewee said that this is also the case out at sea where naled cannot be identified (see interview 29 quote 55-20 appendix to chapter VIII). Usually, "naled" becomes scratched when stepping or driving on its surface. This was highlighted by locals (see interview 29 quote 55-17 & quote 55-18 below) as a danger for them, especially for hunters and fishermen since it is happening with more frequency than before. They also create obstacles for truck drivers who frequently get stuck. Trucks easily break down as well. This causes delays in deliveries of food and supplies. Locals unanimously attributed this phenomenon to climate change and permafrost thaw. One of the respondents pointed out that the switch from high to low tide causes the ice-plates to collide, producing big cracks in them. Water enters these cracks and later freezes.

INTERVIEW 29 QUOTE 55-17 Sh: "These overflow ice (naledi) are dangerous for our hunters. They can fall into naled, get wet and freeze to death. That's because there is some water inside."

INTERVIEW 29 QUOTE 55-18 F: "This is dangerous. The same thing in our place. There were some cases of people dying like that during a blizzard."

VIII.A.2.2.6) Winter roads

Winter roads, or "zimnik" in Russian, are frozen water surfaces formed in winter (rivers, lakes or sea ice) and are important for northern communities as they allow seasonal transport of food and supplies to remote areas when there are no permanent roads. Winter roads also support local motility and mobility. They are commonly found in tundra and wetlands areas as the soil is soft

and swampy and when it freezes, it becomes hard enough to drive or walk on it. In interviews, locals mentioned changes in the periods of operation.

INTERVIEW 25 QUOTE 26-5 K: "We all are dependent on winter roads there. We realize that the duration of winter roads has changed."

They think that winter roads are now opening later than before due to warmer temperatures, reducing the length of their operating seasons. This was also identified as a problem for delivering fresh products (see interview 19 quote 18-4 appendix to chapter VIII). Some interviewees even mentioned that in remote settlements it is common to receive expired products (see interview 4 quote 5-4 appendix to chapter VIII). An authority from Tiksi claimed that a new investment project proposes to open a new winter road on the Lena River between Kyusyur and Tiksi to improve connections between these settlements.

VIII.A.2.2.7) Roads

Roads damage was mentioned by both Tiksi and Bykovsky's inhabitants (see interview 22 quote 11-5 appendix to chapter VIII). Roads were frequently identified as the infrastructure most impacted by permafrost change. The main challenges for roads are the accelerated deterioration caused by permafrost thaw and the increasing need for maintenance.

INTERVIEW 27 QUOTE 33-3 Y: Due to strong thawing, our roads are severely damaged. It turns out that the roads that we are driving now, they were in perfect condition just five years ago - they were new (...) Over the course of five years, pits have appeared everywhere, everywhere logs have leaped up. That is, the earth is constantly in motion. It is necessary to constantly maintain, but for the maintenance of our village the budget is not enough."

Most villages and settlements do not have the finances to cope with the high costs of maintenance. An authority from Tiksi said that despite efforts to cover roads, permafrost prevents good conditions from lasting for long and reparations are needed periodically, which increases the costs of maintenance and exploitation. The lack of machinery to do this type of work in the district increases the difficulties in preserving infrastructure, such as the airstrips at the airport. Unpaved roads for northern settlements was identified as an easier, more affordable long-term solution. One respondent attributed the road damage to constant movements of the soil,

provoked by the fact that there used to be wetlands before which were later covered with soil, but continue to move.

Another phenomenon related to soil conditions and roads occurred in Tiksi in 2016. The road in front of the bank collapsed and, according to locals, a huge hole about 1.5m deep and 10m wide appeared into which the road fell. They believed that water was flowing from the mountains through underground cracks and washed this part of the road away.

VIII.A.2.2.8) Damage to Buildings/houses

Another visible manifestation of changes in permafrost, according to locals, is damage to and collapse of buildings. The load-bearing capacity of permafrost is decreasing due to rising temperatures. When permafrost thaws, it sinks and damages the foundations of buildings built on it. Most buildings and houses in northern settlements were built using specific techniques for frozen ground conditions. Locals are familiar with these processes and techniques and explained that the shifting of the permafrost moves the buildings as well. Traditional construction techniques took this natural process into consideration and left a thin layer of empty space or backlash for airing which increases the building's stability. 'Strip foundations' were also used: the piles (logs) were laid horizontally on the surface around the walls of the building. The building was slightly elevated but still close to the surface. Buildings on permafrost with such foundations move a lot because the logs follow the ground movements. They also tend to sink when the permafrost thaws. In the early 80s, local construction techniques changed and people switched to building on pillars. However, the same problem eventually occurred. One respondent from Bykovsky said this problem is more frequent since the 90s due to accelerated thawing of permafrost.

In Tiksi, this process is mainly observed in large buildings, while in Bykovsky, houses and shelters are most affected. Inhabitants from Tiksi attributed this to both permafrost thaw and a lack of maintenance.

INTERVIEW 2 QUOTE 82-1 A: "Well, [in the future] there will be the very same ... The same, like you said yourself: the buildings will be destroyed. In the Republic of Sakha [buildings are built] on piles. Because constructions are deteriorating over time. Because of the erosion of the ice ground around."

However, four respondents claimed that the cause is purely of human origin (lack of maintenance) and one associated it with water leakages. In fact, most buildings have not been repaired since Soviet times (see interview 31 quote 9-3 below) and the high price of repair prevents inhabitants from overhauling their homes. One respondent specified that infrastructure in general is becoming obsolete and that human waste in the ground may be increasing the negative impact.

INTERVIEW 31 QUOTE 9-3 E: "Well, the buildings became unstable because they have not been repaired since socialism, let's say. Many years, more than thirty, have passed since socialism. Almost 35 years! And if the buildings are not repaired here, then, naturally, cracks will form under extreme conditions; houses are being destroyed. Some houses ceased to be in operation, because they went through cracks. These are already irreversible changes that led to this state. Because when there was socialism, at a strictly defined time, houses were being renovated - it was necessary. That is, they were maintained in a normal state: holes and cracks were closed (...) So it's not even due to climatic conditions, but to service conditions."

Bykovsky's inhabitants also mentioned the influence of permafrost on "vremyankas" (temporary houses) and "balki" (mobile temporary houses) which are generally situated in remote areas and are used for journeys to fishing or hunting grounds. In the past, they were lodges for hunters, old dugouts. Occasionally, people who became stranded, for example due to a break-down or weather conditions, used them as refuge. Since commercial hunting is no longer practiced in the region, these shelters are important for locals practicing subsistence and network hunting.

The movement of the ground due to lower load-bearing capacity of the permafrost entails multiple risks for people living in these buildings (see interview 13 quote 35 appendix to chapter VIII). After being asked about any relationship between changing permafrost conditions and infrastructure, one woman living in Tiksi recounted a dangerous event involving her newborn child (see interview 12 quote 13-4 appendix to chapter VIII). While cooking in the kitchen, she heard a terrible noise in the living room, where the baby was sleeping in a crib. A cobblestone had fallen from the ceiling to the floor, right next to the crib. She found out that other apartments in the same building had several cracks and holes as well.

Despite the dangers of these living conditions, solving the current housing situation in Tiksi is complex as many different sectors of the population are involved (local and regional

governments; the owners of abandoned apartments in Tiksi; inhabitants, etc). People in Bykovsky seemed more familiar with and mentally prepared for this type of situation. Most interviewees said that if coastal erosion eventually washes away their houses, they will be forced to resettle in a new place and rebuild their homes. Others have already had similar experiences: for example, a fisherman from Bykovsky had to rebuild his shelter further inland because the previous one had been washed away by coastal erosion.

VIII.A.2.2.9) Ice cellars (“lidniki”)

Ice cellars (or “lidniki⁵⁹” in Russian) are a distinctive part of traditional northern lifestyle. They are built below the frozen ground to store frozen meat and fish, the basis of their diet. Locals respect nature’s rhythm and therefore fish and hunt during specific seasons. Outside these, obtaining fish and meat is very challenging. Therefore, ice-cellar stock frozen traditional food for long periods of time without a need for electrical refrigerators. However, they require regular maintenance: they have to be iced, aired and cleaned. Icing prevents the surface of the ice-cellar from degrading (see interview 22 quote 20-2 below). Freezing prevents microorganisms from growing and gases (methane, carbon dioxide, mercury and nitrous oxide released when permafrost thaws) from building up. Maintenance delays the deterioration of the surface and the underground structure. Properly airing and cleaning is required to remove gases and to avoid the growth and rooting of microorganisms. In winter, ice-cellar are aired to refreeze it using colder outdoor air.

INTERVIEW 22 QUOTE 20-2 PE: “They [ice-cellar] melt in the autumn and we take out our food from there. And we leave them open. If you don’t open it in time - it will rot, it becomes very warm inside. It thaws anyway. From the end of September - beginning of October it already starts to thaw. It needs to be dug 10 meters’ deep, but it will anyway thaw. It becomes wet and cold only outside. Even in winter, when it’s -50° C outside, inside [the ice-cellar] it is still warm.”

Ice-cellar are strongly dependent on air temperature and permafrost conditions for their functioning. During the warm season (with temperatures above zero), atmospheric temperature progressively starts to heat the ground and by the end of the warm season (beginning of winter), the ground reaches its warmest point and this is when it thaws most. Then, cold weather slowly

⁵⁹ In Russian: “Ледники”.

cools the ground. Currently, this heat exchange between the atmosphere and the ground is slowing, and even in winter, the ice-cellar is too warm and needs to be aired to refreeze it.

Ice-cellars may contain several rooms and storeys and can be owned by families or organizations (such as fishing farms). In Bykokvtsy, Artel "Kholkhoz" has a commercial one while its inhabitants have smaller versions. Ice-cellars are essential for commercial purposes: fishing/hunting farms stock their products frozen for months until summer navigations begin and a reefer ship picks up the tons of fish stocks before distributing them to other cities such as Yakutsk or Moscow. This interdependence between villages and big cities for the export and import of traditional products is part of the Sakha Republic culture. This is also the case within the family unit. Villagers send fish and meat to their relatives and friends in the city who send money or materials for hunting and fishing. Interestingly, annoyed at the idea of being displaced elsewhere, one woman listed ice-cellars as one of the belongings that would be impossible to take with them (see interview 25 quote 18-1 appendix to chapter VIII).

An authority from Tiksi (see interview 1 quote 144 appendix to chapter VIII) also highlighted the importance of supporting and maintaining ice-cellars belonging to the Ministry of Agriculture. Each can store up to three hundred tons of fish, an essential storage facility for northern villages and settlements.

Locals said that, unlike in the past, permafrost thaw is threatening the stability of their ice-cellars and food security is at risk their products rot. This represents exerts pressure on the cultural and commercial life, especially in small settlements and villages, where the use of ice-cellars is a widely used tradition. Now, locals in villages have to dig deeper in the ground to preserve their fish (see interview 19 quote 14-7 appendix to chapter VIII).

INTERVIEW 22 QUOTE 9-2 PE: "The ice-cellars began to melt. We dig [build] the ice-cellars to store the meat. They didn't thaw before."

As for farms, accelerated thawing of their ice-cellars means that fish and meat are stored in optimal conditions for shorter periods of time and more maintenance work is needed. Despite adaptive measure and efforts to continue using ice-cellars, locals express a feeling of uncertainty about the future if the situation continues at the same rate (see interview 29 quote 28-10).

appendix to chapter VIII).

VIII.A.2.3) Flora & fauna

In their narratives, locals associate changes in climate and permafrost with a series of modifications in their ecosystems, including flora and fauna. Some respondents simultaneously refer to both climate change and permafrost thaw. For others, they are interchangeable or complimentary concepts. In all cases, these climate processes are perceived as being responsible for changes in migration patterns and the dispersal of plants and animals. In general, changes in fauna (especially big mammals) appear to pose the biggest challenges for locals.

VIII.A.2.3.1) Fauna

One of the most visible changes in the tundra ecosystem is the increasing number of big mammals approaching Tiksi, Bykovsky and their surrounding areas. Locals allege to have recently spotted polar bears, walruses, orcas, belugas and seals. The last three were sighted in the water bodies of Bykovsky. Sturgeons (*Acipenser baerii*) too were repeatedly spotted in the Lena river estuary. Locals also signaled changes in the arrival time of birds. One local woman from Bykovsky (see interview 23 quote 6-12 appendix to chapter VIII) found bees (*Apis*) and hornets (*Vespa*) in the settlement for the first time in her life. Ecosystems function through an exchange of energy and materials between its components and are based on interdependence between species. Therefore, changes in one may trigger changes in another, for example, changing fish migration patterns will produce changes in the migration of ringed seals (*Pusa hispida*) and bears (*Ursus maritimus*) (see interview 29 quote 18-34 appendix to chapter VIII). Another example, cited by an inhabitant of Bykovsky, is that "the hare (*Lepus timidus*) feeds on a "willow" shrub (*Salix glauco*). Therefore, we have a hare (*Lepus timidus*). And due to the fact that there were hares - we got sables (*Martes zibellina*). Everything is interconnected." (see interview 27 quote 23-5 appendix to chapter VIII).

One respondent living in Tiksi (see interview 5 quote 17-7 appendix to chapter VIII) stated that since 2014, he's observed a large number of belugas (*Delphinapterus leucas*) swimming through the Kara Strait (around the Taimyr Peninsula) on their way to the Laptev Sea. These belugas were waiting to catch the omul (*Coregonus migratorius*) on the edge of the ice. In Bykovsky, locals sighted around 150 belugas. They also mentioned having found ten orcas (*Orcinus orca*) in the

area, which eat belugas, seals (*Pusa hispida*), walruses (*Odobenus rosmarus*) and other smaller species. The new arrival of these big predators was suggested as a possible reason for why omul did not come up last year.

Among locals, there also seems to be a general agreement on the increasing number of animals from other regions now approaching the tundra (ecological niche shifts) such as sables, hares and ravens (*Corvus corax*) (see interview 27 quote 6-1 below).

INTERVIEW 27 QUOTE 6-1 Y: "Changes. If we consider it of a natural nature, then, as I said, new animals have appeared. This is a sable, a hare. About 15 years ago they were not here. People could not even imagine that there would be such animals (...) This, I think, is due to climate change. Summer is warmer, and winter is colder. They still somehow influence these changes."

Finding these animals in these areas is unimaginable for locals. Wolverines (*Gulo gulo*) were also spotted in Tiksi 3. Inhabitants from Bykovsky remembered experiencing an unusual invasions of lemmings (*Lemmus sibiricus*) between 2010 and 2011. They also identified new insects, including wasps (*Vespula vulgaris*), dragonflies (*Anisoptera*) and an increasing number of mosquitoes (*Aedes nigripes*). They also associate the changes in migration routes of wild reindeer (*Rangifer tarandus tarangus* L.) with changes in permafrost and climate (see interview 2 quote 20-1 appendix to chapter VIII). Reindeer used to migrate to the Laptev Sea straight through Taimylyr but this is no longer happening. Sometimes, they leave for the south earlier than before. Other supplementary sources of pressure have impacted on reindeer herds. There are more swamps in the reindeer pastures. New insects associated with warmer temperatures have appeared. Sharp sudden changes in weather conditions producing thick layers of ice-crust cause reindeer to hurt their hoofs when they try to get the moss from under the ice.

The arrival of new animals to this area produces both positive and negative feelings among locals. On the one hand, some animals, especially those with fur like hares or sables, are seen as potential new products to be hunted and traded, and therefore, as a new source of income. In some cases, new animals could also be food sources. On the other hand, co-existing with some predators is perceived as a potential danger for the community, especially for those who depend on traditional activities, such as hunting, gathering or fishing.

Changes in shoals and schools of fish were of particular relevance in the local narratives and therefore need to be analyzed separately. Locals observed a sharp reduction in the amount of fish in recent years, a major concern, especially for inhabitants of Bykovsky, as they depend exclusively on fishing. One young respondent, a native of Kyusyur, also mentioned a reduction in the size of fish. Only one respondent seemed to be skeptical of the idea of changes in fish schools, alleging that was due to the fact that they do not fish at an industrial scale. Perceiving these changes is hard for fishermen.

Most of the respondents refer to this sharp decrease in fish but tend to ignore the reasons, while others propose different possible explanations and theories for this phenomenon.

Respondents attributed changes in fish circulation and availability in Arctic waters to multiple factors: brackish water distribution, water salinity, winds, later river ice formation, and also to some oil and gas exploration on the Laptev sea.

Local inhabitants do not fish in the sea but mainly in internal waters (rivers, streams, lakes, islands in the Lena Delta). They rely on a small variety of whitefish: omul (*Coregonus migratorius*), muksun (*Coregonus muksun*), chir (*Salvelinus alpinus*), nelma (*Stedonus nelma*), Siberian vendace (*Coregonus sardinella*), whitefish (*Coregonus pidschian*), among others. Omul is the fish with the highest commercial value. It is an anadromous, and therefore, lives in low-saline areas. They live on the border between fresh and salty water known as “brackish waters”. These anadromous fishes are born in brackish waters of coastal lagoons and the mouths of larger lowland rivers and bays. It spends most of its life in the sea before returning to fresh water to spawn. Fishing Siberian sturgeon (*Acipenser baerii*) is forbidden in Russia, with an exception in some zones of the Lena river. A fishing (license) for a designated area must be applied for.

It should be pointed out that only Kholkhoz Arktika (in Bykovsky) and MUP “Taimylyrsky” (in Taimylyr) have fishing grounds along the coast (see Figure 57 below). The others are located on the Lena river and internal waters. Small boat brigades split the fishing grounds and bring back the fish. Artel Kholkhoz, as well as other entities, individual entrepreneurs and fishing organizations use annual plans to define the amount of fish (quotas) they can catch in order to be able to continue using the specific ground they have legally been assigned. In fact, locals from Bykovsky indicated that last year Kholkhoz did not fulfill their fishing plan, reflecting once again,

the decrease of fish in the area.

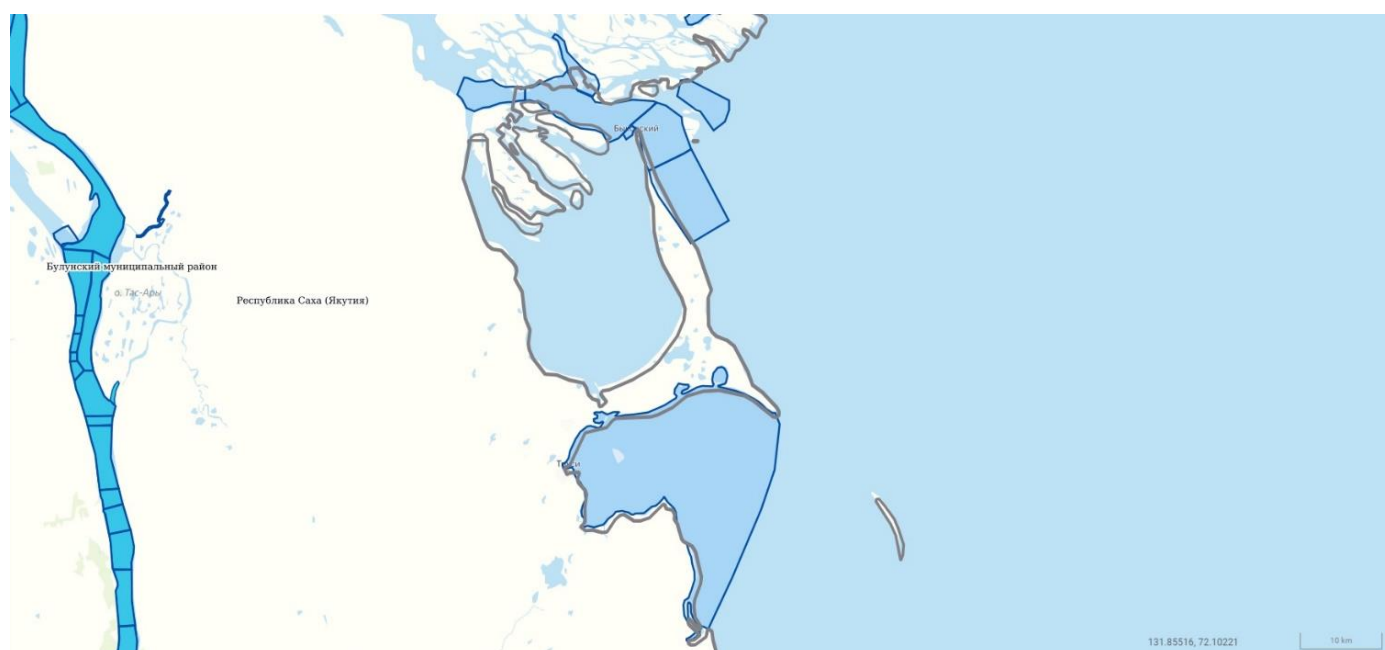


Figure 56: Fishing grounds in the Tiksi-Bulunsky area are delimited in blue.

Source: <http://priodayakutia.sakha.gov.ru/app/10>

Locals say that the fish spawning areas may have moved northwards because the inflow of freshwater from the Lena River to the Laptev Delta area has increased. This is seen as one possible explanation for why fish are not running upstream like before. Some respondents also mentioned that the increase of freshwater is due to accelerated permafrost thaw. The water of Neelov Bay is mostly fresh in summer as it is close to the Lena Delta and its large freshwater discharge. From the east side, the Bykovsky Cape acts as a wall against the sea. This explains why some residents from Bykovsky talk about having fresh water in the Neelov Bay and even being able to drink it. In most of the interviews, locals referred to this phenomenon as “desalinization of sea water”.

INTERVIEW 22 QUOTE 8-1 Y: “Regarding the renewal of fish, I think it's all because of the desalination of sea water. What we used to have here on the shore was often salt water at high tide. Now, regardless of the high tide or low tide, our water is always fresh - you can drink it, its seawater (...) Climate change is new animals, shrubs and desalination has increased (...) I would say that the full flow of the Lena River makes itself felt. From another side, in recent years, the Lena River itself has also been falling in level, and its full-flow is decreasing. But at the same time, the water keeps desalinating. I don't know ... Maybe this really is the thawing of permafrost?”

It is believed that the water at the shore was often salty at high tide. But now, regardless of the tide, the water in Bykovsky is always fresh. Locals even highlight that it is possible to drink the sea water. They expressed concern about the increasing desalination of the sea water and its possible consequences for their ecosystems. The explanation for this phenomenon is still unclear and different hypothesis are proposed. Some locals (see interview 21 quote 3-7 appendix to chapter VIII) mentioned the scientific research conducted in the area and concluded that fish are moving deeper into the sea because the brackish water where they normally live is being pushed deeper into the sea too. Locals said that, in the past, brackish water used to be closer to the coast of Bykovsky, where their fishing grounds are.

Another important element, according to our respondents, influencing fish and brackish water distribution is water salinity. Salinity increases as the temperature of the water decreases and thus, salinity levels increase in winter. Sea water freezes while the freshwater discharges coming from rivers decrease as well. Therefore, both fish and plankton move closer to the delta where water salinity is less.

One fisherman pointed out that fish food (plankton and other forms of small biota) are moving deeper into the sea, and consequently, the fish move deeper as well (see interview 21 quote 17-13 appendix to chapter VIII). Consequently, there are fewer fish in the places where people used to put down their nets.

Locals also referred to the influence of winds on water and fish circulation (see interview 29 quote 18-8 appendix to VIII). Winds from the north (from the ocean) provoke waves that increases the amount of water and move the salty and fresh water and the plankton towards the south, closer to the land. Thus, fish normally follow these waves.

A new, more recent factor possibly affecting fish availability is the increasing number of predators in the area. Both whales and belugas feed on fish, and have been spotted in the area in recent years. Fishermen see big mammals as a threat to their livelihood as they can eat several tons of fish per day (see interview 12 quote 14-10 appendix to chapter VIII).

Other respondents referred to ongoing rumors that trawlers may be overfishing the area (see interview 14 quote 146 below). They say that they catch tons of fish and leave with little control

over them. These trawlers are a threat for locals who fish with small boats at a smaller scale.

INTERVIEW 14 QUOTE 146 AI: "Last year, they said there were fewer fish in general. But this was due to trawlers. They come, catch tons of fish and leave. But, it seems to me, this is not the only reason why. It is also connected with something else, some kind of periodicity going on, maybe. Well, the waters are federal, someone may be, some organization will come, but we don't know who comes here – they just catch and leave. And our locals just go on boats. They don't fish much."

Another hypothesis mentioned is that since 2012, oil and gas explorations started in the region and this may have led to oil dripping. However, this was signaled as a local rumor (see interview 26 quote 4-6 appendix to chapter VIII).

One resident from Bykovsky (see interview 27 quote 4-10 appendix to chapter VIII) alluded to the possibility of the changes being associated with a natural cycle. In the past, fish disappeared for a couple of years but then reappeared. This might be the current situation.

This shows the multiplicity and complementarity of factors that might influence fish distribution as well as the undeniably deep knowledge of locals about the changing reality they are living in. If the brackish waters keep moving deeper into the sea or beyond the 20 mile zone (legally considered internal waters), locals say they will be forced to fish deeper in the sea, which would require: 1) conducting supplementary scientific research in these waters to evaluate the feasibility of this activity in terms of fish preservation, 2) obtaining special authorization from the government to fish in these waters, 3) buying new and more expensive technical equipment (fleet, fishing material, etc) 4) training personnel. Switching to sea fishing would also increase the risks that fishermen face. First of all, because they could be forced to get into border zone areas but also because this involves bigger risks than fishing close to the shoreline.

INTERVIEW 28 QUOTE 8-4 SE: "As for the fishing, the fish "went further into the sea" – they say. Before, the ichthyologists said that the water of Lena went too far in the sea, and the fish followed it. But if you would go there – it's all the border zone. When you go around 10 kilometers away from here. Even less. The border guard doesn't allow fishing beyond those last islands (you can see these islands, right there). That's why you cannot fish. Those waters belong to the Federation.

The fish are following the fresh water. The white fish (Omul, Muksun)".

When contrasting Russian laws with local assumptions, it is evident that the changing circulation and availability of fish represents one of the biggest challenges for locals. The Order of the Ministry of Agriculture of Russia No. 348 on fishing rules for the East Siberian fishery basin, stipulated that fishing is only allowed in very specific and limited areas as follows:

- amateur fishing (hobby, recreation, sports, leisure, personal consumption) by individuals and organizations in fishing grounds for common use; in special territories designated for these purposes; and in fishing grounds designated for industrial fishing with a permit (agreement).
- Fishing for the purposes of maintaining traditional livelihoods and traditional activities by indigenous small-numbered peoples in the districts where these people live, with or without a fishing site.

VIII.A.2.3.2) Flora

As a result of changes in climate and permafrost, locals observe new species appearing in Tiksi, Bykovsky and surrounding areas. In general, respondents observed bigger, more colorful plants, trees and bushes (see interview 19 quote 9-4 appendix to chapter VIII). Due to ecological niche shifts, native flowers from southern regions started appearing in this area too. For example, fox berries (*Vaccinium vitis-idaea*) and blueberries (*Vaccinium corymbosum*) were spotted in the tundra. According to inhabitants, blueberries appear in Tiksi during extremely hot weather conditions. Some also said that berries are now bigger than they used to be in the past. Trees that were small are now bigger. It is currently possible to find big bushes of willows near Tiksi. Locals also observed the vegetation greening.

In Bykovsky, interviewees (see interview 23 quote 6-5; interview 25 quote 8-17 appendix to chapter VIII) specified that vegetation is undergoing unprecedented changes: caspian willows (*Salix pruinosus acutifolia*) are unusually big; bushes can now reach the size of a man; eglantine (*Rosa rubiginosa*), arctic birch (*Betula nana*), slippery jack (*Suillus luteus*), girolles (*Cantharellus cibarius*), russula (*Russula emetica*) and milk caps mushrooms (*Lactarius stipitatus*) are now frequently spotted in the village.

Changes in vegetation also concern the maturity level of some berries. For example, the red

bilberry (*Vaccinium myrtillus* L.), despite being native to Bykovsky, never reached the state of ripeness of today, instead the berries remained in their green state.

Different explanations for these modifications were proposed by local inhabitants. They believe they are associated with: 1) permafrost thaw; 2) warmer weather (climate change) and/or 3) anthropogenic activities. Some of them referred to multiple causes simultaneously (see interview 17 quote 5-7; interview 27 quote 6-4 appendix to chapter VIII). The use of some types of machinery could lead to erosion, damaging the vegetative layer and leading to irreversible destruction.

Different reactions to these changes were noted among the respondents. Some welcomed the changes as pleasant to observe and embellishing the landscape. However, others showed concern about what these signals could be indicating at a global scale: a woman from Tiksi interpreted it as a possible indicator of global warming and expressed her fear of the consequences.

INTERVIEW 15 QUOTE 15-4 CM: "Well, I like it. In general, I love nature, I love flowers - to observe all of it. But they just stand somehow terrifyingly, and I think: "What if it is, for real, going to be some kind of global warming. What if it all somehow suddenly will change. Like, science fiction is a fiction, but sometimes there is also a piece of reality in the science fiction."

VIII.A.2.4) Changes in landscape

Interviewees also expressed their concern about changes in their environment due to untreated garbage in the tundra (mainly landfills). This was mainly mentioned by inhabitants of Bykovsky and people frequenting the tundra who perceive this as producing ecological harm. One of the respondents also specified that the waste in the soil accelerates permafrost thawing and that a processing and treatment program, like in Tiksi, is required in Bykovsky. Little information was obtained about the landfill in Bykovsky Cape but locals openly expressed a desire to deal with this topic and to get rid of the garbage in the tundra (see interview 15 quote 15-6; interview 29 quote 47-7 appendix to chapter VIII).

VIII.A.III) Socio-economic dimension vs climate change and permafrost thaw?

During the fieldwork conducted in Tiksi and Bykovsky, some interviewees pointed out that the socio-economic and political reality strongly condition the possibilities for the residents of

northern settlements. They are already facing other challenges such as high prices, unemployment, out-migration, lack of maintenance of infrastructure and buildings, among others. This remarks were often to counterbalance the relevance of climate change and permafrost thaw in day-to-day activities. However, this chapter demonstrates that the effects of the socio-economic, cultural and natural dimensions in northern coastal settlements like Tiksi and Bykovsky cannot be isolated from each other. Residents determine the specific meaning of their effects and their priority in the context of the broader loop of interactions characterizing life in their settlements. In this sense, climate change and permafrost thaw emerge as two increasingly important stressors that have an interplay within this synergistic loop of interactions but which are often discursively dissociated from the other dimensions. Nonetheless, because of the nature and extent of the impacts of permafrost thaw and climate change, we propose that they should not be considered as antagonist to the socio-economic and political arenas, as suggested by some residents. Instead, they should be addressed as elements that are interwoven with these and should be integrated into the global equation when evaluating the living conditions, challenges and future opportunities in the north. Doing this does not counterbalance the primary role of the socio-economic and political challenges. The use of a holistic analytical approach should provide enough flexibility to capture the complexity of the northern world as a system, where its interactions and impacts are often difficult to categorize within conceptually rigid boundaries. This should also capture the relational context in which locals attribute sense and meaning to the challenges and negative impacts they are currently undergoing. Consequently, the resulting analysis could foster synergic action, leading to benefits at multiple scales simultaneously.

This is particularly relevant within an atmosphere of uncertainty which is reflected in different forms of social distress and cultural fragmentation, reinforcing the notion of de-structuration of the system from the inside.

INTERVIEW 18 QUOTE 8-9 S: "S: Well, we are hoping for the best. That it will get better. But we also fear that it will get worse. (laughs)"

INTERVIEW 18 QUOTE 8-11 S: "S: Well, I don't know. But if I speak as an acting head of Agriculture [department], I fear that it will be impossible for reindeer to feed themselves. Because

if it rains after the heavy snowfall, it will be a guaranteed death, so to say, for reindeer – no way to nurse them. Because, as they say, in 2017 a large number of horses died of exhaustion caused by this reason. Because of this crust of ice, they couldn't dig out their forage [with their hoofs]."

Understanding how climate change and permafrost thaw affect traditional activities in the north requires a holistic analytical approach that integrates multiple dimensions simultaneously. Despite an overall optimistic feeling about the future of the area, some residents mentioned that traditional activities are at risk and might soon disappear if this trend is not reversed (see interview 17 quote 2-6 below; interview 21 quote 17-3 below). This is particularly true for indigenous rural villages in the Bulunsky District as young people are no longer interested in maintaining this lifestyle and often abandon traditional practices. This is the result of a multi-faceted and complex reality that shapes life and livelihoods in rural northern settlements. The lack of attractiveness fits in the context of a globalized world where urban culture dominates (Kennedy et al., 2018). Moreover, the harsh conditions in which these activities are practiced (physical effort; being isolated from family for days because of lack of connectivity; low remuneration; among others) also discourage them.

INTERVIEW 17 QUOTE 2-6 T: "(...) Here in our place, in the North, the conditions for traditional activities have been disappearing for people in recent years. For us, for example, for Evenkis. Like, traditional fishing, reindeer herding, wild reindeer herding, hunting for fur animals. As for today, domestic reindeer herding is already on the decline. For example, back in the days, we had more than 40 thousand reindeers in the district. In the 1970s, around 1977 (...) But in my opinion, the federal government and our region are paying insufficient attention to the preservation of traditional activities. They do initiate measures but they are insufficient, so small, minimal. It has to be changed globally, cardinally. The number of domestic reindeer is declining. It means that the number of local people conducting these activities is also decreasing. They are also dying out, if there is no activity, people cannot adapt to lifestyle like in Tiksi, they are decreasing in numbers. Soon, it will be possible to see local people only in a museum (laughs). There is such trend."

INTERVIEW 21 QUOTE 17-3 K: "And about reindeer herding, it is a difficult question. I already said before: the average age of a reindeer herder is 55 years. There are no young specialists. This structure ... well, how to say – is under [threat]. If there is no youth, then there will be nobody to

take care of [reindeer]... Well, there will be no one, there will be no reindeer.”

Moreover, unlike Soviet times, younger generations from families involved in traditional activities no longer have guaranteed job opportunities in the country. Before, rural graduates got a job in their settlements but these programs were discontinued. Returning to their homelands was a condition of being accepted at the University or Institute (Argounova-Low, 2007). On the technical side, GPS collars to avoid losing herdeer in the wild are extremely costly. Moreover, increased electromagnetic noise and challenges associated with the use of advanced geo-positioning systems in the Far North (Fondahl et al., 2020) reduce the possibilities of incorporating technological solutions. Moreover, some members of the community are reluctant to use these forms of technological assistance as they threaten important aspects of traditional knowledge, for example, orientation in nature.

INTERVIEW 22 QUOTE 33-3 PE: “I used GPS before. And my memory became weak because of it. Those places that I used to know like the back of my hand without GPS, even in them I began to get confused – I began to rely on GPS. Then, after, I threw it away, and I began to rely on myself again.”

These harsh conditions are exacerbated by climate change and permafrost thaw. For example, changes in soil conditions affect reindeer migration routes. Some reindeer herders mentioned that this often causes injuries and death for many animals. This is a concrete economic loss for them. The new migration routes of fish in Bykovsky mean redrawing fishing grounds which are legally fixed. These impacts have not yet been legally considered or included. The latest draft of the law governing the Arctic Zone of the Russian Federation (AZRF) (2017 version) only addresses educational programs and the preservation of indigenous cultural heritage, language, folk arts and crafts (Fondahl et al., 2020). In addition to the need to create a concrete legal mechanism to protect the lands used by indigenous northerners for their “traditional activities” (extractive projects), these new environmental modifications caused by climate change and permafrost thaw represent a concrete threat to these activities. These changes need to be prioritized within the Russian Arctic sustainable development policies. It is clear that bio-physical changes due to climate and permafrost cannot be pondered without considering the socio-economic, demographic, cultural, and political ramifications.

To address the impacts of changes, including those from climate change and permafrost thaw, on traditional activities requires integrating them within a broader process of re-signification of the territories. This should reevaluate the ties and roles of place, activities and community within a newly globalized northern world characterized by changes in intersubjective meanings (Santos, 2001). Younger generations are not exempt from the effects of globalization and their current and future decisions are strongly influenced by new information obtained, for example, through Internet. This will also be reflected in new emerging forms of power relationships and the use of the natural environment.

VIII.B) DESTRUCTURATION OF THE NORTHERN WORLD

Analyzing the body of narratives reveals that local residents from Tiksi and Bykovsky have always experienced socio-economic, climatic and environmental variations, especially since the Soviet breakup. Now, however, changes in climate and permafrost are triggering deep simultaneous modifications in the northern world at an unprecedented rate. According to residents from Tiksi and Bykovsky, the effects of both phenomena are increasingly threatening in every sphere of their lives, exerting additional pressure on an already delicate socio-economic and demographic situation. The de-structuration of the northern world that they used to know is increasing their overall feeling of uncertainty about the future. Despite their efforts to find new and more suitable ways to interact with their surrounding environment and with other residents, the interviewees emphasized the need for state action.

The complex network of changes that characterizes the current de-structuration of the northern world draw attention to several key questions that define the future for Tiksi and Bykovsky. This includes the reluctance from the youngest members of the settlements to get involved in traditional activities, as well as the increasing bio-physical challenges (associated with climate change and permafrost thaw) that these activities are currently facing.

Even if respondents cannot identify a specific moment in the timeline when these changes became more intense, they generally agree that accelerated climate and environmental changes started in the modern period and have intensified in the past few years. Within this recent past,

they frequently refer to "Soviet times"⁶⁰ or the "Soviet period"⁶¹ as a central point of reference. This is particularly relevant for the analysis of their narratives as, according to Nikolayenko (2008) "a shared understanding of the past helps citizens make sense of the present and the vision for the future". For many northern residents, Soviet memories include a generalized socio-economic prosperity in the north which was reflected in different spheres.

INTERVIEW 34 QUOTE 9 EF: "Earlier in Soviet times everything was good. Provisions came from Moscow and from St. Petersburg, Leningrad. First priority. The food was very good. Clothes, everything. The seaport worked well. Then, during perestroika, in the 90s, when everything came to ruin and the seaport was closed. People began to leave, experts left."

Many respondents manifested negative attitudes towards the Soviet demise which was not only an important period in the recent history of northern residents, but a relevant element within the local identity construction and social cohesion. It has become a symbolic frame of reference to which current living conditions are compared.

INTERVIEW 13 QUOTE 12 SP: "Earlier in Soviet times, there was generally beauty. We had everything. And now, look, everything is somehow not very. And there were a lot of ships, and now there is not a single ship. "

INTERVIEW 15 QUOTE 28-6 T: "Of course! Absolutely. This is a very important factor - nostalgia, memories of youth. An excellent standard of living in younger years compared to what it is now. Of course."

This respondent who moved to Tiksi in 1983 also integrated it into their personal experiences as a point of reference:

INTERVIEW 7 QUOTE 54 AA: "Well, of course, it changed. I used to work here, there were constructions in the village every day, and now there is nothing here."

Collective memories from this era shape the way northern residents experience ongoing modifications but also influence the ideal future they yearn for. The influence of this period is

⁶⁰ In Russian: "В Советское время".

⁶¹ In Russian "В Советский период".

reflected in the current mindset of residents from Tiksi and Bykovsky.

INTERVIEW 1 QUOTE 13 K: "(...) People in the North are 'frozen', so to speak, we still have the mentality of the Soviet Union, when we had communism here, rather than socialism (...) I would first of all talk of the mentality of a person who has lived in the conditions close to communism. Communism is still with him, but in a good sense (...) It was an absolutely good society, even though I'm not a communist and have never been one. But there were lots of good ideas back then which should have been encouraged. And there were very many people with an active attitude who lived in that society and they know how it could be. I would say it's a painful problem in our society, particularly here in this settlement (Tiksi). It used to be the sea gate of the Republic of Sakha, all supplies were coming via Tiksi. Life was terrific here. Lots of activities were going on here. But the mentality of those active people has stayed the same, it's impossible to integrate those people quickly [in modern society]."

In light of the recent federal and regional strategic interest in fostering the socio-economic development of the Russian Arctic, and more particularly, of Tiksi and the NSR, the legacies of Soviet times should not be overlooked. A feeling of nostalgia (which is often expressed as a desire to rebuild Tiksi and Bykovsky like in the Soviet days) and a reluctance to leave their settlements could have positive outcomes within the context of de-structuration of the northern world. These could be the case if residents become actively engaged in the environmental and socio-economic policy-making processes. Creating concrete spaces of dialogue between different stakeholders and authorities could allow locals to express their concerns and priorities. This first-hand information could be adapted and integrated into new strategies and plans for the settlements or region. They should aim at helping northern residents to find new and better adapted mechanisms to relate to their natural environment, while protecting the essential economical-productive and socio-cultural components that are now being threatened.

VIII.C) SYNTHESIS

Climate and permafrost are two components of the Arctic system that shape every aspect of life in the northern settlements. This system has been in constant transformation but accelerated changes are now exerting increased pressure on communities in the Republic of Sakha. The narratives collected during fieldwork conducted in Yakutsk, Tiksi and Bykovsky contributed to a

more detailed understanding of the social meanings of climate change and permafrost thaw in the Republic of Sakha. The results from the first fieldwork provided a general overview of the regional situation concerning both processes. Interviewing people living in the city of Yakutsk who were born in or previously lived in other settlements in the Republic of Sakha provided further input into the common points and the differences between the capital city and other northern settlements. A strong level of cohesion was observed in residents' narratives. There was no single way to perceive, describe and assess changes in their natural environment, but personal experiences complemented each other. This enlarged the regional view of permafrost thaw and climate change. For example, while some referred to the effects of permafrost thaw on building stability in the city, others, such a reindeer herder, addressed the effects that this has on his reindeer. Even those respondents who tried to minimize – at least discursively – the role of permafrost for the Yakutian population were able to describe in great detail processes associated with climate change and/or permafrost thaw. The mental map (see chapter VII) obtained from the qualitative analysis and coding exercise gave a rapid visualization of the main concepts, stakeholders and relationships mentioned by respondents in regard to climate change and permafrost thaw. This tool was also helpful to address these processes at a local scale, more specifically, in Tiksi and Bykovsky. In this sense, it acted as a first regional snapshot with the potential to be nourished with new locally-produced information. Moreover, this provided a conceptual framework that helped to define the research questions for the second fieldwork campaign. This was conducted in the coastal settlements of Tiksi and Bykovsky and provided highly precise information about the local opinions and interpretations of climate change and permafrost thaw. This was relevant to study the influence of two particular geographical conditions, being coastal and situated in the Russian Arctic, on local perceptions. Moreover, historical, socio-economic and demographic differences meant that, despite being geographically close, the extent and implications of these phenomena were experienced and narrated differently by their populations.

Both campaigns aimed to place local voices at the core of the research in order to address these phenomena. The main purpose was to increase the available scientific information on the impacts of climate change and permafrost thaw as perceived and experienced by the local populations living in coastal Russian Arctic settlements. This allowed the wide range of meanings and implications attributed to each of the processes to be identified. The qualitative analysis of the

narratives collected revealed that changes associated with climate change and permafrost thaw are causing the “de-structuration” of the northern world as residents know it. However, this does not imply that the previous world has entirely disappeared. Instead, it is suggested that several structures or constitutive elements from the past configuration have partially survived, but the logical and relational context in which they were conceived is changing (Wachtel, 1976). This can also lead to a modification of the meaning that locals attribute to each element of their world. Changes triggered by climate change and thawing permafrost thus reconfigure the interaction mechanisms between local residents, the climate, their natural environment and each of its components, both in economical-productive and socio-cultural terms.

Despite efforts to conceptually delimit the spheres, analysis of the narratives demonstrates that in practice, de-structuration is occurring in different spheres simultaneously and therefore outcomes should be studied while respecting this interconnectedness. However, for analytical purposes, several outstanding citations by locals will be highlighted to facilitate an understanding of the concrete implications of this de-structuration. They will be organized according to the “type” of change that characterizes the first link of the complex chain of events/consequences.

In the economical-productive sphere, climate change and permafrost thaw are most severely impacting on northern sectors that depend on traditional activities and animals and are in close contact with the natural environment. For example, because of increasing instability of the permafrost soil, many reindeer herders mentioned accidents with their animals during the migration periods. Also, specific meteorological conditions cause the soil and food to freeze so that reindeer cannot access it. However, it is also important to highlight that other indirect “external” stressors like cultural changes in these communities can also exacerbate these negative effects on local economies. Globalization is spreading to the Arctic and new interests by younger generations along with challenging working conditions are translating into a sharp reduction of young herders in northern settlements. This could lead to a social reconfiguration of these communities where well-defined roles maintain activities in a particular way and preserve traditional lifestyles. But it could trigger changes in traditional knowledge, land management systems and land uses (Barrett & Wuetherick, 2012).

On the other hand, a shortage of fish or meat at a local scale in northern settlements like Tiksi

and Bykovsky might induce broader regional economic impacts. This is particularly true when urban dwellers depend on their relatives from the villages to obtain such products.

These economic-productive impacts may augment the strong feeling of grief experienced by northern residents following the loss valued species, ecosystems and landscapes (Cunsolo & Ellis, 2018). Narratives provide multiple examples that suggest the need to extend the scope of the analysis to consider that physical ecological losses as well as modifications to traditional activities may trigger grief in certain northern communities. According to some authors (e.g: Stanescu, 2012; Rae, 2003; Spargo, 2004), grief and mourning expose the different connections to others within a system and therefore provide an opportunity to question assumptions in terms of what people choose to value. Despite the geo-morphological, socio-economic differences, residents from Tiksi and Bykovsky maintain close living and working relationships with nature which is currently experiencing deep transformations and landscapes are perceived by many as being at risk from climate change and permafrost thaw.

Climate change and permafrost thaw are also affecting the bio-physical dimension and it is possible to cite several examples: longer autumns (leading to a later freeze-up of water bodies and later closing of the navigation season) and shorter winters (associated with accelerated sea ice melting and earlier opening of the navigation season). According to locals, these physical changes increase uncertainty about the future of traditional activities in the area, especially for northern fishermen: if there is less ice and for shorter periods of time, the ability to practice winter fishing (known as "Podledka") will also be considerably reduced. In addition, in resource-oriented settlements like Bykovsky, the possibilities of redirecting the local economy and finding new jobs that allow people to continue living in these territories are very limited. The importance of fishing as the main activity in Bykovsky is reflected in the fact that the Kholhoz Arktika is the main source of employment in the settlements. Preserving traditional activities in indigenous Russian Arctic settlements is important in a globalized world where ethnic values are threatened leading to a loss of cultural originality and regional identity (Koptseva & Kirko, 2015). In this sense, Paasi (2002) defines "regional identity" as the process of creating territorial borders, symbolism and specific institutes associated with ethnic and cultural identity. It is therefore necessary to integrate the interplay of the territories and the particular relationships developed within them in order to limit the effects of climate change and permafrost thaw.

Local residents also refer to changes in migration patterns and fauna niches. Although some locals perceive this as a new economic opportunity (they could hunt and sell hares (*Lepus timidus*) and sables (*Martes zibellina*), for example), many others see it a threat. Many locals openly expressed their fear of newly arrived polar bears (*Ursus maritimus*) and other mammals to the region which reduces their feeling of safety in their fishing and hunting grounds. This puts extra pressure on people practicing traditional activities: they may resort to buying new technologies to increase their safety when in nature but it may also require the integration of new knowledge about the territories and animal behaviors. It is also important to consider the feeling of grief and mourning that residents may experience as a result of this ecological reconfiguration, especially since many people choose to live in the north from traditional activities for reasons other than merely financial ones. This also determines a particular social-ecological configuration, the cultural elements which are valued by the community and how they define and experience their well-being. The emotional effects of incremental changes associated with new migration patterns and switches in fauna niches are usually ignored because of the temporal dispersion and because there are no particular signals of emergency associated with them (Cunsolo & Ellis, 2018). These non-material dimensions must be taken into consideration in order to understand the particular ways in which these residents insert themselves into this particular natural environment, how they interact with it and which strategies they choose to cope with accelerated change.

Accelerated permafrost thawing leading to rapid coastline erosion triggers multiple interrelated effects. Firstly, there are geo-physical changes as organic carbon previously frozen in permafrost is released to the atmosphere and transformed into greenhouse gases (Lantuit, 2019). Secondly, new permafrost-related landforms (e.g: thermokarst) are created, causing a deep transformation of the traditional landscape which can alter the way people perceive and interact with their territory. More specifically, the ties established in a particular territorial-relational configuration may now need to be redefined. Several elements need to be considered when analyzing the effects of climate change and permafrost thaw on infrastructure. First of all, there is a sharp reduction in the load-bearing capacity of soil and this affects the pillars of most northern buildings. Secondly, inadequate maintenance (often because of insufficient funding) can aggravate poor infrastructural conditions. Narratives from Tiksi suggest that it is worth delving into the concrete experiences that residents might have had in these deteriorated buildings. This

represents a possibility to integrate into scientific research and policy-making emotional associations and experiences related to the damage to residences due to climate change and permafrost thaw. Sometimes, despite negative events occurring in their homes, people refuse to leave. This is evidence of local attachment to place and should not be disregarded. As Quinn et al. (2018) suggest, identifying particular forms of place attachment can enrich the scientific understanding of communities' responses to changes when new risks arise. In other words, it is an opportunity to design adaptive strategies within a broader and more dynamic framework that considers the ties between local residents and their meaningful places. This is particularly important if we consider that places hold emotional, symbolic, spiritual and intrinsic values that actively contribute to particular forms of living (Adger et al., 2011). Incorporating emotional and psychological aspects of risks should not mean falling into dualisms that try to define experiences as being one extreme or the other (e.g: negative vs positive). Accepting the coexistence of different and a priori, "opposite" emotional ties associated with a place does not reduce its validity. For example, in Tiksi, one respondent mentioned her desire to stay in the settlement in the future. Moments after, while discussing the poor maintenance of buildings in Tiksi, she described in great detail an episode where a cobblestone fell from the ceiling in her home next to her baby's crib. Respecting locals' experiences, their associated emotions, as well as their conceptualization of the "well-being" forms part of the notion of fairness that should be applied in adaptation research (Adger et al., 2011).

These non-material aspects also need to be included in the extra expenditures that local governments need to implement engineering adaptive measures. Coastal erosion in Bykovsky, for example, causes destruction of the shoreline where infrastructure and houses are situated. In these areas, there are also two cemeteries and many highly valued places. Emotional ties, symbolic representations and material practices that locals have developed as well as the socio-cultural rupture that moving the coffins could represent need to be included in the overall analysis. This is particularly relevant if we consider that uncontrolled and accelerated coastal erosion may lead to forced displacement of the population from Bykovsky. Better understanding these aspects would therefore extend the scope of the research and focus on identity and well-being issues - which are often overlooked - (Adger et al., 2011).

Another example of complex bio-physical changes triggered by climate change and permafrost

thaw is the increasing number of exposed paleontological carcasses and tusks (including from mammoths) on the northern coasts which are now being sold by younger generations from the villages and remote settlements in the Russian Arctic. In a harsh socio-economic context characterized by high prices, the decline of traditional crafts and increasing environmental pressure, tusk-gathering is perceived by many as a complementary source of income. However, others see it as an activity that goes against traditional beliefs and worldviews. As a result, it could cause social fragmentation and a deterioration of the ties between generations within northern communities. As previously stated, being forced to change the type of activities practiced in northern settlements, especially indigenous ones, could destabilize the cultural and historical foundations of regional identification (Koptseva & Kirko, 2015). This is particularly relevant if we consider that local residents refer to traditional activities as important elements of their northern world. They dignify local lives by increasing their feeling of well-being, identity and given them a particular sense of belonging. Economic modifications are therefore seen as a threat to the stability of the particular socio-ecological system of Russian Arctic rural settlements like Bykovsky (Forbes et al., 2011).

Similarly, coastal erosion has multiple consequences. On the one hand, it causes irreversible degradation of local cemeteries and other significant places. It also raises the possibility of having to forcibly displace the population. Both can involve severe emotional and psychological losses for a community that should not be overlooked. These study cases reveal the importance of territory and climate as well as social harmony and a sense of belonging in the definition of community identity (Tschakert et al., 2017). In this sense, the numerous changes associated with climate described by local residents are seen negatively, given the attachment to "cold weather" of many of them. This highlights the importance of particular climate conditions on lifestyles but also on physical comfort. This is not only closely associated with their general well-being but shapes their adaptive capacity to new climate conditions. This aspect is often overlooked in climate-oriented research. This shows, once again, how changes experienced in the bio-physical dimension also affect important cultural aspects associated with identity consolidation processes.

This wide variety of examples illustrates the challenges locals face in redefining the ways they interact with each component of their environment. They are also being forced to create new tools and mechanisms that allow them to absorb and tackle the negative impacts of climate

change and permafrost thaw. The complex physical-environmental changes that Tiksi and Bykovsky are experiencing can lead to the necessity of renegotiating a wide range of meanings and relationships that were previously defined under different circumstances (Adger et al., 2011). In this sense, it is here stressed that the de-structuration triggered by permafrost thaw and climate change should be analyzed from a cultural, political, economic and ecological context.

The difference in the time it takes for communities and legislation to respond to change need to be addressed (Ford et al., 2015), especially in order to redefine the limits on traditional activities. While communities respond to change on a daily basis, the regulatory regimes require much more time to be modified and updated.

The bibliography shows that climate change occurred in the past and lessons can be gleaned from analysis of previous civilizations who also experienced it, such as the Roman or Maya empires (Fiske et al., 2014). Although Wachtel (1067) focused on the impacts of the Spanish Conquest on the Inca empire in Peru between the years 1520-1570, it is possible to find some parallels with the current transformation that northern communities are currently experiencing as a result of accelerated climate change. He suggests that these changes were not triggered by a single event (the arrival of white Europeans), but instead were the result of the colonialism in the area. Similarly, in this dissertation, the concept of “de-structuration” is used to reflect the multidimensionality of climate change and permafrost thaw in Arctic settlements. The intention is not to focus on the effects of one event in isolation but instead to examine the complex processes unchained by both processes, as well as their interconnectedness with the various aspects of northern lives. Climate change affects human lives in many ways and addressing this complexity requires analyzing multi-scale interactions in order to identify the main drivers as well as the impacts (Fiske et al., 2014).

Social sciences try to understand what people perceive and why they act like they do. Answering questions of this type underlines the importance of qualitative methods in this research domain (McCarthy et al., 2014). In this sense, the information collected during both field campaigns has allowed the multiple actors, spheres and processes in constant interplay as a result of climate change and permafrost thaw to be connected. Respondents provided new valuable information. They interpret and evaluate events through a site-specific frame of reference that integrates a

series of elements including the harsh climate and socio economic conditions; the national and regional historical processes; the heterogeneous demographic structure and a particular sense of mobility. Social representations of residents from Yakutsk, Tiksi and Bykovsky demonstrate that socio-economic, cultural and natural dimensions are overlaid when addressing the impacts of permafrost thawing and climate change. They interact with each other in a synergistic feedback loop. It is only by understanding the various interactions that the reality of northern life can be reconstructed. Similarly, in order to determine the extent and implications of the “de-structuration” of the northern world, it is essential to identify the multiple interactions between each of the elements of the system. Cultural aspects are particularly relevant as these can shape the way people respond to climate-change-related risks (Adger et al., 2013). Doing so also gives a better understanding of their specific needs in terms of targeted action and the most appropriate approaches. However, it is also necessary to identify the “external pressures” that exacerbate the challenges of climate change, including social changes, the loss of traditional knowledge and changing demographics (Ford et al., 2015). This is particularly relevant for settlements like Tiksi and Bykovsky where local socio-economic conditions are dependent on external decisions.

Moreover, the way Tiksi and Bykovsky inhabitants describe and interpret changes in their environment demonstrates that the elements adopted and integrated into their systems as “valuable” by Northern communities is not homogeneous or predictable. A deep understanding of what is vital for residents and why, will provide a more solid base to co-formulate legitimate, effective and site-specific adaptive strategies. According to Ford et al. (2015), when adaptive strategies ignore the non-material dimensions, this can severely diminish local resiliency. It also contributes to the definition of a new organization within this “new world” while remaining faithful to locals’ desires and worldviews. Attempting to address impacts without considering the material and symbolic synergistic feedback processes of each dimension (socio-economic, cultural and natural) could lead to meaningful structuring features for people living in northern settlements being overlooked. This is why analyzing the extent and severity of impacts on each of the three main dimensions (socio-economic, cultural and natural) in northern settlements needs to consider the interrelationship between them.

Impacts associated with climate change and permafrost thaw are hard to place within clear

boundaries, to define in quantitative terms or using external criteria. The constant overlap between dimensions emerging from local narratives also appears when trying to understand the impacts which exceed the natural dimension and also affect local culture and worldviews.

Finally, it is important to highlight that changes affect stakeholders differently depending their level of contact with nature. The more dependent they are on nature, the more affected they are by the effects of climate change and permafrost thaw. This includes indigenous peoples, but also those northern residents who obtain food and resources from nature to survive in harsh climate conditions. However, even people working in administrative jobs, for example, will also be impacted as they depend on these people for products like fish and meat. This strong interdependence between northern residents (“villagers”) and urban dwellers underlines the multiscale effects of climate change and permafrost thaw. This is why the notion of “de-structuration” of the northern world appears to be broad enough to reflect the multidimensionality and complexity of these phenomena.

Chapter VIII introduced and analyzed a series of elements that local residents mentioned during the interviews. For example, it was possible to establish that the idea of “change” is a concept that is used in discourse to address a broader general uncertainty about changes in their environment and social configuration. This chapter also highlighted the relevance of national and regional legacy in the way local residents perceive such changes. Moreover, their activity, place of residence and place of birth can also shape how each person appraises the impacts of climate change and permafrost thaw. This network of multidimensional impacts identified by interviewees suggests that the northern world is currently experiencing a process of de-structuration. Chapter IX will address the associations between de-structuration, mobility and motility in northern settlements. Within this framework of uncertainty, this chapter will also present the main elements to take into consideration when evaluating quality of life, future perspectives and how these interact with adaptation in the settlements.

CHAPTER IX: CURRENT AND FUTURE PERSPECTIVES IN THE LIGHT OF CLIMATE CHANGE AND PERMAFROST THAW

Understanding the extent and severity of changes in northern communities due to climate change and permafrost thaw is a complex task, especially if the intention is to qualify them. In this chapter, I focus on community based on place, while acknowledging that localities may include different social networks, communities or identities (Mihaylov & Perkins, 2014). This chapter aims to:

- 1) obtain a better understanding of site specificities and local interpretations of ongoing changes in climate and permafrost
- 2) how these influence local future plans and mobility trends.

IX.A) INTRODUCTION

Past events influence local ways of perceiving their lives and livelihoods. In their narratives, many residents from both settlements remembered the lifestyle during Soviet times with nostalgia (see interview 15 quote 17-15 appendix to chapter IX) and frequently referred to it as an example of outstanding quality of life. Those living in the North during this era experienced what is considered by many to be one of the moments of splendor in the region. This was due to several elements: first of all, transportation to and from the North was more accessible because the Soviet pricing system did not reflect the real costs. The high costs due to remoteness and the limited periods when navigation is possible were subsidized from the Russian budget for Northern shipping (Heleniak, 1999). Locals mentioned having access to a wide diversity of products, excellent professional services and high quality healthcare during Soviet times. Women mentioned being able to buy fashionable clothes and accessories which contributed to their general well-being (see interview 15 quote 37-2 appendix to chapter IX). There were also affordable direct flights to Moscow from Tiksi, the port functioned year-round (see interview 15 quote 12-19 appendix to chapter IX) and roads and buildings were maintained. The government also provided benefits that included higher wages, earlier pension entitlement and subsidized vacations for longer periods of time (Gjørsv et al, 2020). These were different manifestations of one of the most prosperous periods in the North. This prosperity came to an end after 1992 when

the liberalization of prices led to a sharp increase in the prices of goods and services in the North. Places located closer to the sources of production were not as severely as impacted as northern settlements. Much of the economic activity in the North diminished and the relevant workforce became redundant in the context of the new market conditions.

After this, northern settlements underwent dramatic changes and life there nowadays presents several challenges, according to locals. These include high prices of housing, food, services and in some cases, a feeling of isolation due to limited access to central urban settlements/cities caused by the long distances and high prices of flights. The quality of services in the North also shapes the way locals evaluate life in the settlements. In fact, poor Internet access and insufficient heating conditions have led to a reduction in the standard of living. Moreover, accelerated changes in the climate and in their environment put extra pressure on traditional activities and are perceived as concrete threats in their lives (see interview 22 quote 7-4 appendix to chapter IX).

The experience of a prosperous socio-economic development followed by the collapse of the Soviet centrally planned economy has affected Northern inhabitants. These past experiences influence the way locals perceive and evaluate current changes and the socio-economic reality they now live in. Such was the case of a woman living in Tiksi (see interview 15 quote 13-1 appendix to chapter IX) who mentioned that her "romantic feelings" of nostalgia for what Tiksi used to be during Soviet times, the tundra, nature and seeing her remaining friends from childhood who still live in the settlement calm her down and give her joy in life.

When asked about life in their settlements, locals compared their current reality to their past lives in the Soviet era which is now over (Marchesini, 2015 p. 164) (see interview 13 quote 12; interview 7 quote 35; interview 34 quote 9 appendix to chapter IX). Blustein (2008, p.8) affirms that melancholia gives people "a sense of rootedness and historical continuity and in this way comforts them with a sort of existential reassurance". This is particularly relevant as it saves people from indifference and despair. Sharing a common past gives sense and meaning to their lives. This could be the case of elderly people who, although acknowledging the extreme challenges of life in the North, declare that they are unwilling to leave. Shared memories within a community can give a common notion of purpose and therefore, guide action. Similarly, nostalgia can filter

local interpretation of their current reality and determine how they feel about living in the North. Nostalgia can also shape local projections of the future of the settlement and their personal lives. For example, an old woman living in Tiksi projected her feeling of nostalgia to the future and manifested her desire for younger generations to contribute to “raise their homeland”.

The Republic of Sakha’s population has historically demonstrated high mobility between regions and within them (see Russian Census 2010) and this can now be considered to be culturally rooted. Movement within the territory was also supported by Soviet policies. Policies aimed to attract volunteer workers to the industry of mineral resources (which became one of the pillars of the Russian economy) in remote northern regions (Heleniak, 1999). The legacy of a centrally planned economy is still observable nowadays in terms of mobility patterns and the demographic composition of northern settlements/villages. Among our interviewees in Tiksi, for example, only 4 were born there, while the others were natives of other districts (such as the Ust-Aldansky District), neighboring settlements such as Taimylyr or Kyusyur, and a minority came from as far away as Azerbaijan. In Bykovsky, only one of the respondents was born in the settlement. The others came from Tiksi, Tumar (or Sagastyr) and Crimea. Most of them mentioned having lived in at least one or two different settlements/cities or having some of their family living in different regions/districts. Mobility is inherent to the culture of the Republic of Sakha, and could contribute to providing a better understanding of the current situation in northern settlements in the context of accelerated climate and permafrost changes. It can be considered as a means of “generating and relieving stress within a social and ecological framework” (Savishinsky, 1971). This is why, it is not surprising that people move around the territory in search of better career prospects, higher studies or better healthcare services.

The purpose of this chapter is firstly to identify and describe the main regional and local mobility trends in the past that shaped the lives of the inhabitants of Tiksi and Bykovsky. Secondly, it analyzes the role that history and past references play in influencing (directly or indirectly) locals to leave or to stay. Finally, other drivers that locals mention will be taken into consideration when evaluating their current standards of living and their aspiration for the future.

IX.B) PAST MOBILITY TRENDS

From the analysis of our respondents' narratives, three main past mobility trends in the area were identified:

XI.B.I) Locals who left Tiksi and came back

Two interviewees mentioned having moved to bigger cities (Moscow and Ukraine respectively) before eventually coming back to the settlement. This appears to be because they missed some specific characteristics or aspects of life in the North. Both, a woman working in at the Tiksi administration and a horse breeder, did not regret their decision to come back. In fact, although it gives greater access to job opportunities and entertainment options, life in big cities can also have its downsides. Their narratives had several points in common: first of all, both residents left Tiksi to look for better job opportunities after the Soviet breakup. However, they also mentioned feeling overwhelmed due to the breakneck speed of the new life, the lack of social networks there and missing the familiarity they had in the settlement. Additionally, the woman felt unwelcomed by the local population in their new destinations (see interview 15 quote 14-3 appendix to chapter IX). The emotional effects were such that her family (including her 12-year-old child), had difficulties to adapt and needed to see a psychologist. She mentioned missing the cultural development of Tiksi, its multiethnicity and the presence of "comrades" or friends (see interview 15 quote 17-2 appendix to chapter IX).

The horse herder said that based on his previous experience in Moscow, he plans to no longer leave Tiksi. He mentioned being unable to adapt to the constant movement that characterizes big cities. He said he intends to teach his children everything he knows (probably in terms of the traditional lifestyle) but the final decision about what to do or where to go after their studies is theirs. (see interview 22 quote 21-2 appendix to chapter IX). He openly acknowledged the current problem of people "disappearing" (leaving) from the settlement, but the situation seems not to depend uniquely on them as a family.

XI.B.II) Those who came to Tiksi (comers) and left

Interviewees also mentioned that, in some cases, newcomers (from central districts) could not cope with the Northern lifestyle and left after a short period of time. Although I did not obtain any first-person account, our respondents believe that this is due to the extremely high prices,

the harsh environmental conditions and the lack of a social network in northern settlements. Practicing traditional activities allow locals to obtain their own fish and meat, which form the basis of their diet. Not practicing these activities can also diminish the ability of newcomers to adapt (see interview 21 quote 16-5 appendix to chapter IX).

XI.B.III) Those who came (comers) and stayed

Of the newcomers that arrived in the North during the Soviet Union era looking for new professional horizons and adventures, some of them settled down and stayed in Tiksi, Bykovsky and neighboring settlements. Most of them planned to stay for a season before going back to their place of origin. This was the case of one respondent born in Azerbaijan who arrived during the 80s and started working on rafting. He could still remember how active the settlement was seasonally and the prosperous construction industry in the area (see interview 7 quote 9 appendix to chapter IX). Among our respondents, there were also people from other districts (such as the Ust-Aldansky District) or from closer settlements/villages such as Taimylyr or Kyusyur. In Tiksi, only four respondents were native to this settlement, while in Bykovsky, only one. The others came from Tiksi, Tumar (or Sagastyr) and Crimea. The latter studied at the nautical school in Crimea before moving to Tiksi and working in the local fleet. Since 1989, he lives in Bykovsky. This is not surprising as students at the Black Sea Navy School in Crimea were frequently designated to Arctic ports. Komsomol travel tickets promoted adventurous professional experiences in the Russian territory for young professionals during the Soviet Union era. Early retirement for civil servants and northern inhabitants is one of the main economic benefits of living here. For this reason, some people stay in northern settlements until retirement and then migrate (to their homeland or places with which they have developed emotional bonds mainly) (see interview 24 quote 26-1 appendix to chapter IX).

IX.C) CURRENT CONCERNS AND FUTURE PROSPECTS

This section analyzes how locals perceive their current reality in terms of viability, which elements they take into consideration for coordinating action, and what role nostalgia and climate and permafrost changes (developed in detail in chapter 8) play in their desire to migrate. This will extend the knowledge of what is considered necessary for northern inhabitants from Tiksi and Bykovsky to lead meaningful lives in a changing Northern World. Decoding the complex network of relationships between northern inhabitants and their environment can also help identify the potential impacts that eventual forced displacements could have on inhabitants living in coastal communities undergoing rapid coastal erosion, such as Bykovsky.

Describing the economic profiles and specificities of Tiksi and Bykovsky may give a better understanding of how their inhabitants perceive and react to ongoing changes and which decisions they consider to be desirable for their future.

Tiksi is the only urban settlement and administrative center in the Bulunsky District. Consequently, it is considered to have a better infrastructure and a more diversified economy than the surrounding villages which are strongly reliant on traditional activities. Its population is composed of a wide diversity of nationalities, including Belarusians, Russians, Buryats, Kazakhs, Kalmyks, Kyrgyz, Tatars, Uzbeks, Ukrainians, Chukchi, Evenki, Evens and Yakut, among others. Bykovsky, on the other hand, has a different economic and demographical profile: firstly, because it is a fishing settlement and its establishment has been reaffirmed during the Soviet Union. Moreover, Bykovsky is an Evenki rural settlement which is eight times smaller than Tiksi in terms of population. The main nationalities are Evenki, Yakut, Even and Russians. During interviews, local inhabitants agreed on the fact that the possibility of continuing to live there is highly conditioned by:

1) the presence of fish in the water,

2) infrastructure and

3) the continuity of Kholkhoz Arktika's activity (see interview 29 quote 5-5; quote 63-1 & quote 63-3 appendix to chapter IX).

Analysis of local narratives demonstrates that a wide diversity of elements and processes are considered when they interpret and evaluate their current reality in order to determine whether their places remain viable or not. These include personal experiences, interpersonal relationships, cultural background and shared historical processes. In northern settlements, post-Soviet nostalgia also sways local perceptions of their standards of living and what they expect for their lives and places. Place is a broad concept that has physical, geographical, architectural, historical, religious, social and psychological connotations (Knez, 2005). Ryden (1993, pp. 37–38) specified that place is “much more than a point in space... [it] takes in the meanings which people assign to that landscape through the processes of living in it”. Additionally, Knez’s (2003) theory identified climate as a “nested physical structure in places that may have a significant impact on functional as well as on psychological connotations of places”. This is particularly relevant for northern inhabitants as place and climate are key elements that develop emotional ties, symbolic representations and material practices for locals in that particular region of the globe under particular circumstances. A warmer climate in Tiksi and Bykovsky, where extreme cold is a constitutive element of the culture and worldview, could have irreversible cultural and psychological consequences.

For many locals, the notion of “here” frequently meant “in the Bulunsky District” rather than literally “in our settlement (Tiksi or Bykovsky)”. People with high motility and mobility present a broader notion of “here” to include the city of Yakutsk (which they frequently visit for various reasons). The delimitation of what each local considers as “here” and its significance is strongly influenced by personal experiences, symbolic and emotional connections and the meanings attributed to each place. It also relates to the elements each place contributes which are culturally appreciated or required. Additionally, the relationship of indigenous people with places can also include kinship, familiarity, obligation and care (Dandy et al, 2019). These elements are also relevant in determining the impacts of climate and permafrost change.

Although many respondents said they might migrate in the near future, it is important to highlight that the relationship between the perception of changes and the decision to migrate is not linear and strong emotional bonds to their places may make them stay (Barcus & Brunn, 2009). Moreover, according to Relph (1976), experiencing hardship in the place to which they are

attached could strengthen this feeling. This could be particularly relevant for people who stayed in the North even after the Soviet Union dissolution.

In the narratives, the current socio-economic situation in these settlements appears to be one of the main elements constraining the possibilities for people in northern settlements. Although the idea of leaving the settlements was also mentioned by elderly people, this trend seems to be particularly accentuated among the younger generations in these communities. After finishing their studies in bigger cities, only a few are able to return to the northern settlements as job positions are limited or inexistent in certain domains.

“There is no way to find any job here [Bykovsky]. There are no jobs. There are no jobs in Tiksi either. This is the problem of small villages. There are no enterprises. I would say that educated people have no jobs here. Well, just a few.” (interview 24 quote 26-1)

“Well, there is no work. There is no place for them [young people] here [Tiksi]. Because of this, they are leaving. Now, the reindeer herders are not even young! Only the old ones go (herding). Their [human] nature is not dragging them there, I guess. Probably because parents didn't [plant this seed] in them. Only children of reindeer herders go in summer, every year. Only they stay [in the reindeer herds]” (interview 13 quote 102)

These quotes seem to globally summarize the current situation in northern settlements and villages and could be a starting point to better understand the current migration trends in the region. Overarching observations show that current socio-economic conditions are one of the main elements hampering professional development and forcing inhabitants to leave, especially young ones (see interview 29 quote 63-5 appendix to chapter IX). Considering the limited job opportunities after graduation in these settlements, most migrate to bigger cities that provide them with a wider range of possibilities. Yakutsk is the most popular urban center in the Republic of Sakha to which people migrate in search of better job prospects, higher education or medical assistance. Among locals, it is common to find parents supporting and financing their children's studies in bigger cities who affirm that their children will most likely not come back to the northern settlements. For example, a woman working in the Tiksi administration whose son is studying in Saint Petersburg firmly dismissed the idea of her son returning to Tiksi. Although he

has an offer to come back, she said he seems uninterested in returning (see interview 31 quote 23-4 appendix to chapter IX)

People from Bykovsky share the same vision about their children's future. However, while in Tiksi the main destination appeared to be Yakutsk (see interview 28 quote 4-43 appendix to chapter IX), in Bykovsky, some families considered Tiksi as a potential destination that could provide better opportunities to people from villages after finishing their studies. A woman with one son studying in Yakutsk, said that he will probably not return to the North, but if he found a job, he would probably settle in Tiksi (see interview 25 quote 36-1 appendix to chapter IX). People from the villages seem to exclude the possibility of their children returning to the villages, preferring that they stay in big cities or bigger urban settlements like Tiksi. A native of Taimylyr living in Tiksi (see interview 18 quote 11-4 appendix to chapter IX) acknowledged the complex situation that young people are currently facing and reaffirmed that the lack of jobs prevent them from returning to their settlements after graduating. In fact, most interviewees mentioned having at least one young member in their family studying in bigger cities. With these elements in mind, the desire to leave was not judged negatively (see interview 31 quote 4-2 appendix to chapter IX). Although they were also concerned, others analyzed the broader implications for the development of the settlement and the region of massive youth departure. For example, a resident from Tiksi working at the port said that one major problem of youth emigration is the consequent lack of specialists in the area (see interview 20 quote 6-3 & interview 15 quote 36-2 appendix to chapter IX). On his side, a reindeer herder expressed a different concern related to youth emigration. For him, young people leave to study and do not come back to their villages to herd as they did in the past. Therefore, he suggests that technological benefits, such as Internet, could attract young people to come back and live from traditional activities such as reindeer herding (see interview 21 quote 19-2 appendix to chapter IX). While encouraging people to study, he also suggests encouraging them to come back and exercise their professions in their villages/settlements. Education was also identified as a way of incentivizing more children to become involved in traditional activities. A veterinarian at a reindeer breeding enterprise in Kyusyur, remembered that when he was in 9th grade, there were different specializations related to traditional activities and that he went to the field on spring vacation to learn how to herd reindeer. For him, having these opportunities at school could increase the number of non-

indigenous kids enrolling in traditional activities (see interview 21 quote 6-8 appendix to chapter IX).

Although emigration seems to be a predominant trend among young people, the future can also be also filled with uncertainty for others. For example, an authority from Tiksi mentioned that his daughter left when she started her studies at University and did not come back. She is now living in Moscow and does not plan to return to Tiksi in the near future. However, his son remains in Tiksi and is developing his own communication project. He does not know what his third and youngest son will do in the future (see interview 1 quote 102 appendix to chapter IX). A 24-year-old economist working in Tiksi for the Taimylyr administration mentioned the possibility of leaving in two years, but if she didn't like the new place, she would consider coming back to Tiksi as she loves the settlement (see interview 39 quote 1-13 appendix to chapter IX). Her elder sister is studying in Yakutsk and the middle brother will follow his sister's steps. However, her mother does not want to go anywhere as she loves Tiksi and finds most places too hot when she goes on vacation (including Yakutsk).

A man born in Magadan, now living in Tiksi, said that small improvements in quality of life (such as better Internet connection) can attract young people (see interview 19 quote 32-8 appendix IX). He also mentioned that according to recent statistical information, the number of people arriving and leaving are similar. According to the information provided in the Statistical Yearbook of Republic of Sakha (2019) on municipal migration (arriving, leaving and population gain/loss), the trend of emigration from the Bulunsky District has significantly decreased since the 2000s. In fact, 2018 registered the lowest migration level, with only 26 people leaving the Bulunsky District. Detailed information at the settlement scale is nonexistent. Although this information could be useful to reflect general migration trends at a district level, it does not provide information on the ages, gender nor reason for emigration (see Table 8 below).

Even if the main reason for emigration of young people seems to be socio-economic, this is also accompanied by other structural problems such as a complex housing situation (many abandoned by their owners who left the settlement after the Soviet breakup).

Year	Incoming	Quitting	Migration gain (loss)
1990	1384	1630	-246
2000	256	670	-414
2010	673	280	393
2012	464	1005	-541
2013	325	805	-482
2014	295	458	-163
2015	383	466	-83
2016	420	432	-12
2017	366	484	-118
2018	424	450	-26

Table 8: Migration trends in the Bulunsky District between 1990 and 2018. Source: Statistical Yearbook of Republic of Sakha (Yakutia) (2019).

One respondent affirmed that this situation is accentuated by the unwillingness of owners to sell their properties as "some kind of development is visible in the future" and that they want to "preserve their real-estate so that in the future they can sell it" (see interview 2 quote 218-1 appendix to chapter IX). People from Tiksi and Bykovsky agree on the fact that young professionals will leave these settlements and "flourish somewhere else" (see interview 26 quote 35-1 appendix to chapter IX). Northern settlements have already experienced emigration in the past, especially since the perestroika period as one of the major consequences of labor shedding. Limited job opportunities in northern settlements are proven to initiate mobility processes among the youngest sectors of the population (either permanent or temporary emigration). This could be interpreted as an adaptive strategy adopted to reduce the effects of unemployment in remote areas. In addition, many of our respondents have lived in at least one or two different cities/settlements/villages before or have some of their family scattered in different regions. This was the case of a sailor from Crimea and a freestyle wrestling coach living in Tiksi who lived in Churapcha before, where he studied. The topic was addressed with a certain spontaneity, demonstrating that this is the logical continuity of events. Many experienced it in the past, and

now have members of their family facing similar situations. This leads to a general empathy towards the emigration of young people with no stigmatization.

Despite the current complex socio economic situation, different possibilities were mentioned for the future of the settlements. Some openly stated that the future will probably be worse than now (see interview 14 quote 82 appendix to chapter IX). This woman declared being afraid of the possibility of “going down” in floods if permafrost thaw continues. A native of Magadan seemed to be more optimistic: “It will be the same as in Soviet times” accompanied by development as he imagines Tiksi becoming the transportation hub of the Northern Sea Route (see interview 19 quote 26-2 appendix to chapter IX). There was also a group of respondents who, based on their emotional ties with their settlements, consider the possibility of a better future with them being “reborn like a phoenix” (see interview 15 quote 34-2 appendix to chapter IX). Another respondent associated this improvement with the possibility of having new federal investment in the area (see interview 13 quote 77 appendix to chapter IX). The head of agriculture, a native of Kyusur (see interview 18 quote 8-9 appendix to chapter IX), said that a better and a worse future are both valid possibilities. The situation could deteriorate if it rains after heavy snowfall (or if it rains in subzero temperatures), causing the rainwater to freeze in the form of a crust preventing reindeer from foraging with their hooves (mainly grass and lichen). Their hoofs and knees might get damaged or broken. Also, eating icy foraged food is not good for their digestion as it has too much water. Changes in climate seem to shape the future of herders.

This diversity of possible scenarios for the future of the settlements is closely related to the decisions of locals, especially in terms of mobility.

IX.C.I) People willing to stay

Communities such as Bykovsky and Tiksi where environments are changing rapidly due to climate change (Chapin et al. 2014), are among those that have been identified as likely locales for climigration. However, analysis of our interviews reveals that many respondents are firmly unwilling to leave. For some, leaving their settlement is not even an option they consider. Strong emotional ties founded in multiple and interacting drivers (climate, social belongingness, education level, lifestyle of the area, landscape, feeling of security, Soviet memories, among others) sustain their desire to stay (Hay, 1998). In most cases, these elements interact

simultaneously in individuals. Attachment is expressed in different ways: for example, two respondents from Tiksi revealed that climate plays an important role in the way they feel about these settlements and therefore underpins their decision to stay. One of them mentioned that she would only consider going to Yakutsk, but the summer is too hot there, while Tiksi, on the contrary, "is better" (see interview 8 quote 105 appendix to chapter IX). The other narrated the nightmare of going on vacation to Ukraine to visit her family, as she cannot stand the warm temperatures (see interview 15 quote 16-3 appendix to chapter IX).

Similarly, an inspector of the environment living in Tiksi seems unwilling to leave the North. For him, this is not just anywhere, but a place where his father and grandfather were born too. Landscape, the tundra in particular, also seems to be an important part of his emotional ties (see interview 5 quote 42-2 appendix to chapter IX). Others focus on the feeling of security they experience in Tiksi because it is a border regime area (see interview 15 quote 17-2 appendix to chapter IX).

In other cases, despite the challenges of living in northern settlements like Tiksi and Bykovsky, some respondents declared that they love their district and settlement, and therefore, will not leave (see interview 12 quote 5-1 appendix to chapter IX). The length of time of residency also contributes to making some residents feel like this is their "home place". An authority from Tiksi who arrived in the settlement when he was eight years old mentioned not being able to imagine going anywhere else in the near future (see interview 1 quote 98 appendix to chapter IX). A similar perspective was given by an older inhabitant who considers that if their health allows it, people should continue to live in their birthplace until the end (see interview 28 quote 38-1 appendix to chapter IX). However, others who need long-term medical assistance see the lack of medical infrastructure and professionals as a reason to leave the North and settle in bigger and better equipped urban centers (see interview 33 quote 72 appendix to chapter IX). Elderly people who mentioned not wanting to leave are forced by health issues requiring medical assistance to consider the idea of emigrating. Others are willing to stay for economic reasons: they plan to stay in the settlement until they retire and obtain their northern pension before emigrating elsewhere afterwards (see interview 24 quote 26-1 appendix to chapter IX).

Another important element for locals in Tiksi and Bykovsky is traditional food. Fish and meat are called “black food” in Sakha while “ground food” includes everything which is gathered (berries, mushrooms, herbs). Both types of food are essential for all northern families as they are the basis of their diet. The tie is so strong that some respondents said that they bring meat and fish with them when they go on vacation so as not to miss it (see interview 26 quote 68-14 appendix to chapter IX). Moreover, it is also closely connected to their traditional activities which contribute meaning to their lives and to a broader state of well-being (see interview 29 quote 65-18 appendix to chapter IX). Black food is normally fished or hunted by male members of the families. Most respondents indicated that they rarely buy them in shops but prefer to hunt/fish themselves or get them from relatives. They think that if everyone decided to leave the villages, there would be no one to send meat and fish to the cities and bigger settlements. This is particularly relevant in a context where buying these products in Yakutsk is prohibitive as they can cost two or three times the price in the villages.

The previously cited examples show that locals incorporate a wide diversity of elements when evaluating viability in their settlements and characterizing their relationships with place. When living conditions become problematic, locals are capable of developing and adopting new adaptive strategies or mechanisms, leading to different migration patterns (e.g., Black et al. 2011; McLeman and Smit 2006; McLeman, 2017). The multiple and simultaneous direct and indirect relationships coexisting in one social-ecological system make it difficult to isolate the effects of climate on emigration from other factors and processes using observational data alone (Entwistle et al., 2016).

The decision to stay has been interpreted by some authors (e.g: Huntington et al, 2017) as a strategy to reduce the shock and stress that leaving could cause them. For example, one woman from Tiksi who emigrated in the past but came back to the settlement because she missed her comrades and friends from Tiksi, highlighted the importance of a developed social network for people from Tiksi (see interview 15 quote 17-2 appendix to chapter IX). The decision to stay also stems from people’s desire to pursue individual or collective dreams: one respondent, a native of Taimylyr living in Tiksi, said that he is not planning on moving as he has always dreamt of working his own farm in the settlement after retiring (see interview 2 quote 105-1 appendix to chapter IX). Similarly, in Tiksi, attachment seems to be at the core of some people’s desire to “rebuild” the

settlement as it was in Soviet times (see interview 15 quote 34-2 appendix to chapter IX). These reasons have positive connotations as they disclose forms of community commitment to the place, despite the hardship. To do so, locals take different forms of concrete action, such as finding alternatives (ways to achieve similar outcomes through different means) or buffers (using reserves to delay the unwanted impacts) that help them to cope with rapid changes (Huntington et al, 2017).

However, this desire to remain in place (attachment) can also be considered as a negative if it reflects people's inability to move and leads to a feeling of being "locked in" (e.g., Allison and Hobbs 2004; Barnett and O'Neill, 2010) or if staying puts their lives at risk (Huntington et al, 2017).

IX.C.II) People willing to leave

Mobility is a fundamental aspect of human freedom and entails the freedom to seek opportunities to improve living standards, health and education outcomes, and/or to live in safer, more responsive communities (UNDP, 2010, p.1). Aspiring to better conditions of living encourages mobility among northern residents too. Analysis of local narratives reveals the broad range of elements considered by residents of Tiksi and Bykovsky when they decide to leave. Narratives reveal that older generations do not judge negatively young professionals leaving these northern settlements as they are fully conscious of the difficulties that they experience. Thus, older people seem to apply different interpretations and expectations to themselves and to their children. While some openly express their emotional attachment to place and their unwillingness to leave, they respect young people's decision to leave. Some say they are fearful of the possible negative effects of climate change on health (see interview 14 quote 92 appendix to chapter IX). This woman identified health issues as the reason why she believes that leaving the settlement will be necessary.

The purpose of this section is not to quantify the correlation between each element mentioned and the desire to leave. Instead, it is intended to highlight the diversity of aspects that locals take into consideration in evaluating the quality of life and viability of their communities.

IX.C.2.1) Inner mobility

Another different form of mobility appeared in local narratives: some aspire to return to other settlements, which were, in some cases, also their historical homelands. A resident of Tiksi whose parents came during Soviet times from Kyrgyzstan and the Ivanovo region said she wanted to return to the city of Novgorod. She added that poor healthcare in Tiksi was also a concern for her, especially when extreme winter conditions make it impossible to leave the settlement by plane (see interview 31 quote 21-3 appendix to chapter IX). Despite being clear about leaving in the near future, she highlighted that she will miss the feeling of greatness that nature provides her in Tiksi.

Another woman who was born and lived in Tiksi expressed her intentions to move to her father's homeland, Kyusyur (see interview 11 quote 133 appendix to chapter IX).

IX.C.III) Tiksi: a future ghost town?

Narratives from the residents of Tiksi and Bykovsky provide invaluable information on their emotional ties, concerns, needs and future perspectives. Even if the main purpose of this dissertation is to focus on permafrost thaw and climate change, making sense of these narratives requires placing them in a broader national and international geo-political context. By doing so, it will be possible to better understand the main priorities for the Russian Federation in the Arctic currently and how these interplay with what locals perceive, desire and expect. It is impossible to predict if Tiksi will become a ghost town or not. However, narratives demonstrate that decisions by locals to stay or leave and the future perspectives for settlements like Tiksi and Bykovsky, are based on a multiplicity of factors including place of birth, age, gender, professions, life experiences, access to and participation in support networks, nostalgia, attachment, financial situation, etc. Comparing these narratives with key official documents on the current and future development of the region might reveal general trends and development opportunities in the area. In this way, interweaving local perceptions with socio-economic development policies could reinforce synergies at multiple scales.

Tiksi was founded in 1933 in this strategic geographical location to promote the development of the Arctic and more specifically, the Northern Sea Route (NRS). Using the NSR could represent major savings in distance, time and expense for shipping between Northwest Europe and

Northeast Asia/Northwest America (Ragner, 2000). The crisis experienced after the dissolution of the Soviet Union brought about the disintegration of the established economical mechanism of the Northern Sea Route (NSR). International interest has increased because of climate change and melting sea ice (Fondahl et al., 2020). This could open previously ice-jammed waterways, allowing access to new resource-rich sites that can be explored and exploited (Erokhin & Tianming, 2018).

Recently, its strategical position made it particularly attractive to China. In 2017, China officially included the Arctic shipping lanes in the Belt and Road Initiative (BRI) transport network. Russia supports the BRI. The Russian authorities aim to receive China's financial participation in the development of the NSR (Radushinsky et al. 2017). In exchange, China would be provided with advanced technologies and important investments (Erokhin & Tianming, 2018). Using the NSR would give China faster access to the European and the US east coast markets. However, its potential development faces some technical challenges due to the need for an icebreaker escort, the variability of ice cover, the presence of floating ice and the variability of the navigable season (Fondahl et al., 2020).

The Russian Federation still sees the Arctic as an important region that could provide strategic resources for the country's development and the NSR as a key transportation-communications system (Osnoy, 2008). Tiksi was - and still is – the biggest town in the Eastern Russian Arctic and responds to national geopolitical interests (Ivanova & Potravnoya, 2020). Unlike other northern settlements of similar population size, Tiksi is the only one connected by water (Lena River) with large urban centers (like Yakutsk). Today, some sectors of the population of the Republic of Sakha believe that Tiksi could be soon become a ghost town because of massive emigration, just like the Russian North after the Soviet breakup. At this time, deliveries of supplies and maintenance of industrial sites and infrastructure were massively cut (Fondahl et al., 2020). Despite this historic trend, Tiksi is seen today as a key center for the stimulation of socio-economic development in the Arctic Zone by the Russian Federation. The federal and regional interest in the Arctic, is reflected in the numerous documents and policies for socio-economic development recently adopted at multiple scales.

For example, in 2017, the Republic of Sakha created the “North Yakutian support zone of the Arctic Zone of the Russian Federation⁶²” (Potravniy & Motorina, 2017). Nine support zones were created to develop the Arctic: Kola, Karelian, Arkhangelsk, Nenets, Vorkuta, Yamalo-Nenets, Taymiro-Turukhansk, North Yakutia, and Chukotka (see Figure 57 below). The purpose of these zones is to attract investment to guarantee an accelerated economic development while improving living conditions for the northern residents (Osnoy, 2008). They aim to activate the transport system, including the NSR, rivers and automobile passage corridors, air and railway connections. Also to boost the extractive economic activities associated with the energy, mineral and biological resources of the Arctic, while reinforcing interregional cooperation. Economic development is expected to bring social benefits by improving local amenities and creating more job opportunities (Dmitrieva & Buriy, 2020). In 2019, the “Strategy for socio-economic development of the Arctic Zone of the Republic of Sakha until 2035” was signed. This document focuses on social, industrial, transit, environmental and innovation areas. It considers investment in modernizing the northern transport system (airports, aircrafts, roads), seeks to provide better internet connection, more commercial opportunities based on social responsibility, preserve the traditional lifestyle, culture and traditions of the Northern indigenous peoples, improve the education and health systems and promote Arctic tourism (Yakutia adopts Arctic zone development strategy, 2020).

More recently, in 2020, the Ministry of Arctic Development and the affairs of the People of the North of the Republic of Sakha, in collaboration with the executive bodies of the Republic of Sakha, the Administration of the Bulunsky District and the citizens, developed the “Comprehensive Plan of Development of Tiksi for the Period up to 2025⁶³” (Kondrateva, 2017). In October 2020, Vladimir Putin signed the Strategy for the Development of the Russian Arctic Zone and National Security to 2035⁶⁴.

⁶² In Russian: “Северо-Якутская опорная зона Арктической зоны России в Стратегии пространственного развития Российской Федерации”.

⁶³ In Russian: “Рассмотрен комплексный план развития поселка Тикси до 2025 года”

⁶⁴ In Russian: Указ Президента О Стратегию развития Арктической зоны России и национальной безопасности до 2035 года.”

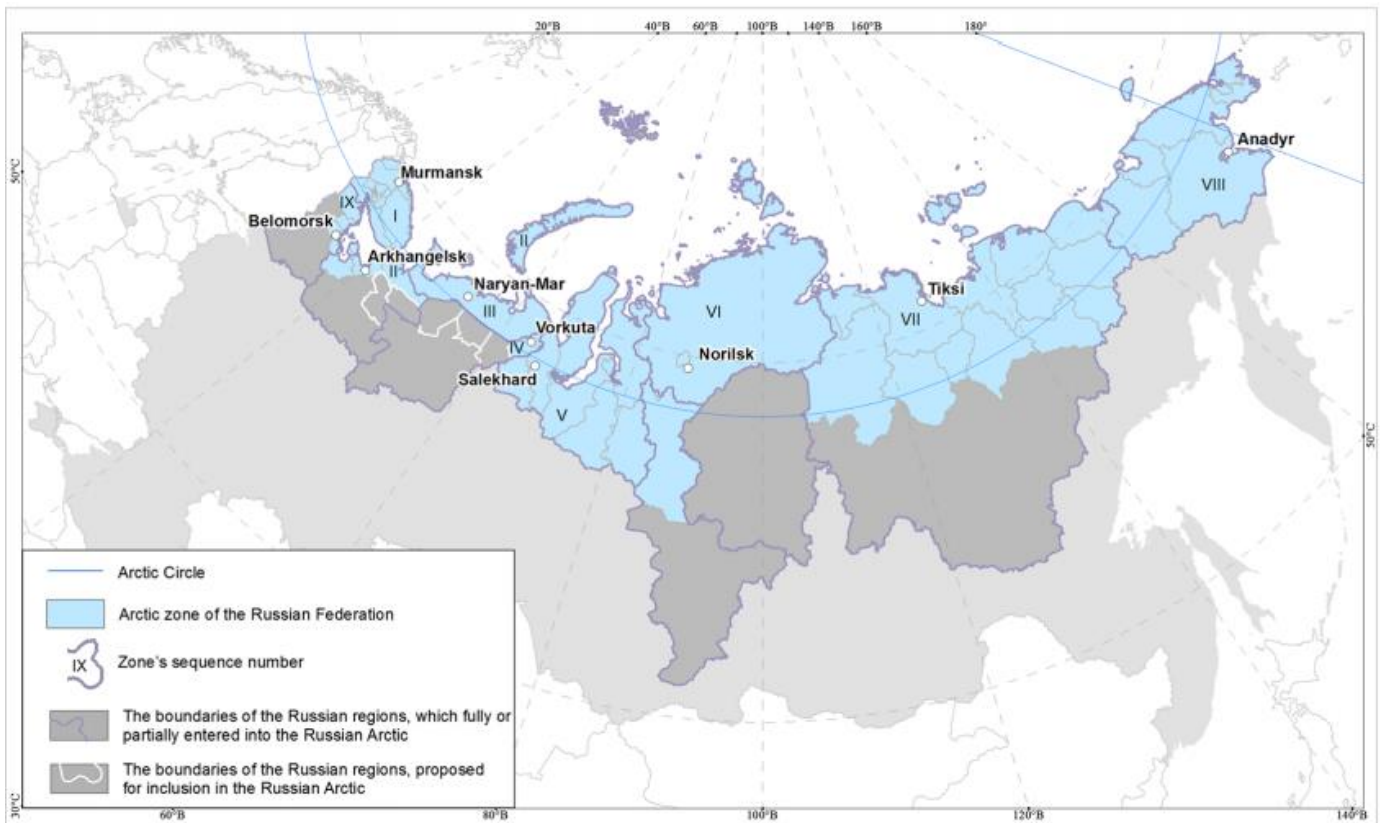


Figure 57: Location of the 9 support zones of the Arctic Zone of the Russian Federation; I – Kola, II – Arkhangelsk, III – Nenets, IV – Vorkuta, V – Yamalo-Nenets, VI – Taymiro-Turukhansk, VII – North Yakutia, VIII – Chukotka, IX – Karelian. Source: Dmitrieva & Buriy (2020)

Although the aforementioned list of documents is not exhaustive, it does provide solid examples of political action for the Arctic in support of local inhabitants' impressions of Tiksi's future perspectives. When asked about future perspectives for Tiksi, residents often mentioned that "it is said" that a future development of the area was going to occur soon (see interview 13 quote 77; interview 13 quote 34-2 below)

INTERVIEW 13 QUOTE 77 SP: "Well, if you try, people can lift up Tiksi, I guess. If you invest some kind of ... how to say ... well, if you would help with money, to build all these ... So that the management works well. Depending on our top Russia. Before, we used to have a port here. We had an international port. Now everything is closed, so we have nothing. There is no good. If it was restored, there could be an improvement."

INTERVIEW 13 QUOTE 34-2 T: "We love this settlement very much! And we believe very much that it will revive."

Since January 1992 with the economic transition, many people living in Tiksi opted for emigration. However, this was not the case for everyone as many developed ties with these new northern settlements and decided to stay in what they now considered their home. This was particularly true for workers who arrived during the early Soviet period or for those who were born and raised there (Crate, 2013). The qualitative analysis of these narratives demonstrates that determining liveability and the future possibilities for Northern settlements like Tiksi and Bykovsky is complex, non-linear, not deterministic. Despite the challenges of the past and the present, some local inhabitants are openly optimistic about the future of Tiksi, and considered that its “revival” - just like in the Soviet days - is a possibility (see interview 15 quote 34-2; interview 2 quote 220-5 below).

INTERVIEW 15 QUOTE 34-2 T: “We love this settlement very much! And we believe very much that it will revive.”

INTERVIEW 2 QUOTE 220-4 A: “Moreover, now the military are returning. Some kind of development is visible in the future, and therefore no one wants to sell now; they preserve their real-estate so that in the future they can sell at a higher price”.

In other cases, it appears that some stressors seem to push some sectors of the local population to consider the idea of leaving Tiksi. This mainly concerns older people for whom access to reliable healthcare is important. This is partially explained by a lack of specialists in the local hospital (see interview 33 quote 17 below). Having to travel to Yakutsk regularly to get medical attention is expensive and challenging for people with reduced mobility. Moreover, during the winter it is often impossible to be sure of being able to leave the settlement because of extreme weather conditions (see interview 33 quote 17; interview 1 quote 98 below).

INTERVIEW 33 QUOTE 17 NK: “In the hospital here, we do not have enough specialists. At the end of the year I got sick, I had a stroke. I was lying in the hospital. Sanaviation⁶⁵ took me to Yakutsk through the blizzard. I am so grateful to the doctors that they saved me. And so there

⁶⁵ In Russian: “Санавиацией” = helicopter or air ambulance that provides emergency medical assistance in remote regions.

are not enough specialists at all. When we need to undergo an examination, we have to fly to Yakutsk again to be examined.”

INTERVIEW 1 QUOTE 98 K: “(...) And of course, I cannot picture myself here as a pensioner at 80 years old. I don’t have any plans in this direction. But in the near future I’m not going to move from here. It’s my home place, I was brought here when I was eight, where shall I go from here?”

Thus, Tiksi appears in narratives as an unfriendly settlement for pensioners, especially because of the limited health services and the extreme climatic conditions. For younger people, other types of local stressors determine their future professional possibilities. For example, those who want to build a career in the arts can feel limited and therefore consider the idea of leaving the settlement (see interview 1 quote 102 below).

INTERVIEW 1 QUOTE 102 K: “(...) My eldest daughter has not returned (to Tiksi). She's very clever and beautiful, like her father. She has her projects there (Saint Petersburg), her own dance school, and also she's a manager of a fourth floor in a trade center where they have cinemas, studios of arts and so on – she's an artistic person. So the district cannot satisfy her requirements, what she wants to do...”

Finally, locals mentioned that living conditions and infrastructure maintenance (sewage, buildings, port, roads) also influence their decisions with frequent references to past living conditions (see interview 15 quote 11-3 below).

INTERVIEW 15 QUOTE 11-3 SM: “I remember when I was very-very young we had good roads here. Now you see... And seaport [was good]. (This happened) Because here we got my granddad, and he was a chief engineer at the seaport here. And he built the start of this seaport here. And now when see it – I want to cry because it’s very broken. They abandoned the North.”

Developing the Russian Arctic is very costly, mainly because of the high prices of goods that need to be shipped from distant regions and because of the poor transport infrastructure (for example, lack of paved roads (Fondahl et al., 2020) Also, the extreme environmental and climatic conditions increase the need for expenditure on maintenance. Northern settlements have also a particular demographic situation resulting from mass emigration of the working-age population between

the 1990s and 2010s, a low birth rate and an increasing aging population. Additionally, making northern settlements attractive to workers from other regions/districts implies offering higher wages and a good quality of life with good social and cultural services. Depending on their place of origin, the polar days and nights may involve additional expenses to facilitate biological adaptation to these new conditions (Ivanova & Potravnoya, 2020).

However, in addition to the federal and regional policies adopted, an authority from Tiksi enumerated some concrete examples of measures to develop the settlements in the Bulunsky District: improvements in the housing system; increasing the number of households with a centralized system of water supply, sewage system; increasing the amount of households from rural settlements with central heating; repairing and improving local boiler stations' capacity. All in all, some form of Arctic development is expected in the near future, with Tiksi as an active administrative center and more active navigation through the NSR.

The body of narratives gathered in this research demonstrates that local forms of social cohesion and place attachment have been developed by northern residents from Tiksi and Bykovsky. Integrating these valuable elements into policy-making and decision-taking processes could reinforce local forms of governance and therefore, actively contribute to achieving "sustainable development" of the region (one of the goals of the 2013 Strategy for the Development of the Arctic Zone of the Russian Federation and Guaranteeing National Security to 2020). When asked what they would miss most if they left, the irreplaceable human ties that people develop in northern settlements like Tiksi and Bykovsky are often mentioned as well as the fact that they love "knowing each other and knowing the place". A student born in Tiksi, living and studying in Yakutsk (see interview 18 quote 13 below, Yakutsk 2019), highlighted the importance of strong social ties, which are often hard to recreate in the new places of residence, especially in big urban centers like Yakutsk.

INTERVIEW 18 QUOTE 13 (Yakutsk 2019) R: "People who grew up here in Yakutsk, it's pretty easy for them to come and go. My classmates from Tiksi and from Siktakh need to go back home. Every summer, I come back. Its love for your birthplace maybe. It's not similar for people who grew up in bigger cities. The negative point is that there isn't a lot of people. So when moving to another place, it's really hard, you need to introduce yourself, to know how to socialize. Talk with

people again! Tiksi is really small and we know each other, it is simple to meet people, you come out and say hi! Here, there is a lot of people who come and go from Yakutsk.”

Another young student from Tiksi living in Yakutsk pointed out his desire to come back to Tiksi in the future if the socio-economic conditions improve (see interview 16 quote 1 below, Yakutsk 19).

INTERVIEW 16 QUOTE 1 (Yakutsk, 2019) A: “Tiksi is my favorite home, I love it so much. If I could, I want to come back to Tiksi because I feel a responsibility for the whole land. That is why I want to work for my home, for the people who live there. Weather is not so cold as in Yakutsk. There is very strong wind, 15 m/s. It is very difficult because people leave Tiksi. It is the economic situation...it’s very difficult to find good jobs with high salaries and people don’t know what to do. It’s dangerous because people dream. Infrastructure is really bad, internet (he laughs) even worse! By the way, I think that in the future it will be better because the Arctic is an area of interest for the government. It will take time.”

Depending on the future policies elaborated by the Russian government, the region can either continue its emigration trend, or stabilize and encourage residents to stay or even attract new residents from other regions. This is particularly important considering that most of the respondents that mentioned their intention to leave, were “externally forced” –at least discursively – by the current disadvantageous socio-economic conditions in the North.

These strong northern ties as well as the interest of some young people in coming back to Tiksi and in getting involved in the future development of the settlement should not be overlooked in policy-making processes. They represent a part of the population that share particular emotional ties with the territory and with other local residents. In the current context where the socio-economic development of Tiksi and the NSR is expected, integrating their experiences, necessities and forms of attachment to the northern lifestyle is fundamental. This allows strong social ties to be interwoven with an increasing range of opportunities in the North to attract people who left Tiksi to return.

These narratives introduce the opportunity to reappraise local forms of knowledge which are intrinsically valuable and important, especially in territories with harsh climatic and environmental

conditions. The explicit and detailed knowledge of the accelerated climate and permafrost changes as well as the interpretation of their impacts can provide useful input for the development of legitimate site-specific adaptive strategies by authorities and local residents. Moreover, information collected demonstrates that residents identify the impacts of accelerated permafrost thaw on infrastructure and should therefore also be included in any thinking about new industrial development in the Arctic (Fondahl et al., 2020). This is a key topic not only for the Russian Federation (as permafrost covers 65% of its national territory), but also for the regional and local governments.

IX.C.IV) Bykovsky: coastal erosion and future possibilities

The challenges that the rural settlement of Bykovsky is currently facing slightly differ from those of Tiksi - the administrative center of the district. This is mainly due to their different geomorphological and socio-economic conditions. Analysis of narratives from residents from Bykovsky demonstrate, once again, that cultural, natural and economic dimensions constantly overlap. For them:

- The future of the settlement depends on the survival of the Kholkhoz Arktika, and this in turn, relies on the presence of fish in the Laptev Sea and surrounding waters (see interview 29 quote 63-1 below). Fish availability will, in turn, guarantee the continuity of the support and share network.
- Local residents express their interest in staying in the settlement, but this is also conditioned by the rate and extent of permafrost coastal erosion in the Peninsula of Bykovsky (see interview 24 quote 15-1 K below).

INTERVIEW 29 QUOTE 63-1 E: "If the infrastructure keeps going, the village will succeed. The village will exist as long as the collective farm is working (...) yes! We depend on fish. This is the main economic sector."

INTERVIEW 24 QUOTE 15-1 K: "If it goes fast, the village will disappear. If a land fall happens somewhere in the middle, Bykovsky will no longer be a peninsula. It will be an island. If the thawing goes in the middle it may happen without a doubt. If a summer happens to be warm and rainy. Water is warm and it can make the ice thaw."

The aforementioned complex network of relationships demonstrates that the future socio-economic perspectives for Bykovsky are not exempt from the influence of climate change and permafrost thaw. Even if there was no explanation for changes in fish availability and distribution, climate change and permafrost thaw would be identified as possible stressors. Coastal erosion also seemed to be explained by a variety of processes, but accelerated permafrost thaw because of increasing temperatures was seen as a valid explanation by local residents.

It is possible to assume that if Tiksi was re-developed, its satellite villages would also benefit indirectly. For example, because supply of goods and supplies would be guaranteed, there could be better access to the internet, improvements in the transport system, a higher demand for fish, among others. This could also reverse the trend of youth emigration by creating more job opportunities for them.

However, if the rate of coastal erosion continues to increase, forced displacement would be the only possible alternative for the residents. Even if this type of measure has already been applied in the area (see examples in chapter 9) and forced displacement is a possibility addressed by local residents in the interviews, there is still much uncertainty about where they would be resettled. The social and cultural elements at stake vary depending on the new destination. If they resettle in Tiksi, differences in culture and lifestyle between residents of both settlements may emerge. Being geographically displaced could be particularly stressful for some residents of Bykovsky due to the irrecoverable loss of their symbolic and meaningful places. As a result, their frame of reference would also be altered. Their settlements are often on lands where their ancestors lived and contain their sacred places (for example, the cemeteries where their relatives are buried) and hold a unique and irreplaceable value for current residents. This is an element that should not be overlooked in policies because this can shape their final decision on whether to leave or stay in the settlement. One respondent (see interview 28 quote 26-2 below) mentioned that although living in Tiksi provides some benefits (for example, education), some locals may decide not to leave.

INTERVIEW 28 QUOTE 26-2 S: "(...) If there will be no fishing – it will happen. We will be relocated to Tiksi. For people with children, it could be good. Their children will study there and so on (...) For example, in Tumat. Tumat was closed, and in 1975, people were relocated to Bykovsky. But

the elders stayed. My parents and others stayed there, around 30-40 people stayed. And we studied in the boarding school. The last ones to move out from Tumat were my parents, after the 1980s. Because they were not hunting anymore. They were hunting polar foxes there. They all aged and got mentally and physically tired. They could not keep it up anymore. So they moved here to their children. The same will happen to Bykovsky too. In case of the replacement, people with children will move out, and some locals will have to stay and will die out here.”

On the other hand, being resettled inland in the continent would have other implications. In this case, the continuity of their main traditional activity could be threatened depending on the specific location. Therefore, their special ties to the environment could be diminished. These include fishing in areas where they have fishing rights and quotas, using certain techniques, at very specific moments of the year. Fishing is not only an essential economic activity but also a way of bringing dignity to their lives and livelihoods. Consequently, being resettled in a place where they no longer have the possibility to maintain traditional fishing would imply a dramatic change.

Little official information was obtained on the current and future expectations for Kholkhoz Arktika. However, these narratives contribute greatly to our knowledge of what local residents of Bykovsky perceive as valuable elements to maintain a lifestyle aligned with their values, identity and worldviews. The body of local narratives contains concrete examples of the importance of non-material and symbolic aspects of their lives and livelihoods. These elements constantly emerge in their narratives, especially when evaluating their current living conditions and the future perspectives for Bykovsky. Therefore, these should be integrated into the policies and plans for the region, especially if forced displacement becomes inevitable. Even if forced displacement due to poor socio-economic conditions is not new to the region, having to abandon their places can trigger a complex series of adverse cultural and psychological effects. Unlike Tiksi, addressing the risks associated with climate change and permafrost thaw in Bykovsky implies managing the risk of irreversible loss of the settlement and their valued and sacred places. This demonstrates the urgency of a comprehensive socio-economic analysis accompanied by concrete locally-relevant adaptive strategies for the residents. This plan should not ignore the inseparability of the cultural, natural and socio-economic dimensions for the people of this rural settlement. Concrete alternatives for local residents regarding climate change, permafrost thaw and the socio-

economic development of the area should target the site-specific identity and cultural aspects. This would not only facilitate their implementation, but also prepare them for new forms of local governance.

IX.D) QUALITY OF LIFE

For some, the quality of life in the North is not one that they want for themselves or their children. Therefore, emigration appears to be way to escape to find better conditions in their new destinations. Problems include the deteriorating condition of buildings, the lack of clubs and entertainment facilities (see interview 15 quote 26-1 appendix to chapter IX). Similarly, a 42-year-old man working in Tiksi's administration said that he hopes someday to leave to live near a lake in Karelia (Western Russia). However, this plan appears to be distant as his youngest child is only five years old and still has to finish school before being able to make this decision (see interview 19 quote 30-4 appendix to chapter IX). Lack of both infrastructure and job opportunities hinder residents in projecting themselves in these settlements in the future. Some of them explicitly detached their desire to migrate from the effects of climate change or permafrost thaw. A native of Bykovsky said: "[What really matters to me] is job, salary, infrastructure, accessibility. There is no leisure here." (see interview 23 quote 23-2 appendix to chapter IX). This worker from the social development, youth policy and sport department in the administration of the Bulunsky District aspires to develop his career in this domain and therefore plans to move to Yakutsk in the future. Another resident of Bykovsky mentioned having bought an apartment in Yakutsk, where his wife is currently living and working and his plan to look for a job there after graduation (see interview 27 quote 43-1 appendix to chapter IX). There is also an undeniable interplay between the uncertain future development of the area with decisions by locals to leave. A woman from Bykovsky mentioned having heard rumors that in the near future, there will be new oil exploration projects in the area, and therefore Tiksi or Bykovsky's populations might need to be resettled. She also acknowledged that permafrost thaw is a threat as it could melt the entire settlement (see interview 26 quote 30-1 appendix to chapter IX). Faced with the possibility of having to leave the settlement, she mentioned that she will miss eating meat and fish all year round (see interview 26 quote 66-1 appendix to chapter IX).

IX.D.I) High prices

One element that narratives of people in Tiksi and Bykovsky have in common and that shapes their notion of livability in these settlements is the price of goods and supplies which are uniformly defined as “extremely high”. Locals refer to it as an element that restricts the possibilities for development and diminishes quality of life in the North. It is one of the most visible legacies of the Soviet breakup. The subsequent liberalization of prices led to a sharp increase of goods and supplies’ prices in these settlements. People who lived here during Soviet times remembered with nostalgia the different reality at that time: A woman from Tiksi specified that vegetables were produced locally and they also had an animal farm and a small private farm (see interview 15 quote 30-4 appendix to chapter IX). Another resident of Tiksi said that fruits and vegetables are now extremely expensive as there is no longer extensive sea transport like before: now, most of them are sent by plane, which increases their price (see interview 13 quote 129 appendix to chapter IX). A different perspective was given by a resident of Tiksi who attributed higher prices to the fact that shops are now owned by entrepreneurs rather than the State (see interview 15 quote 31-3 appendix to chapter IX). For him, subsidies allowed oranges to be bought in the North at the same price as on the mainland.

Extremely high prices are perceived as a problem in several aspects of local life, starting with local purchasing power. One respondent from Bykovsky detailed that one kilo of potatoes costs around 200 rubles, one kilo of apples between 300 and 400 rubles and a box of eggs up to 700 rubles (see interview 29 quote 65-7 appendix to chapter IX). This is why “you can only buy one or two things. We cannot afford more” (see interview 29 quote 67-10 appendix to chapter IX). Consequently, the diversity of products they can afford is also limited (see interview 15 quote 29-7 appendix to chapter IX). Mobility is also influenced by high prices and going to vacation is rarely affordable for locals (see interview 12 quote 5-2 appendix to chapter IX). Although it was not possible to address this topic in more detail during the interviews, such statements could, along with other factors, increase the feeling by some residents of “being locked down”.

High prices represent even a bigger challenge for low-income families living in the area (see interview 12 quote 20-5 appendix to chapter IX).

High prices not only affect locals in the northern settlements but also newcomers. One respondent from Bykovsky mentioned that some of them cannot cope with these prices (among other things) and eventually go back to their places of origin (see interview 21 quote 16-5 appendix IX). In other words, high prices can be interpreted as an element that curtails the adaptive capacity of newcomers to the North.

IX.D.II) Salaries

Local narratives reveal that for most of them, another big concern is the fact that salaries are not high enough to ensure a good quality of life in the North. The owner of a family farm affirmed without hesitation that their monthly income as a family is not enough to save money and most of their incomes are spent (see interview 22 quote 27-2 appendix to chapter IX). This situation is worsened by the high prices of food but also of the gasoline required for transportation in cars and snowmobiles. A native of Tiksi who lived before in Bykovsky said that “administrative workers have a small salary” (see interview 23 quote 27-7 appendix to chapter IX). He specified that of the 38,000 rubles earned, 15,000 go to rent a flat in Tiksi, plus about 18,000 for utility bills. This is why their savings are minimal or nonexistent. Basic food products, housing expenses, loans, mortgages and technical equipment required to live in the North - such as snowmobiles - were the most commonly mentioned expenditures for residents in both settlements (see interview 21 quote 23-2 appendix to chapter IX). Some respondents mentioned paying a mortgage for an apartment in Yakutsk, for example, an authority from Tiksi (see interview 2 quote 118-2 appendix to chapter IX). Another respondent from Tiksi even considers that because he has a large family, their expenditure exceeds monthly income (see interview 18 quote 14-3 appendix to chapter IX).

An older couple in Bykovsky perceive that inflation has been increasing in recent years: after having their children, she had to find a job as one salary was no longer enough to maintain the entire family like before (see interview 26 quote 64-1 appendix to chapter IX).

A woman from Bykovsky said that although her husband’s salary is “enough in terms of income”, everything is spent on products and on providing financial support to their children and grandchildren (see interview 33 quote 83 appendix to chapter IX).

IX.D.III) Financial support

In Bykovsky, female respondents declared having fixed monthly salaries, while their husbands engaged in fishing activities receive irregular payments. After catching the fish, they deliver it to other regions and once it is sold, they receive the money. Most respondents in Tiksi had administrative jobs, meaning that they have fixed monthly incomes.

Financial support from family members appeared in narratives as an important element to counteract high prices in the North. Despite receiving a slightly higher average salary in the Bulunsky District than in Yakutsk (see table 2 below), our respondents unanimously agreed on the fact that their salaries and pensions do not allow them to save money or pay for supplementary expenses. Families in the Republic of Sakha traditionally provide their relatives with financial support, when this is possible. This trend is even more evident in northern settlements, where many older people openly said they wanted to stay there to obtain better pensions (higher because they are in the North). For example, a native woman from Tiksi mentioned that she lives in the North so that she can financially support her son who is a student at Leningrad University (see interview 31 quote 21-3 & quote 24-5 appendix to chapter IX). She also pointed out that she can't pay for necessary repairs as they are too expensive in northern settlements.

	2013	2014	2015	2016	2017	2018
Bulunsky District	41.237	52.066	59.639	62.468	66.351	NA
City of Yakutsk	46.542 (1.463 USD)	51.111 (1.346 USD)	54.631 (901 USD)	59.000 (882 USD)	62.206 (1.066 USD)	68.870 (1.095 USD)

Table 9: Monthly average salaries in Bulunsky and Yakutsk between 2013-2018. Source: Statistical Yearbook of Republic of Sakha (Yakutia) (2019)

IX.D.IV) Traditional activities

Traditional activities and natural resources also play a key role in balancing local budget. However, an authority from Tiksi made a clear distinction between the expenses incurred in surrounding villages and Tiksi. He said that in villages (such as Taimylyr) people has access to traditional food by hunting and fishing themselves (see interview 13 quote 120 appendix to chapter IX). In Tiksi, residents are obliged to obtain fish and meat from relatives or friends living in villages through a

sharing and support network. This increases the total food expenses of Tiksi residents (see interview 2 quote 118-2 appendix to chapter IX). In Bykovsky, fish and meat are easily obtained and locals exchange or sell them (see interview 26 quote 40-1 below).

INTERVIEW 26 QUOTE 40-1 I: "I have a salary of 30,000 rubles. With our prices, this is not enough at all (...) Fish and meat - that's just it. Yes, we exchange and sell them (...) I both hunt and fish. My father taught me everything. Both hunting and fishing."

Another resident from Bykovsky affirmed that obtaining food by traditional means reduces his family's budget by almost half. Having access to food all year round in northern villages is possible due to ice-cellars where they keep their products stocked (see interview 27 quote 45-1 appendix to chapter IX). In a fishing village like Bykovsky, fish is not only part of the traditional food, but it is also seen as the main source of employment for residents and is their main economic sector (see interview 29 quote 63-21 appendix to chapter IX).

In northern villages, the consumption of meat and fish prevails over vegetables and processed food which are imported and therefore more expensive (see interview 24 quote 28-2 appendix to chapter IX). Both Tiksi and Bykovsky residents receive or buy reindeer meat from herders from Hara-Ulah and Borogon (see interview 25 quote 6-18 appendix to chapter IX). The expenses entailed in hunting and fishing activities are considered to be minimal in comparison with the cost of other products and the benefits cover the costs many times over. These expenses include bullets, gasoline, boots, licenses, among others (see interview 24 quote 31-1 appendix to chapter IX).

In the current configuration, traditional food acts not only as a buffer against the high price of products but also as an element that contributes to the feeling of liveability in these settlements: "Yes, this is my traditional food. By this, I can say, I live." (interview 27 quote 45-1 appendix to chapter IX). In order to show the importance of fish in Bykovsky, another resident affirmed that: "If the fish will be, everything will be." (interview 28 quote 8-3 appendix to chapter IX). Similarly, a lack of fish and reindeer constrains northern liveability. According to the estimations of a young reindeer herder, more than 50% of everyday meals contain fish or meat in different forms (see interview 21 quote 22-5 appendix to chapter IX), therefore, residents feel that without these, they cannot live. (see interview 2 quote 122-2 appendix to chapter IX). Living in the North without

these basic and essential products is unimaginable for our respondents (see interview 21 quote 16-4 appendix to chapter IX). Fishing is not only the basis of local salaries but also an element that enhances their general feeling of well-being, as stated during interviews (see interview 29 quote 69-13 appendix to chapter IX).

Bykovsky's industrial fishing products are principally sold in Yakutsk and distributed in other regions of the Republic of Sakha. According to the previous resident, Artel "Kholkhoz Arktika" sells its fish for about 260 rubles per kilo. The final price of fish in Yakutsk is normally between 500 and 600 rubles, although on special dates such as New Year, its price can double (see interview 29 quote 69-2 appendix to chapter IX). When referring to the key role of fishing and fish in the village, a woman also expressed her concern about the potential negative impacts of climate change on traditional activities, especially on reindeer herding as swamps and holes can appear due to permafrost thaw (see interview 24 quote 20-9 appendix to chapter IX). According to her, this will have greater impacts on herding than on fishing activities.

IX.D.V) Share & support network

High prices and low salaries – as described by local residents- appeared to be among the main challenges that northern residents from Tiksi and Bykovsky face. These are counterbalanced by traditional activities (fishing and hunting), according to locals. Closely associated with these activities is the share and support network that is culturally rooted and helps the villages and settlements cope with harsh socio-economic conditions. It is implicitly accepted that within this network, people (friends and relatives) can exchange material (food, materials for hunting and fishing, etc.) and non-material (administrative procedures, providing, helping students to enter university) favors. This particular kin-based connection does not rely on previous contributions but instead is a form of mutual aid based on a spirit of strong solidarity and reciprocity. Climatic conditions and remoteness have historically caused locals to embrace this philosophy which aims to voluntarily take care and support each other with what each member has. These are appreciated human qualities among residents of the Republic of Sakha (see interview 2 quote 6-1 appendix to chapter IX). The share and support network is valuable to family members and friends but also to newcomers (see interview 24 quote 31-7 appendix to chapter IX). The idea is that kin connections confer real strength to people (Argounova-Low, 2007). This is why I refer to it as a "share and support network". This network is also connected to the local cosmological or

ontological understanding of the world. For example, it is possible to cite the Tungusic collective representations which consider that the natural environment is controlled by spirits which inhabit it (Lavrillier, 2013). For some indigenous peoples of the Republic of Sakha, such as the Evenki, "Buga" refers to the biophysical environment, the spirits inhabiting it, and a main spiritual entity which manages the environment, the relations between its constitutive elements and the way humans interact with them (Lavrillier, 2005). Taking this into consideration is essential to understand the spiritual representations that guide the interactions between humans and the natural environment in this area. For instance, this relationship is characterized by gifting and counter-gifting, as well as by a set of prohibitions. If humans do not respect them, "Buga" can become angry and therefore it could cease offering goods to humans. When humans hunt or breed successfully, for example, they must offer something to Buga in return for providing them with this fortune. Another important rule which is implicitly accepted by local hunters is the one of "not taking too much from the environment during hunting". These rules also shape human interactions: meat, fish and other natural products obtained from traditional activities should be shared with other humans (Lavrillier, 2013). Another important practice in the region is known as "nimat" which refers to "distribution of equal shares of spoils of the hunt among the whole local community" (Forsyth, 1989, p. 76). This concerns hunting, fishing and gathering and includes families within the same settlement but also those from neighboring settlements (Bereznitsky et al., 1997). This is not purely a channel of physical exchange but is a complex network built on deep spiritual foundations.

A resident of Bykovsky said "our people live in the old good times, we help each other. We support newcomers and treat them well." (see interview 29 quote 72-1 appendix to chapter IX). This is also visible in historical events: during the Second World War, the large proportion of the population of Churapchinsky District (in Central Yakutia) was resettled in the Bulunsky District because of droughts and starvation. They arrived in the region to work on state farms as there was a high demand for fisherman to respond to the ongoing food crisis. During this episode, locals supported them and taught them how to live in the area (see interview 2 quote 246-1 appendix to chapter IX).

During harsh times, these support networks give people the possibility of calling on their kin and friends for sympathy, help, shared belonging and survival (Argounova-Low, 2007). There are two major levels of support networks:

1) between people in villages and settlements

2) between people in cities and villages/settlements

In the first case, residents from settlements within the same or different district/region (especially in the North) can exchange or sell their main traditional products to each other. This is the case for Bykovsky and Tiksi's residents who obtain reindeer meat from Namy (situated on the river) and Naiba (on the coast). Bykovsky's main product is fish.

The second case requires special attention as it characterizes the particular way in which villages, settlements and cities in the Republic of Sakha interact in terms of traditional food supply. In this region, the most visible example concerns the capital city of Yakutsk. This type of network is the basis for what Argounova-Low (2007) described as "close relatives and outsiders" relationship.

The manifestations of mutual support are multiple and diverse. A woman living in Bykovsky highlighted the importance of having a brother who provides her and the rest of the women in her household with fish. For her, this is the only secure and accessible way to obtain fish. Some other residents treat her with meat, although at a smaller scale (see interview 25 quote 38-1 appendix to chapter IX). This reduces her food costs. This was also the case for many other respondents from Tiksi who said that they do not need to buy meat nor fish because they are locals, which means they are part of the social support network where these goods are shared (see interview 15 quote 29-2 appendix to chapter IX). They receive both meat and fish, but also other products that are important in Northern settlements, such as different varieties of berries including lingonberries, blueberries and cloudberries (see interview 18 quote 12-4 & interview 11 quote 149 appendix to chapter IX). Some people obtain meat and fish from relatives living in other settlements. This was the case of a woman who is a veterinarian in Tiksi whose brother is a reindeer herder and fisherman (see interview 14 quote 138 appendix to chapter IX). A young economist living in Tiksi (and her mother) also receive fish from her father's relatives who still live

in the village. Her mother's family moved to Yakutsk (see interview 39 quote 6-2 appendix to chapter IX).

Those who do not have relatives engaged in fishing or hunting buy these products directly from villagers through informal trade networks interacting on Whatsapp groups where they coordinate their purchases. For example, a woman from Tiksi buys fish using these channels of communication (see interview 31 quote 25-5 appendix to chapter IX). This is perceived as a more financially convenient option than buying these products in standard shops. The extent of this implicit support network is such that one local affirmed that in Taimylyr, for example, no one buys meat at the shops. Even if they don't know anyone in the village, they eventually ask a stranger to sell to them or share some meat instead (see interview 18 quote 15-4 appendix to chapter IX). According to this respondent from Bykovsky, even newcomers can find a way to enter into the informal barter exchanges with locals (see interview 21 quote 20-5 appendix to chapter IX).

In this context, shops mainly sell fruit, vegetables, milk and other basic household products. Among our respondents, the ratio spent in the local shops remains relatively low. An authority at the Port of Tiksi estimated that expenditure at the local shops represents only 10-15% of the total requirements (see interview 8 quote 117 appendix to chapter IX).

Guaranteeing a strict control on what, where and the amount of products they buy, exchange and receive is essential to preserve the fragile balance in each household's budget as prices "do not correspond to their wages" (interview 15 quote 29-5 appendix to chapter IX). In some cases, residents from the North prefer to buy directly from traders that offer better prices than those in their places of residence.

Support networks also play a key role in terms of supporting the members of the communities from villages that migrate to bigger cities like Yakutsk to pursue higher studies at the university or to find employment. This applies even at the administrative level. For example, the Association of Indigenous Peoples of the North of the Republic of Sakha sometimes contributes so that indigenous students can go to university. As a public entity, they try to represent their community and defend their rights by providing them with official support. This is considered essential by local families who send their children from remote areas to big cities like Yakutsk where the cultural shock can be overwhelming (see interview 28 quote 34-25 appendix to chapter IX).

Having a support network in the new place of residence reduces the psychological stress that young students experience on arrival. Another important form of support to relatives from villages and settlements is doing their administrative paperwork in Yakutsk, thus preventing them from having to travel to the capital city.

During informal conversations with some of the respondents, they mentioned that this is a common practice in the region. Some even had children living in their relatives' houses in Yakutsk where they are currently studying. Their families from villages and settlements sent them different products (potatoes, fish, meat, berries, etc.). Similarly, when they go gathering, people apply this "reciprocity principle" and leave things buried in the ground as a way to express their gratitude.

The qualitative analysis of narratives also exposed the necessity of contextualizing the local perceived impacts of climate change and permafrost thaw in the broader regional context. More specifically, local life experiences demonstrate that the effects of both processes surpass the borders of the Bulunsky District and might soon be felt in bigger urban centers like Yakutsk.

Trying to determine the extent of the impacts associated with permafrost thaw and climate change in Tiksi and Bykovsky requires sorting out the chain of events and the multiple relationships that exist between stakeholders. At this stage of the research, it became visible that city dwellers and rural relatives interact within a broad, culturally rooted share-and-support network which is based on strong kinship ties (Argounova-Low, 2007). This extended kinship network is at the core of the city-village and village-village connections in the Republic of Sakha.

The activities of fishermen, hunters and herders are defined by season. There is a peak of activity in the summer. Once food is obtained, it is separated into one part for consumption which is usually stocked in ice-cellars so that provisions last throughout the year. Another part is shared with relatives and friends from the same village (who are not involved in traditional activities) or from other villages (see interview 15 quote 29-2 below) This solidarity is extended to newcomers that move to the North (see interview 29 quote 72-1 below).

INTERVIEW 15 QUOTE 29-2 L: "I never buy meat and fish. Because I am a local person. They send me meat and fish. Also the berries, jams. Well, all that is needed. Even sour cream and cottage cheese –there are cows in Borogon."

INTERVIEW 29 QUOTE 72-1 F: “Do you know what? Our people, they live in old good times. We help each other. We support newcomers and treat them well. We can just give it (fish) to him. We will not sell it. We will just give it. This is a kind of tradition (...) if it is just for a meal, we treat people. It is like in Nelemnoye. All people are connected there. They are friends or relatives. All people provide each other so.”

It is important to highlight that sharing traditional food between northern residents is essential as it helps them to cope with the effects of low salaries and high prices that characterize their local economies. This became particularly important after the dissolution of the Soviet Union as state policies regulating the prices of goods and supplies were suspended. Being able to obtain meat and fish does not act as a “supplementary income”, but instead is an essential link in northern communities. Without relatives or friends who provide these products, people would not be able to access the two main products in the diet of the Republic of Sakha.

Other part is shared with relatives living in bigger urban centers like Yakutsk. Buying fish and meat at the supermarkets there is very expensive so, once again, relatives in the village become their best alternative. In other words, urban dwellers depend on their relatives in the villages to get traditional food. Fish, eggs, meat, milk, butter and cream play an important role in the local culture, for example, special ceremonies (such as weddings and anniversaries) always include these products and are an indicator of well-being and wealth (Argounova-Low, 2007).

Narratives demonstrate that food is part of the regional commodity exchange. Respondents seem to agree that climate change and permafrost thaw may be at the core of the shifts in availability of and access to fish and reindeer. In this sense, it is suggested that the symbolic and real impacts of both processes in northern settlements like Tiksi and Bykovsky could be wider than expected. If northerners cannot fish and hunt reindeer, the consequences will be felt along the entire chain of stakeholders involved in the share and support network. This means that the impacts of a shortage of these products can reach distant regions like the capital city of Yakutsk and other big urban centers in the Republic of Sakha. Within a regional context in which food is symbolically and literally important (Argounova-Low, 2007), climate change and permafrost thaw can degrade the culturally rooted relationship between rural and urban dwellers.

This is another concrete example of how material and non-material dimensions overlap when analyzing the implications of climate change and permafrost thaw in Tiksi and Bykovsky. Within this complex economic-spiritual network, the impacts are felt by people involved in traditional activities. This can diminish local residents' ability to lead meaningful lives and can affect their overall well-being⁶⁶ (see interview 29 quote 69-13 below).

INTERVIEW 29 QUOTE 69-13 E: "Fish is not only the basis of the salary. It is the basis of well-being. It is for food and other things."

The increasing difficulties associated with practicing these activities also lead to an overall reduction in the fish and meat obtained seasonally. As previously mentioned, these products are the basis of the Yakutian traditional diet. In remote northern settlements where the costs of imports make food very expensive for locals, not having access to these essential products can produce a switch in regional and local nutritional habits, possibly leading to malnutrition. This would not only affect the families of hunters and fishermen, but also their relatives in neighboring settlements.

The last actors to be impacted by this dysfunction in the share and support food network are the urban dwellers. The fish and meat shortage will affect the urban supermarkets that resell these products, but also the urban dwellers who receive supplies of fish, meat and berries from their relatives and friends living in the villages. In this case, it would no longer be possible to continue celebrating with traditional food. This would also provoke an inevitable increase in the price of these products as they become scarce.

To conclude, it is possible to see the share and support network as a manifestation of the complex social structure within the Republic of Sakha. This milieu is one where unique forms of solidarity and cooperation interact, bringing together modern and traditional aspects of northern lifestyle. These social and spiritual bonds between city and village citizens which are implicitly accepted in the region, are now endangered by climate change and thawing permafrost. More specifically, they put at risk one of the fundamental underpinnings of the functioning of this network: access to traditional food. This reinforces the urgency to develop interregional policies capable of

⁶⁶ In Russian: "благополучие"

addressing these multilevel and multidimensional (economic, social and spiritual) impacts. Moreover, integrating the symbolic and material foundations of the share-and-support network between city and village into socio-economic development and environmental policies is essential because of its strong dependence on territorial dynamics and meaning.

IX.D.VI) Forced displacement

Another possible future scenario for locals from certain northern settlements is forced displacement (also see Chapter 8, section VIII.A.3.2.1). This was a core topic in the narratives of residents living in Bykovsky where accelerated coastal erosion is a widespread concern. Being forced to leave the settlement appears, sometimes, to be the natural continuity of accelerated environmental changes currently ongoing in the peninsula. This possibility is increasing likely especially since one of the senior Tiksi authorities declared that no technical adaptive measures to combat coastal erosion will be implemented as they are not financially viable (see interview 1 quote 148 appendix to chapter IX). Where the population will be displaced is still uncertain, but one resident of Bykovsky who was born in the no longer existing village of Tumat in Bulunsky District mentioned that some people may choose Tiksi, while others may go to Kyusur or to the city. Only a few will try to stay in the settlement. He imagines a potential resettlement of Bykovsky just like the one that took place in Tumat (see interview 28 quote 26-2 appendix to chapter IX). One particularity he identified is the absence of fish in Bykovsky as a reason that could motivate people to leave the settlement. In this sense, forced displacement is not associated with coastal erosion alone, but also with the possible absence of fish in the future. As previously described in other sections, the fishing activity in Bykovsky supersedes the pure economical dimension and is also a concrete material and symbolic practice that reaffirms local identity.

Another resident did not express major concerns about the possibility of being displaced. In his opinion, not being attached to a network of highways or permanent roads, and having a vast area which could still be accessible by navigation, increases the flexibility to choose a new location nearby where the new settlement could be established following displacement (see interview 24 quote 17-1 appendix to chapter IX). He stated that the small volume of cargo necessary to bring provisions to the settlement could allow similar transportation systems to be maintained if the community is resettled close by: ships could continue to arrive at Tiksi with cargo which would then be distributed to neighboring settlements by winter roads.

IX.D.VII) Investments in developing northern settlements

For some residents, their overall perception of development in the settlement and the region is another factor in their future choices in terms of mobility. Many expressed that they recently identified some signs of development in the area (Bulunsky District) which was also confirmed by the authorities in Tiksi. A particularity of development is that it is closely attached to financial investments and funding projects offered and implemented by external agents, in this case: federal, regional and local governments. This is also a legacy of Soviet economic development which was centrally planned and where the State mobilized resources for rapid industrialization. In this sense, one resident from Tiksi said that fishing and reindeer husbandry in the region are being developed with State financial support (see interview 34 quote 15 appendix to chapter IX). Another form of support appeared in a narrative from a woman living in Bykovsky who affirmed that in order to adapt to current changes, there is a lot of reliance on governmental decisions (see interview 25 quote 20-1 appendix to chapter IX). She also admitted that things are being done by authorities, but the small size of the population and the settlement reduces the budget available for investment.

In this context, some residents still perceive that the only possibility for development in their settlements and villages is through investments from the different levels of governments in Russia (see interview 15 quote 39-7 appendix to chapter IX). This also applies to the protection and preservation of traditional activities. An interviewee from Kyusyur pointed out that after the government introduced a program providing subsidies per reindeer, the number of people involved in this activity in Kyusyur increased. Three new indigenous family communes got engaged in reindeer husbandry as a result (see interview 21 quote 1-5 appendix to chapter IX). Before, the subsidy was given to farmers depending on the type of herd which was also defined by the type of ecosystem in which they were located (tundra, taiga, forest-tundra). Three different types of subsidies existed and determined the amount of money that farms receive. Bulunsky is a tundra-zone and in order to apply for this subsidy, a herder had to have at least 1100 reindeers. In the taiga zone, you could apply even if you had fewer reindeer. The modification involves fixing subsidies by the size of the herd, making it possible therefore to apply even with a small number of reindeer in the tundra zone. The subsidy amount will therefore depend solely on the number of reindeer bred.

Despite some local forms of progress in terms of preservation of these traditional activities, a pensioner and ex-reindeer herder considers that it is still necessary to obtain more governmental support, especially as reindeer herding activities has been experiencing a sharp decline. He considers that the impact of these activities are small for the national economy, and therefore, these types of funding could be used to improve Russia's image and its politics while benefiting the indigenous peoples (see interview 17 quote 12-2 appendix to chapter IX).

Another way to support local activities in the North is by creating new reindeer herding centers and fishing bases. These are funded by the regional government of the Republic of Sakha. For example, they built three Municipal Unitary Enterprises: the MUPP "Borogonsky" (in Khara Ulah), the MUP "Primorsky" and MUP "Bulunsky". Also, a new fishing base for the "Arktika" Artel was built in Sokol (toponym of a part of the Delta Nature Reserve).

Finally, one resident highlighted the importance of government support and rapid action programs to cope with natural disasters and emergency situations in the settlements/villages. For example, he cited the flood that took place in Kyusur where the government allocated money to replace the lost working materials of the fishing MUP Bulunsky and to build a new massive ice-cellar (see interview 21 quote 4-5 appendix IX).

IX.D.VIII) Adaptation

During interviews, one of the questions inquired about local notions of and associations with the concept of "adaptation". Interviewees were familiar with this word but used it differently depending on their personal experiences and knowledge. For example, one respondent mentioned that adaptation is not seen as immediate action, but measures to be gradually implemented (see interview 25 quote 22-3 appendix to chapter IX). This is closely associated with the fact that both climate change and permafrost thaw are incremental and therefore need to be gradually identified and addressed. Some impacts are more easily identifiable for residents while others are subtler.

Narratives reveal that: 1) locals use this concept when addressing potential local answers to current changes in climate and permafrost; 2) this concept is used to describe four subsequent processes. First of all, locals tried to identify which sectors of the northern communities will be

better adapted to environmental changes. Secondly, many explained in detail the consequences of irreversible changes in traditional activities and how this affects the worldviews of indigenous peoples. Simultaneously, locals analyzed the potential adaptive capacity of animals (especially of reindeer) to ecological change. Lastly, they considered and evaluated different technical and material adaptive measures that could help to mitigate undesired impacts.

IX.D.8.1) BEST ADAPTED

Human adaptive potential was the point of entry to the topic. For some, humans are naturally adaptive creatures capable of overcoming adversity (see interview 15 quote 24-5 appendix IX), while for others, adaptation is perceived as unachievable, especially if there is extensive thawing (see interview 13 quote 161 appendix to chapter IX).

Three respondents agreed with the fact that locals are better adapted to grapple with extreme climatic and permafrost changes. In this case, it is important to highlight the connotation that they attribute to "local". As developed in Chapter 8 (page 166), "here" appears to be associated to the Bulunsky District instead of literally Tiksi or Bykovsky. Similarly, within this context, the term "locals" refers to people from the district. Some respondents used the word "northerners"⁶⁷. These notions seem to reflect specific shared experiences/abilities/forms of knowledge. This appears to be how respondents distinguish between people living in northern settlements and those from southern regions or districts. This was particularly important as some interviews conducted in Tiksi revealed that many of our respondents were originally born and raised in neighboring settlements like Kyusyur. Participants often moved from one settlement to the other in order to pursue their studies, eventually moving to bigger settlements like Tiksi (either temporarily or permanently) after graduation. However, a common way of referring to themselves was as "locals", regardless of their exact place of birth (see interview 13 quote 7 appendix to chapter IX). A freestyle wrestling coach born in Kyusyur who lives in Tiksi considers that "northerners" will be able to counteract the negative impacts of warmer weather in the region (see interview 8 quote 88 appendix to chapter IX). This could be due to the fact that people living in these settlements have already adapted to living in extreme cold conditions. This same respondent also specified that among locals, indigenous people will be the first to adapt to

⁶⁷ In Russian: "северные".

changes because of their nomadic lifestyle which is closely associated to nature and requires improvisation.

Similarly, a woman working in the Department of Culture and Spiritual Development in Tiksi pointed out that families engaged in traditional activities have a higher adaptive potential (see interview 12 quote 17-5 appendix to chapter IX). Her opinion is based on the fact that, unlike people living in big cities disconnected from nature, people practicing traditional activities are intrinsically versatile and rely on their adaptive capacity. She also believes that newcomers⁶⁸ will also face bigger challenges to adapt. This is based on a belief that living in the North provides residents with special forms of knowledge that allow them to survive in these living conditions. Another woman from Tiksi agreed with the idea that locals will adapt more easily than newcomers. She also mentioned that the health status of some locals varies with meteorological conditions (see interview 15 quote 24-11 appendix to chapter IX). All in all, “locals” or “northerners” and indigenous peoples seem to be those who have better skills and capacities to adapt to new environmental and climatic conditions.

IX.D.8.II) TRADITIONAL ACTIVITIES & ANIMALS

When considering the general adaptive capacity of northern inhabitants, particular attention was paid to the challenges indigenous people and people living from traditional activities face. For them, adaptation involves finding solutions for themselves as well as for the animals on which they depend. A respondent involved in reindeer herding specified that traditional activities are not “specializations” but a lifestyle⁶⁹. This is the reason why people engaged in these type of activities cannot switch to new sectors: for example, for someone who has lived their entire life as a reindeer herder, it is unimaginable to suddenly become a cattle-breeder (see interview 17 quote 3-2 appendix to chapter IX). Similarly, a respondent from Bykovsky noted that people engaged in traditional activities such as fishermen or hunters could not adapt to office jobs (9-17h work schedules). He emphasized that respecting nature’s rhythm and seasonality is essential to practice traditional activities. Being forced to quit their activities would go against their material and symbolic practices that constitute their cultural identity (see interview 25 quote 48-1 appendix to chapter IX). Another element which conditions the future of traditional activities, and

⁶⁸ People who were not born in the North and settle (temporarily or definitely) in northern settlements.

⁶⁹ Translation and transcription in Russian is not available.

more specifically, reindeer herding, is the lack of young people engaged in this activity. The average age of herders has increased to 55 years. If the current trend is not reversed, the future of this activity is at risk (see interview 21 quote 17-3 appendix to chapter IX). According to a resident from Bykovsky, northern inhabitants will continue to adapt to any environmental changes as they cannot control them. They will continue to adapt to new conditions, just like their ancestors did in the past (see interview 28 quote 14-3 appendix to chapter IX).

Another concern among locals is the adaptive capacity of animals. There seems to be general agreement on their limited capacity to adapt without human intervention. For example, a pensioner, who used to fish, hunt and herd reindeer, considers that the only way to prevent animals from starving due to the formation of ice-crusts is to have forage reserves (see interview 18 quote 9-2 appendix to chapter IX). As for humans, he thinks they have a better adaptive potential and that probably everyone will eventually adapt. A young reindeer herder and veterinarian also shares similar points of view and appears to be more concerned about the predicament of reindeer which he described as "more complex". Reindeer are highly sensitive to warm temperatures as their skin holds in the heat. When this happens, young reindeer move to nearby mountains and sometimes develop bronchopneumonia during the summer. This is why extreme temperatures can increase the morbidity of reindeer (see interview 21 quote 15-8 appendix IX). An ex-reindeer herder who is currently working as a horse herder expressed his concern about possible new epidemics resulting from warmer temperatures in the North. Lichen conditions and availability could also represent a threat for reindeer (see interview 22 quote 19-5 appendix to chapter IX).

When asked about the impacts of climate change and permafrost thaw specifically on indigenous peoples, many respondents automatically refer to reindeer herders. That is, "reindeer herders" is often used as an example of "Indigenous peoples".

Even if respondents were not directly engaged in these activities, they knew that some changes are having negative impacts on indigenous peoples (see interview 8 quote 43 appendix to chapter IX).

IX.D.8.III) TECHNICAL & MATERIAL ADAPTIVE STRATEGIES

Technical and material adaptive strategies were frequently identified as possible solutions to the problems presented by climate change and permafrost thaw. However, they also highlight the complexities associated with them. Local narratives reveal heavy dependence on funding to cover the expenses associated with implementing technical and material adaptive strategies. An authority from Tiksi proposed that the costs of airstrip maintenance should be included in contracts with road builders. However, this proposal has still not been treated by the State Duma (see interview 1 quote 176 appendix to chapter IX).

The owner of a reindeer farm expressed his interest in putting electronic GPS-collars on his animals in order to reduce losses in his herds. However, they are expensive and so remain out of the reach of locals (see interview 21 quote 5-15 appendix to chapter IX).

A resident of Tiksi mentioned that permafrost thaw is accelerating the degradation of ice-cellars. For this reason, those with enough financial resources buy electric refrigerators which avoids the laborious maintenance of ice-cellars required by new warmer conditions (see interview 19 quote 14-9 appendix to chapter IX).

Another difficulty in implementing technical and material adaptive strategies concerns the poor communication networks in the Republic of Sakha. A representative of the family farm in Tiksi compared the communications systems in the Republic of Sakha and Finland. The former has a weak communication network which prevents the widespread use of cell phones. This is the case even in villages and settlements. Sometimes, they do not have internet access neither. Improving this situation could be of particular interest to people who are immersed in nature for long periods, such as fishermen, hunters and herders (see interview 21 quote 5-22 appendix to chapter IX).

The wife of a fisherman from Bykovsky identified other possible forms of adaptation (see interview 25 quote 33-1 appendix to chapter IX): more nets and more workhours are needed to compensate for recent abrupt wind changes and a strong decrease in landings - which is the total amount of fish caught by fishermen and brought back to the dock for sale.

An authority from Tiksi mentioned one government program to introduce musk ox to the Anabar tundra, Chokurdakh and the Chekanovsky ridge and four sites in the Republic of Sakha. The

purpose of this program is to preserve biodiversity but also to introduce a new commercially attractive species in the region. If the musk ox brought from Canada acclimatizes to regional conditions, there will be more specimens to be hunt in the future (see interview 2 quote 245-1 appendix to chapter IX).

Among Bykovsky's interviewees, most of them agreed on the need to implement technical measures to reinforce the shore. Two respondents specified that a Larssen sheet piling project has been evaluated as a possibility (see interview 23 quote 18-6 & quote 18-15 appendix to chapter IX) to protect from water rises and to prevent soil destruction. Piles are connected with groove interlock.

Similarly, an inhabitant from Tiksi said that those who stay in the settlements will have to build houses and infrastructure in safer areas. He also mentioned the need to implement shore protection technology in the area, but this will undoubtedly require financial participation by the government as these are onerous projects (see interview 19 quote 28-4 appendix IX). An authority from Taimylyr mentioned that the first stage of adaptation would include shore protection initiatives. Longer term, they will probably need to be resettled elsewhere (see interview 2 quote 88-1 appendix to chapter IX).

Although displacement is considered to be a possible solution for some locals (especially if the rate of coastal erosion continues to accelerate), it is important to analyze in detail the implications of such a measure and to explore options in terms of new possible locations. These do not seem to be easily identifiable. According to the Deputy Head of the Administration of the settlement, there are sanitary facilities in the direction of the tundra. Therefore, the new village should probably be built beyond this point. But this would make it less accessible, especially by boat as it implies moving deeper into the tundra. Civil engineering structures appear to be an easier option to strengthen the coast (see interview 27 quote 41-1 appendix to chapter IX). Accessibility is essential for these settlements so as to maintain connections with other regions and receive goods and supplies: the lack of roads is compensated for by water bodies that increase the mobility of inhabitants from Bykovsky and Tiksi. This way, they can reach Yakutsk via the Lena River. This facilitates connections with central cities and other inner land settlements (see interview 25 quote 27-2 appendix to chapter IX).

One respondent from Bykovsky gave a different response to the eventual necessity to leave the settlement: she has a flat in Tiksi, so moving to this settlement is her main alternative (see interview 25 quote 31-2 appendix to chapter IX). However, this might not be an option for everyone, especially for people working in traditional activities who would not be able to adjust to the lifestyle that office jobs entail (see interview 25 quote 48-1 appendix to chapter IX).

Finally, one respondent said that one way to adapt to new conditions is by carefully studying areas and creating marks to identify dangerous places on the ice to warn people driving snowmobiles, for example (see interview 22 quote 30-2 appendix to chapter IX).

IX.D.8.IV) ADAPTATION & AGENCY FOR POLICY-MAKING

The narratives of residents of Yakutsk, Tiksi and Bykovsky complement each other and interweaving them provided a broader understanding of the extent, meaning and implications of changes in climate and permafrost. Delving into the particular way locals perceive and interpret events, places, bonds and risks also helps identify the different forms or strategies considered as legitimate to tackle the negative impacts and how they are implemented (Vanderlinden et al., 2020). For the purpose of this research, and using narratives as an entry point, "adaptation" is seen as a threefold concept: as a process, as an end-state and as the challenges to operationalize it (Kennedy et al., 2018). The appraisal of local narratives can also contribute to the formulation of site-specific forms of adaptation based on their life experiences and particular interpretations, thus avoiding measures conceived and implemented from the outside. Centralized decision-making to deal with current changes can undermine important cultural and spiritual aspects of northern life.

Narratives demonstrate that northern residents implement or have implemented a wide diversity of adaptive strategies to cope with changes in the Northern World. This is why, it is accepted that this concept is a boundary object, that is, "an entity shared by several different communities but viewed or used differently by each of them" (Baggio et al., 2015). Adaptation by northern coastal settlements like Tiksi and Bykovsky should not be limited to adjusting to new threats, but should also promote territorial reorganization. This is particularly relevant as most of the symbolic cultural processes are strongly associated with their places and the particular ways of interacting within them.

Using local narratives as an entry point reveals that changes to climate and permafrost are often associated with other types of change (for example, socio-economic). This is why it is suggested that new adaptive strategies and policies should respect the interconnectedness of dimensions as perceived by residents. This will contribute to the formulation of more comprehensive solutions capable of tackling the multidimensional and multilevel effects of climate change and permafrost thaw. In addition, analysis of the narratives helps to understand the contextual specificities and challenges of each of these coastal communities, as well as their past experiences (Kennedy et al., 2018). Previous events and experiences shape the way they perceive current changes and what to expect from the future. For example, considering that one of the possible future scenarios for Bykovsky is forced displacement, it is normal that residents learn from the experiences of other northern communities forcibly displaced in the past. This will shape the associations and sense that they attribute to this possible scenario. Another example could be the sharp reduction in reindeer herds in the nineteenth century in Tiksi because of warmer temperatures (Krupnik, 2000). This fact was often mentioned by local residents from rural settlements as an example of what to expect from their own future if current trends continue.

Adaptive strategies should be designed and applied to those places that northern residents have appropriated and define as "here". The possibility of formulating interregional policies needs to be considered when measuring the extent of the impacts associated with permafrost thaw and climate change as many non-material cultural processes are strongly rooted in the territory and locally valued places need to be integrated. Territoriality plays a key role in these coastal settlements because it is only within particular places that they have learned to build particular forms of living and interacting with their natural environment. Moreover, these places have an emotional connotation as their ancestors lived there. Nowadays, some places have been classified as "taboo places" within the communities because of the new dangers associated with permafrost thawing (see interview 12 quote 8, Yakutsk 2019)

INTERVIEW 12 QUOTE 8 (Yakutsk 2019) S: "(...) earlier, 2 maybe 3 centuries ago we had epidemics. For examples of Siberian Ulse and others, black death. The people and the cattle were buried in some places but we don't know exactly where. Now permafrost is thawing and they are appearing during the autumn or they come to the water, rivers, lakes. We still don't have any diseases like epidemics in the Republic of Sakha, but the example of Yamal shows us that this is

a big problem for us and the future. We know that in the Republic of Sakha we have more than 200 sites where people and cattle were buried because they died of Siberian Ultsa and they can be anywhere, we don't know where they are. They are buried in a big territory; we only know the names of these territories but they didn't give us information on where exactly they are. We lose our traditions. Our grandparents know the places but maybe we do not know that this is a site where people were buried. We have taboo places. People cannot come to these places; this was like a safe tradition (...)"

Faced with accelerated change, adaptation should also consider the effects of outdated norms and legal frameworks. For example, adapting to the changes in migratory routes of some fish species, requires – according to locals – updating and extending the legal limits of their fishing grounds near Bykovsky.

The particular socio-economic and cultural background of these settlements should not be overlooked. Some of the tools that emerge from the interconnectedness between these dimensions can act as adaptive mechanisms for northern residents. For example, the share and support network which actively contributes to reducing the negative impacts of high prices, low salaries and remoteness. Paying particular attention to the symbolic and cultural practices is essential because, firstly, they are the channel that northern residents use to transfer local knowledge and worldviews between generations and secondly, because protecting them can support the survival of their identities and lifestyles within a de-structured Northern World. Climate change and permafrost thaw are emotional and social issues. Therefore, any adaptive measure for their impacts should, under no circumstances, be limited to the merely mechanic-technical aspect.

Finally, it is demonstrated here that the notion of "adaptation"⁷⁰ is also related to historical events. Northern residents have been implementing different adaptive strategies for centuries since the first settlers arrived in the area. The Sakha adopted a subsistence livelihood which was originally developed in the south but was then adapted to the extreme northern climate conditions. Their

⁷⁰ In Russian: "адаптация"

cows were kept in barns during the cold months and in summer they worked hard to gather enough fodder to feed the cows for the rest of the year.

Northern residents have been adapting to political, socio-economic and environmental changes for generations. This includes both material and non-material practices that facilitated their integration into this harsh environment. The need to adapt is also related to the remoteness, the sparse settlement pattern and the centralized federal and regional decision-making. State policies also strongly interplay with northern residents' forms of adaptation. On some occasions, political decisions were a continuity from the previous period. But on others, this produced a social and cultural shock, for example, when new collectivization policies were introduced (Fondahl et al., 2020). Within this context, mobility has been adopted as an effective way of reducing the negative impacts of external stressors in northern settlements and villages. For example, the disimprovement in living conditions after the Soviet breakup led to massive emigration from the North to other regions of the Republic of Sakha and the country. Similarly, nowadays, within a complex socio-economic and bio-physical reality, many respondents from Tiksi and Bykovsky mentioned the idea of moving to other regions. If the youth emigration trend accelerates in these coastal settlements, the capacity to adapt of those who refuse to leave may be diminished (Kennedy et al., 2018). Moreover, this could push northern communities to experience cultural fragmentation and loss of their traditions as there will be no young people to receive these ancestral forms of knowledge and continue practicing them in these territories. Taking into consideration the federal interest in developing the Russian Arctic settlements, youth emigration would also increase significantly the expenses involved in importing workforce from other regions.

Taking these meaningful site-specific elements into consideration has the potential of increasing local acceptability and applicability of new adaptive strategies or plans suggested by authorities. It is demonstrated here that adaptive possibilities are conditioned by other factors such as the economic profile of each settlement and its demographic composition. As demonstrated in chapters VIII and IX, climate change and permafrost thaw do not impact on the residents of Tiksi and Bykovsky equally. Residents from rural fishing settlements, like Bykovsky, will develop a different forms of interaction with their natural environment and therefore, a different degree of dependence on it, while settlements like Tiksi, the administrative center of the Bulunsky District,

naturally provide wider and more diversified job opportunities. For example, more people work in administrative positions which are not as affected by climate and environmental changes as traditional activities (fishing, hunting, breeding). These pre-conditions shape the type of challenges associated with climate change and permafrost thaw but also the adaptive responses possible to these.

The destructuration of the Northern World, on the one hand, reflects the complex series of modifications they are experiencing as well as the associated impacts on each sphere of their lives. On the other hand, it is possible to interpret it as a concrete opportunity to transform the existing social cohesion, the desire to stay in their settlements and nostalgia into new forms of local governance with an increased level of involvement of the local community. This destructuration confronts local authorities and residents with a series of new questions that need to be answered. This can be used to create new spaces for debate between the different stakeholders of these coastal settlements and between neighboring settlements as well. Reinforcing the strategic interactions between stakeholders should be a priority in policy-making processes addressed to adaptation, development, infrastructure and organizational innovation. Building trust and fostering cooperation between stakeholders and different settlements can reinforce the social cohesion necessary to successfully implement new policies in the area.

Another important element that has to be taken into consideration is the role that Tiksi has within the Bulunsky District and how it differs from its surrounding villages. Tiksi is an administrative center that naturally attracts residents from other neighboring settlements for study or job opportunities. If the main activity of Kyusyur – reindeer herding – disappeared – the entire population would be forced to leave the settlement. Within this adverse context, the decision would be forced and not voluntary. This could damage their sense of identity and cause cultural fragmentation at a community level. But this would also mean that for many, moving to Tiksi and adapting to this new and very different lifestyle could be extremely challenging. These people's lives and livelihoods are rooted in seasonality, high mobility and strong ties with their natural environment (see interview 1 quote 26).

INTERVIEW 1 QUOTE 26 K: (...) As regards reindeer herding, fishing, you don't do it every day. For example, people make hay, then they get prepared for hunting, then for fishing and so on. I

don't want to change this way of life in my people, because I think it is right, intrinsically. They like to live this way, and so do I. I don't want to go to work every day, if I know that my fishing season starts just a month and a half before New Year, so I'm preparing for it, because it's what gives me money for the future. Then there comes April and May, time to hunt. Then I get ready for summer fishing and haymaking."

The type of jobs available in Tiksi are conceptually antagonistic to their lifestyle (see interview 25 quote 48-1). These statements become particularly relevant within the context of possible forced displacement of residents from Bykovsky (see interview 25 quote 49-16). Locals pointed out that traditional activities and their bonds with nature are elements which are not easy to transfer or replace. Adaptation strategies should not overlook these aspects as they allow indigenous people to lead meaningful lives in harmony with their cultural identity.

INTERVIEW 25 QUOTE 48-1 K: "Yes, for sure. If people move to Tiksi they will find that working there is different. You have to work by the hour there⁷¹. Fishermen cannot work like that. They work during fishing season and then they come back. This is their working arrangement. They go winter fishing, they come back. "

INTERVIEW 25 QUOTE 49-16 Sh: "If Bykovsky is closed because of these impacts and people are relocated, for example, to Tiksi, it means that they lose their connection with nature, they lose their identity, they lose their traditional occupations. It will be a change of mind. Because you must understand that our traditional mind, our life conditions are different. We cannot work like Europeans from 9 AM to 6 PM behind the desk. Our life rhythm is different. For example, for some months we can relax. You can say that they are lazy, they don't do anything. But sometimes for a short period they have to put in work all of themselves. Without any sleep, without any rest they have to do a very hard job: to catch fish, to hunt animals. It is very dependent on seasonal activities. And if these people are relocated to Tiksi – there is a different lifestyle, different activities that people perform in a society."

⁷¹ In Russian: "По часам" refers to working hours (from 9 to 18h, 5 days a week).

Forced displacement and being resettled in areas where people can no longer practice their traditional activities would not only mean changing roles within the regional and local social structure, but would also have negative impacts associated with living in a territory that is essentially unknown for them, where they no longer have their affective ties to or memories of their ancestors. It would be an irreversible symbolic loss of their memories, worldviews and lifestyles (see interview 25 quote 52-2).

INTERVIEW 25 QUOTE 52-2 Sh: “In my opinion any move can influence it. Even if they don’t move far. You stay at your place where your father and your relatives lived. There are some traditions at this place. I think that a new home can give you something new and so on. I mean that home it is not just a place or a territory. It is a land that was owed by several generations of people. A man is attached to it. A new place can be more comfortable and have some positive sides, but there are some solid threads, invisibles threads in our soul that may change. They can change a lot in human feelings and relationships. ”

To conclude, my encounter with local residents and their explicit request for coordinated action to tackle their adverse socio-economic conditions, climate change and permafrost thaw revealed the necessity to delve into the concept of agency. This was desired to avoid attributing the role of victim to the residents of Tiksi and Bykovsky who are now exposed to new risks. Instead, it was intended to portray them as adaptive agents who have been adapting to diverse stressors in this area for centuries. Within this context, I decided to examine their words and life experiences to better understand what type of action they consider legitimate and desired, as well as who should implement it and how. This was particularly relevant as it could reveal useful information on concrete action to cope with adversity (Brown & Westaway, 2011). Moreover, efforts to co-design adaptive policies should consider the current differentiated capacities and resources of the participants in order to guarantee a fair contribution (Vanderlinden et al., 2020).

Despite some individual efforts, narratives collected in Yakutsk, Tiksi and Bykovsky unveiled a high dependence of the local population on external agents when it comes to taking formal action. Even if it is not the purpose of this dissertation, this could be interpreted as a legacy of the national and regional historical and political processes. Most aspects of life in the Russian Federation were centrally controlled by the federal government: a clear example of this is that

during the Soviet era, the prices of products were regulated and fixed by the government. Similarly, the Committee of the North was in charge of educating and promoting development of indigenous peoples. For this purpose, they transformed their native traditional organizations into functional political structures (Fondalh et al., 2020). These forms of external intervention in northern residents' lives are still reflected in the way they currently conceive action for adaptation.

Faced with complex series of changes, residents of northern settlements refer to their limited capacity to act. Some forms of action considered by them include: investment in technical adaptation (e.g: supports to protect the shore from erosion; better internet access in the North), creating mitigation and adaptation plans, forced resettlement, updating of the limits of their fishing grounds, creating new laws that increase the amount of fish that they can catch, among others. The common denominator of these examples is external action. The deconstruction of the Northern World in addition to the feeling of nostalgia of many residents exacerbate their feeling of uncertainty. They openly express the need for federal and regional action at a political level to address this new complex reality.

Further scientific research is needed to clarify the real possibilities of coordinated community action to deal with these new changes. Federal interest in developing the Russian Arctic, Tiksi and the NSR should be taken into consideration. Further information is also needed to identify the concrete spaces that the federal and regional governments create for local communities' action.

IX.E) SYNTHESIS

Local residents cited multiple examples of multidimensional challenges to their quality of life recently experienced in the settlements of Tiksi and Bykovsky, especially since Soviet dissolution. During the post-Soviet era, locals had to find new strategies to cope with the effects of living in a new reality characterized by deep political, economic, demographic and territorial reconfigurations (Heleniak, 2010). Taking into consideration the time scale used by respondents, it is possible to infer that these communities are currently in the early stages of a new period of social, cultural and ecological restructuring. Within this context, to evaluate the liveability of northern settlements and villages, non-bio-physical stressors that are also impacting on residents' lives and livelihoods need to be included. Narratives reveal that analyzing the complexity of the

current situation in these settlements requires assessing each impact within a broader network of interrelationships.

Several authors have tried to measure quantitatively the strength of attachment to a place as well as the symbolic meaning that people attribute to places by using positivist approaches (Quinn, 2018). However, the purpose of this research is not to define conceptual boundaries or measure the different types of the bonds with places (place attachment, place identity, sense of place, place dependence, among others) (Lewicka, 2008). Instead, the aim is to extend the analysis of future perspectives of northern residents for their settlements and to integrate the spatial-affective sphere. Multiple elements emerged from the narratives that could be associated with local forms of place attachment or sense of place (sometimes used as synonyms). They were indirectly evoked during interviews when residents tried to describe the multiple and diverse elements to be taken into consideration when analyzing future perspectives for these northern settlements. Within the context of new socio-economic and environmental conditions - with the associated uncertainty - choosing whether to stay or leave is a complex, non-linear task that requires evaluating multiple aspects simultaneously. More specifically, the variety of elements highlighted by local residents when detailing their own choices, reveals the necessity to delve into those aspects that counterbalance the challenging living conditions and that make some residents reluctant to leave their northern settlements. These are relevant as they may be necessary for locals to lead meaningful lives in Tiksi and Bykovsky, but also as elements associated with the ways in which residents insert themselves into their world. In this sense, Giuliani (2003) underlines the importance of bonds with places in the way human groups determine their existence. This includes family, relations, friends, workplaces, places of worship, neighborhoods, etc. which enrich their lives with specific values, common goals and particular significance. Integrating these elements into adaptive science will enrich information about broader interrelationships between their valued places, their identity and well-being. Meanings and identities associated with place should not be excluded from policy and planning processes (Fresque-Baxter & Armitage, 2012).

When evaluating liveability in these settlements, residents discursively associate it with two main types of migration: either to stay or to leave. Migration, as used here, refers to the number and patterns of movement by people, whether short or long-term, voluntary or forced (Huntington

et al., 2017). Mobility is here used as a notion that englobes the “freedom to seek opportunities to improve living standards, and health and education outcomes, and to live in safer, more responsive communities” (UNDP, 2010, p.1). Although mobility has been culturally rooted in Yakutia for centuries (Argunov et al., 2017), it is important to identify the context in which decisions associated with mobility and migration movements are taken: the implications of being forced to migrate due to irreversible environmental degradation (e.g: coastal erosion or if the main natural resource becomes scarce - like fish in Bykovsky) will differ greatly from those caused by moving voluntarily to other territories out of choice or for cultural reasons. In this sense, moving to other regions or districts can be perceived as both a mechanism that supports freedom of movement of northern inhabitants, but also as an adaptive alternative so they can escape places that no longer have the necessary conditions to allow them to live their lives in accordance with their worldviews, needs and personalities. In some cases, emigration is considered by locals as an option to pursue their dreams and life projects in places where conditions are more favorable. However, it is equally important to consider potential risks in the migrant-receiving zones (Foresight, 2011) and how this could shape their new lives.

The diversity and richness of narratives collected during the fieldwork demonstrate that migration movements in the Republic of Sakha cannot be predicted by considering quantitative variables alone, but instead other key elements need to be integrated: for example, human-capital attributes, risk-taking traits, community characteristics and the specificities of the migration networks (Heleniak, 2009). Migratory theory indicates that migratory movements are influenced by age, gender, level of education, occupation and income. Moreover, rates tend to be higher for people who just finished school and are starting their professional careers, and lower after retirement age (Heleniak, 2001). This was particularly true for residents of Tiksi who openly expressed their unwillingness to leave despite the challenges that living there involves. In this sense, as Huntington et al. (2018) suggest, this lack of migratory response by a demographic to adverse environmental situations could be explained, in part, by attachment to place. Similarly, Adams (2015) considers that immobility in dissatisfied people is likely caused by attachment to place.

Qualitative analysis of the narratives reveals that people (especially from Tiksi) who desire to stay in the settlement share a sentiment: Soviet nostalgia⁷². According to Boym (2001), nostalgia refers to the desire to return to a specific “place” or “time” from the past, while refusing to surrender to the passing of time. In this sense, it could be interpreted as a “positive” evaluation of the reality from the past which is usually built through memories and recollections, accompanied by a negative appraisal of the current one. This might occur as a result of comparing current difficulties to an idealized past (Sullivan, 2014). Although northern locals consider a wide variety of elements when evaluating their current quality of life (work opportunities, salaries, possibility to save money, role within the share and support network, among others), Soviet nostalgia appears to be a relevant element closely associated with the desire of some locals to stay in their settlements and should therefore not be overlooked in adaptive policy and decision-making. This trend is particularly evident among the older members of the population in both settlements, with a stronger trend in Tiksi. This is aligned with the results from the surveys obtained by White (2010), where age appeared to be a strong determinant of the feeling of nostalgia provoked by the demise of the URSS⁷³. Soviet nostalgia appears in narratives from Tiksi and Bykovsky as a concept with dual significance: on one side, as a point of reference used to compare their current living conditions and on another side, as a deeply rooted feeling held by locals who lived in the North during Soviet times and continue to do so. The surveys conducted by White (2010) show that living standards were closely associated with Soviet nostalgia in the same circumstances. Interviews are a useful methodology to capture the feeling of frustration that some residents - especially those who lived in the North during Soviet times – feel when they compare their current situation with the past in terms of infrastructure, employment, cost of living, transportation, etc. Nostalgia often appears in narratives as a strong desire to “rebuild” the settlement to make it as prosperous as it used to be and to recover the consequent living standards that they used to have during Soviet times. Research also indicates that “trapped” residents often feel doubly vulnerable as they live in the most environmentally risky areas and also have limited resources to emigrate (Black et al., 2013; Foresight, 2011). However, it is also possible to see immobility due to place attachment as an

⁷² In Russian: “ностальгия”.

⁷³ This study identified the “nostalgics” according to their social characteristics and to their response to the following proposition: “It is a great misfortune that the Soviet Union no longer exists”.

element that could potentially be at the core of coordinated community action and therefore, lead to new local forms of spatial agency. Moreover, acknowledging this implies considering differentiated policies for residents depending on their mobility characteristics and preferences, especially if faced with forced displacement (Adams, 2015).

Another relevant sphere of life in the North that requires special attention in the light of climate change and permafrost thaw are traditional activities (especially hunting, fishing and reindeer husbandry). These activities have a central role because they:

1) perpetuate traditional lifestyles and worldviews;

2) attenuate the impact of extremely high prices of products and low salaries in northern settlements/villages;

3) guarantee access by local inhabitants to local traditional food;

4) provide bigger urban settlements and cities with traditional food (for example, Yakutsk);

This said, it is possible to conclude that traditional activities provide residents from the Republic of Sakha and more specifically from northern settlements, with an essential element to nourish – both materially and symbolically – the regional and local share-and-support network which is culturally rooted in the Republic of Sakha. Their relevance lies in their significant contribution to tackling the negative effects of high prices and low salaries in the northern settlements. These networks allow rural and urban dwellers to access traditional food. Hence, some northern locals perceive them as elements that make their settlements more livable. In other words, share-and-support networks enhance the spirit of solidarity between villagers but also between rural and urban dwellers. In fact, residents from Yakutsk depend heavily on relatives living in villages and settlements to obtain fish, meat, berries, mushrooms and other products which are unique to rural areas. Thus, a sharp reduction in fish availability in Bykovsky (from where the fish is normally distributed to other villages, settlements and cities like Yakutsk) would have effects beyond the settlement borders. Similarly, the impacts of higher morbidity of reindeer (due to severe changes in climate conditions) in the regions that produce and send reindeer meat would also be felt in other villages, settlements and cities. This would also be the case for changes in the opening/closing navigation seasons in Northern latitudes. This demonstrates that the bio-

physical effects of climate change and permafrost thaw exceed the limits of traditional activities and are also felt at a broader scale, underlining the undeniable interconnectedness between the material and non-material dimensions. Changes in climate and permafrost thaw represent threats to these non-material networks which are in the heart of the distribution of traditional and essential food products at local and regional scales. They also contribute to maintaining the cultural identity through the perpetuation (in time and space) of shared values and the enhancement of community ties. If natural resources and traditional activities are endangered, the consequences will also reach people not directly related to these activities, but who strongly depend on them.

Considering adaptive strategies in the context of these multidimensional changes requires accepting that adaptation itself is not an uncharted nor recently introduced concept among northern residents. As previously mentioned, the first populations that arrived in these lands have been adapting to extreme climate conditions and later on, to daunting socio-economic conditions. Nowadays, they continue to implement different local and updated forms of adaptation associated with:

- 1) Mobility;**
- 2) Community, share-and-support networks;**
- 3) Natural resources & traditional activities;**
- 4) Strong reliance on government funds and investments.**

The information gathered during both fieldwork studies allowed key elements associated with daily, local and sometimes implicit forms of adaptation between northern residents to be identified. According to local narratives, mobility trends and governmental funding are not directly affected by changes in permafrost and climate. However, the support networks and traditional activities have been proven to be indirectly and strongly impacted by both processes. Locals perceive traditional activities and support networks as elements that help them to continue to adapt to variable northern living conditions - and therefore make their places more livable. Therefore, the deterioration of these elements could diminish the adaptive capacity of northern residents and affect their cultural sphere. Having the certitude of being able to obtain fish and

meat at an accessible price (or for free) is essential for budget management by northern residents. As they no longer have the bio-physical conditions required to guarantee the normal functioning of this system, this could increase the pressure on the already fragile financial stability of northern households (as described during interviews).

Within this deep “destructuration” of the Northern World, it is impossible to predict how migration and mobility trends will evolve, and thus the demographic composition of Tiksi and Bykovsky. However, greater emigration flows triggered by the increasing uncertainty are to be expected. From the previous analysis it becomes clear that climate and permafrost changes represent a bigger threat for communities like Bykovsky, which are entirely dependent on a single economic activity to sustain local employment and the symbolic practices that underpin the local feeling of well-being. Despite popular sayings at a regional scale, it is impossible to know if Tiksi will become a ghost settlement (like Vorkuta in the Komi Republic) in the near future or not. Nevertheless, it is possible to infer that as it is the only urban settlement in Bulunsky, an important administrative center in the area, and better connected to Yakutsk, the possibilities of recovering and implementing adaptive strategies to cope with the effects of climate change and permafrost thaw are higher than for Bykovsky. Additionally, its central role within the district also creates a natural dependence by rural dwellers from neighboring settlements. Narratives demonstrate that one popular theory expressed by residents of Bykovsky is that, under irreversible coastal erosion, its population might be resettled in Tiksi. However, more information related to the possible psychological and cultural implications of applying such radical adaptive measures needs to be collected. Within this context, it is important to highlight the dangers that interventions conceived and applied by outsiders could represent for small northern settlements like Tiksi and Bykovsky. This is why a community-based approach in policy-making and the formulation of locally relevant adaptive strategies should always be prioritized (Ford et al., 2015). Moreover, these forms of local governance can strongly reduce place disruption, preserve place-related values (Von Wirth et al., 2016), and therefore, promote effective adaptation planning (Clarke et al., 2018).

This chapter disaggregated the wide diversity of elements that locals consider when evaluating their quality of life and the liveability of their places. It also provides some concrete examples of how locals are currently responding to the reconfiguration of the mechanisms of interaction between them, the environment, the economical-productive and socio-cultural components. It

also contributes to a better understanding of local decisions to stay in or leave their villages and settlements. Finally, it represents an important scientific contribution to better understanding the specific ways in which climate change and permafrost thaw impact not only on the physical and material dimension, but also on the non-material and cultural components of northern settlements and how these could interact with the future plans of northern residents.

GENERAL CONCLUSIONS

The Arctic is gaining international visibility as a result of the accelerated and evident effects of climate change in this region. The European Nunataryuk Project that funded this dissertation is a multidisciplinary effort to increase the scientific knowledge about permafrost thawing. This dissertation was conceived within this project in order to provide input on the perception of social and cultural impacts of climate change and permafrost thaw in the Russian Arctic, and more specifically in the settlements of Tiksi and Bykovsky (Bulunsky District). There is abundant scientific information concerning the bio-physical implications of these processes, but little is known about the specific impacts on less tangible spheres such as the social and cultural ones. They require equal attention as the numerous interactions that occur within and between these spheres play a key role in how northern residents define and evaluate their lives and livelihoods. This is why, this dissertation focuses on the perception of the impacts of climate change and permafrost thaw on the cultural, natural and socio-economic dimensions. This is particularly relevant if we consider that living conditions in northern settlements have always shaped by the presence of frozen soil (permafrost) and harsh climatic conditions.

In order to address these topics from the locals' point of view, I decided to conduct face-to-face qualitative interviews. Residents' daily life experiences were used as an entry point to develop this research. This was a purposeful decision in order to put locals' voices at the core of this research as they are directly concerned by this complex network of modifications and therefore, should have the possibility to express themselves and to define their necessities and desires.

Moreover, by using their narratives, it was desired to identify site-specific elements and processes that are involved in the construction of meaning. These are essential to understand how residents perceive their current lives as well as the consequent modifications caused by permafrost thaw and climate change. Additionally, it was intended to identify the meaningful elements of their lives, and the deep transformations that they are currently undergoing. This could also provide rich information concerning terminological specificities, causal relationships between each process/event and therefore, actively contribute to rebuild the new risks patterns - as experienced by local residents-. This research also aimed at understanding how and to what extent climate change and permafrost thaw are altering the way in which humans interact with each of the other

dimensions of their lives (socio-economic, cultural and natural).

Considering the importance of mobility for northern residents, it was also desired to study how the transformations that Tiksi and Bykovsky are currently undergoing can alter the dynamics between settlements. Particularly, how could traditional activities, food production and the social configuration could be impacted. Achieving these goals would naturally conduce me to delve into the influence that these complex series of changes have in local residents' future perspectives. This could work as another instance from which new meaningful elements could emerge, contributing to the overall understanding.

To conclude, by collecting this rich qualitative information, it was intended to identify which are the elements that undoubtedly need to be taken into consideration in order to create legitimate, morally respectful and locally-relevant adaptive strategies.

The first fieldwork conducted during the summer of 2018 in the city of Yakutsk (Republic of Sakha), provided major findings concerning the perception of permafrost thaw and climate change at a regional scale (see chapter 7). Interviewing people who were living in Yakutsk but who were born or who previously lived in other settlements/cities helped me obtain a bigger picture of the regional situation concerning permafrost thaw and climate change. All the interviewees were familiar with these concepts and pointed out a detailed understanding of the complex chain of modifications. Locals' narratives complimented each other and contributed to expand the overall state of knowledge regarding the multidimensional impacts and new risk patterns associated to climate change and permafrost thaw in Yakutsk and other settlements in the region. At this stage, it was possible to create a mental map (see Figure 55). In spite of this complementarity, it was possible to observe different types and levels of concern between the respondents. This could be a reflect of their different background in terms of gender, places of origin, occupations, amount of time spent in the nature, etc.

Interviewees identified a similar series of multidimensional changes currently taking place in their environment and societies and were capable to establish causal relationships between them and both permafrost thaw and climate change. Even if these changes are manifested under different forms and therefore affect different spheres of their lives, they are just different facets of the same reality they live in. For example, they are manifested as an increase in the number of mammoth

remains found, or an increase in the number and intensity of floods, the detrimental damage of infrastructure (buildings, routes, pipelines), but also as rapid landscape modifications, or changes in the composition and distribution of flora and fauna in the region. From locals' narratives, it became evident that the material and cultural dimensions of permafrost thaw are two sides of a single coin and cannot be interpreted separately. The processes unchained by climate change and permafrost thaw lead to landscape modifications, deep modifications in the ecological patterns, in the infrastructure, but also exert an increasing pressure on the cultural dimension. More specifically, they threaten their symbolic representations, the material practices and the emotional ties that they have developed in that specific land. For example, the fact that there are more frequent and more intense floods in coastal settlements, opens the possibility of being forcibly displaced threatening their specificities and ways of interacting with their places as well as the meaning associated to them. This type of abrupt and irreversible disruptions may lead to an inner socio-cultural fragmentation. This is why, even if for analytical purposes topics are desagregated, in order to understand local residents' experiences and perception requires respecting the interconnectedness between the material and cultural dimensions to support the legitimacy of the results.

Another major finding is that there is an alignment between the causalities attributed to permafrost thaw and climate change by interviewees and the scientific explanation: climate change is now manifested as higher annual and seasonal average temperatures in the Arctic, which affects permafrost and in return, impacts other dimensions of interest for humans. This should not be overlooked in policy-making processes as it could mean that there is no need to formulate external knowledge-centered interventions as local residents already have a precise knowledge.

Questions addressing the possible solutions or adaptive strategies to cope with the impacts of climate change and permafrost thaw often derived in interviewees openly manifesting the necessity of public policies and state-run programs or funding. Their narratives also revealed that science is perceived as a key source of solutions regarding these processes. These elements are salient as they can provide an overview of the local forms of agency, in this case, are conceived within a vertical and hierarchical structure where their capacity of action seems to be principally conditioned by external financial resources and decisions.

The information gathered during the first fieldwork as well as the results from the qualitative analysis provided an overview of situation concerning climate change and permafrost thaw at the scale of the Republic of Sakha. The mental map (see chapter VII, page 162) created from the gathered information was a helpful tool to visually identify the main concepts, stakeholders and relationships identified in the narratives. This was particularly relevant to become familiar with the local terminology, and to start reconstructing the causal relationships of the processes, as depicted by interviewees. Face-to-face interviews and snowball sampling allowed me to rapidly identify the main authorities (regional and/or local) that could be directly or indirectly concerned by these topics and there, accelerated the process.

Between July and August 2019, I conducted the second fieldwork in the Republic of Sakha, and more specifically in the Bulunsky District. In this occasion, it was possible to delve into further detail the local manifestations of climate change and permafrost thaw in the coastal settlements of Tiksi and Bykovsky. This fieldwork allowed me to understand and reconstruct the specific mechanisms in which these processes affect the natural environment, the relationship that residents have with it, and other non-material dimensions of their lives and livelihoods.

It was also observed that local residents value and interpret changes within a broader frame of reference that is locally-rooted. In the case of Tiksi and Bykovsky, this is associated to harsh climatic conditions, historical events (especially the Soviet times), a particular sense of mobility and the demographic situation. In this sense, the results from this fieldwork demonstrated that the elements that are valued as meaningful by northern residents are not homogenous nor predictable. Moreover, according to the interviewees, changes do not affect everyone in the same way. The level of contact with nature that each person has is identified as one of the main elements that conditions the extent and intensity of the impacts of climate change and permafrost thaw. In this sense, indigenous peoples and northern residents that practice traditional activities are the ones who can feel the impacts of these changes more intensely.

Analyzing locals' narratives further informed us on the way respondents conceive and make sense of the surrounding elements and processes. For example, nature was discursively described as a permanent juxtaposition of different aspects including climate, permafrost, flora, fauna and the natural landscape. Each of these elements are inserted within a broader feedback loop of

interactions. Although, just like in English, in Russian there are four different words to refer to each of these notions, some respondents used “permafrost” and “climate change” and “permafrost” and “permafrost thaw” as equivalent concepts. In this sense, when asking the respondents to describe what they understood by “permafrost”, they often referred to the mechanism that leads to permafrost thaw.

When it comes to climate change, local residents from Tiksi and Bykovsky provided detailed information about changes in seasonal weather that were translated into variations in temperatures, snow conditions, winds and the length of the seasons (reflected in the navigation season’s length, for example). Once again, narratives demonstrated the inseparability of many of these processes. However, there were considerable differences in the way such changes were narrated. This was closely related to the age, place of origin and occupation of the interviewee. In this sense, having lived for a longer period of time in any of these northern settlements and being in close contact with nature could provide a more detailed input concerning such modifications. Younger people often referred to the elderly people of their communities as reliable evaluators of climatic changes. All in all, climate change was perceived as a negative stressor for their lives and livelihoods. This can be explained by the fact that it activates the positive feedback loop of permafrost thaw and therefore, exerts negative effects on other relevant spheres of their World.

Despite being geographically close to each other, the local specificities of Tiksi and Bykovsky exert an influence in the extent and specific manifestations of climate change and permafrost thaw. Such differences were captured in locals’ narratives and suggest that the accelerated changes are now producing unprecedented transformations in the Northern World – as residents from Tiksi and Bykovsky knew it-. In this sense, it is here proposed to refer to a “de- structuration” of the Northern World, meaning that the logical and relational context in which the structures and elements were conceived is now experiencing deep changes. Acknowledging this is particularly relevant because of the implications that this may have on the way local residents build meaning and sense. Locals’ narratives demonstrated that residents are now being forced to redefine the way in which they interact with their surrounding natural environment, climate and the other elements of this complex and sensitive system. Considering the number of stakeholders concerned, the extent and severity of the effects of climate change and permafrost thaw, “de-structuration” emerged as a holistic concept capable to reflect the multidimensionality and complexity of the

changes that northern settlements like Tiksi and Bykovsky are currently undergoing.

One of the major findings of this fieldwork is that the impacts of climate change and permafrost thaw do not act isolated, but instead interacts with other processes or elements associated to other spheres of life in these northern settlements, for example, the socio-economic one. Therefore, this de-structuration is not only triggered by bio-physical processes, but also by other "external" stressors, including cultural and socio-economic changes. It is, in other words, characterized by a multiplicity of simultaneous interactions that can be oriented in different directions. For example, globalization, among others, shape the lifestyle that many young residents (usually engaged in traditional activities in northern settlements) aspire to have. As a result, it is becoming increasingly difficult for elderly people to transfer their knowledge to younger generations in order to preserve their traditional lifestyles. Within this complex chain of relationships, it was also possible to see that bio-physical changes can also trigger social and cultural modifications. For example, a shortage of fish or meat in northern settlements can affect the share and support network that leads to a particular social configuration in the Republic of Sakha. It was also demonstrated that such de-structuration is now reflected in the necessity of new tools or mechanisms to cope with the negative impacts of the changes they are currently facing.

The interconnectedness of the processes, elements and stakeholders involved in the de-structuration of the Northern World should be maintained in any adaptive strategy or socio-economic development policy. Trying to tackle accelerated changes within this complex system isolatedly could lead to an underrepresentation of relevant aspects for northern residents and eventually, reinforce the negative effects.

Conducting fieldworks in Yakutsk (2018) Tiksi and Bykovsky (2019) provided enough information to identify the wide diversity of stakeholders, processes and elements as well as to reconstruct the complex chain of interactions between them within the context of changes in climate and permafrost. In both opportunities, it was demonstrated that when we try to characterize the impacts of such processes, the socio-economic, cultural and natural dimensions become constantly overlapped. For example, accelerated coastal erosion in Bykovsky is currently thawing and degrading the local cemeteries. At a first glance, this could be evaluated as a merely material

impact. However, narratives demonstrate that this unchain a serie of changes that also threat their worldviews: traditional belief says that young people should never get in direct contact with buried people. Instead, in case of having to manipulathe coffins or bodies, this should be done by elderly people because if the cause of their death(such as a virus or bacteria) was still present, this person would have lived enough. Qualitativeinterviews facilitated collecting this information that, when integrated into the overall analysis,changes the diagnosis of the situation. More specifically, for this particular example, climate change and permafrost thaw would not only impact the material dimension (accelerated coastal erosion and cemeteries), but also the non-material or cultural dimension (system of beliefs and worldviews).

The information gathered during the second fieldwork allowed me to, on the one hand, delve into further detail into locals' interpretations of changes associated to climate change and permafrost thaw. On the other hand, to contextualize these changes and new risk patterns within their overall well-being, future prospects for themselves and those for their settlements. At this stage of this research, it became evident that people living in Tiksi and Bykovsky are not only impacted by permafrost thaw and climate change but are also struggling to cope with the political, economic, demographic and territorial aspects. According to local residents, the dissolution of the Soviet Union lead to a sharp decline in their quality of life and therefore were forced to find new adaptive strategies to cope with the impacts. When asked about their future perspectives, most respondents naturally gravitated towards the main elements that helped them evaluate livability in these northern settlements. In some occasions, these elements were closely connected to local forms of place attachment or sense of place. Mobility and migration were naturally integrated into the conversation when residents referred to liveability in these settlements, well-being and future perspectives. A salient finding was that for them, taking the decision to stay or to leave was not linear and could involve a wide variety of - principally non-material - elements. People who openly expressed their desire to stay in their settlements despite the challenging living conditions, found other elements that contributed to counterbalance the undesirable effects. This demonstrated that economic hardship, for example, is not necessarily sufficient to make a person out-migrate. Other elements like the emotional ties between that person and their family, friends, and valued places must therefore be integrated into the analysis. Other personal characteristics like age, gender, occupation, level of education, among others. Elderly people from Tiksi and Bykovsky were the most reluctant to leave the settlement. Soviet nostalgia appeared in

their narratives as a common denominator. It works as a particular moment of the Russian history to which current living conditions are compared to. But it is also a commonly-shared experience between those who were living in the North during the Soviet Union and still do. Locals' narratives reflected the frustration that these people share when they compare their current quality of life to the one they had during the Soviet days. The benefits of the Soviet times are associated to infrastructure, employment, products' prices, transportation, etc. Between these residents, it was also possible to identify a strong desire to see the settlement be as prosperous and developed like in the "gold days". Acknowledging the individual capacities, desires and future perspectives will therefore require a differentiated treatment in policy-making and decision-making processes.

Local's narratives demonstrated that traditional activities play a key role within regional and local culture because they actively contribute to transfer traditional lifestyle and worldviews to new generations; they act as a buffer that reduces the negative impact of extremely high prices (of products and services) and low salaries in Tiksi and Bykovsky; people living from traditional activities guarantee that residents from northern settlements (relatives and friends) have access to traditional food (meat and fish); provide remote urban settlements and cities with traditional food too. In other words, traditional activities are at the core of the share and support network that characterizes the cultural identity in the Republic of Sakha. For these reasons, traditional activities are often related to livability in their settlements. However, in the context of climate change and permafrost thaw, both natural resources and traditional activities were identified as increasingly threatened. Their impacts could be felt by those residents from the Republic of Sakha who are not even related to traditional activities but still depend on them.

The fieldwork conducted in Tiksi and Bykovsky provided insightful information that facilitated the interpretation of the local significance of "adaptation". It refers to any action or measure implemented (or desired to be implemented) in order to tackle the effects of the Northern World's de-structuration. Questions addressing concrete actions that are being done to adapt to changes, or who are the best adapted in the local community, demonstrated that local residents mobilized different elements to answer. For example, mobility. This is necessary, especially in such remote territories, to obtain natural resources for consumption or to pursue upper studies. But it also plays a key role in the context of socio-economic hardship. Even if this does not appear to be the intuitive solution for everyone in Tiksi and Bykovsky, many of the respondents evaluate

the possibility of moving to other regions in the Republic of Sakha in order to find better professional or education prospects. This trend was particularly marked between young people. However, many of these respondents also manifested their desire to see reforms in the North so they can resettle there.

Another element closely associated to adaptation and the overall well-being in the North is the practice of traditional activities. Locals' narratives demonstrated that these exceed the merely cultural know-how legacy, but also operate as a buffer within the socio-economic sphere: hunting and fishing allow people to access traditional food (meat and fish) for a minimal cost (associated to materials required). They are in charge of distributing the food between their relatives and friends (in their own settlements but also in other regions). This is particularly relevant for people living in settlements like Tiksi and Bykovsky as it reduces the negative impacts of low salaries and high prices. However, it is also important for urban dwellers as buying meat and fish from local stores is always more expensive than being provided by a relative or friend. Establishing interpersonal relationships with other residents and relatives in the North opens the possibility to take part of the share and support network and therefore, have access to traditional food. Being part of this network means that one person can contribute in two possible ways: either as a provider of meat and fish, or as a provider of other services/assistance. The latter ones, usually help villagers who come to the city with administrative procedures, accommodation, education, etc. Their roles and contributions are not explicitly fixed and instead are sustained by an widely extended spirit of solidarity and mutual reciprocity. This is aligned with two fundamental characteristics of the local philosophy: when anyone obtains something from nature (an animal, for example), they will give something back in return. Similarly, in order to survive in such harsh climatic and environmental conditions, it is commonly accepted that people cannot survive in their own, but instead depends of others. This fieldwork demonstrated, on the one hand, that this implicit network is now being threatened by climate change and permafrost thaw. This was confirmed by local residents from Tiksi and Bykovsky who provided detailed explanations of how these processes are now impacting the accessibility to fish and reindeers in the North. On the other hand, these changes can impact not only villagers living in the North but also also urban dwellers who will be forced to buy these products at a local store at a higher price. On the other hand, it demonstrates that the share and support network is intertwined to the particular social and spiritual configuration in the Republic of Sakha. Therefore, changes in this network would not only affect people's

economies, but also the way they interact within it.

Narratives also demonstrated that northern residents conceive adaptation mainly through the lenses of external action. They demonstrated a strong capacity to adopt new strategies on a daily basis to cope with some of the impacts of climate change and permafrost thaw. However, some changes seem to exceed their capacity of action, for example, coastal erosion in Bykovsky or the degradation of buildings in Tiksi. In such cases, they openly manifest the need of government funds to implement technical adaptive strategies. For the previously mentioned examples, residents mentioned the idea of implementing technical measures to reinforce the shore to reduce the impacts of coastal erosion. In Tiksi, people pointed out needing more investments for maintaining buildings and repairing the degraded pillars.

The analysis of the narratives collected during the second fieldwork confirmed that climate change and permafrost thaw are triggering the de-structuration of the Northern World and are becoming increasingly relevant issues for local residents. Their effects are manifested in different spheres of their lives and livelihoods but do not affect Tiksi and Bykovsky equally: Bykovsky, due to its strong dependence on traditional fishing, can be easily destabilized by changes in the natural environment and climate, as they can ultimately lead to a reduction in the amount of fish available or render it more inaccessible for local residents (for example, if they change their migration routes or spawning places). If these changes keep evolving, this settlement may be forced to abandon its main economic activity and its population should migrate to new regions. The delicate situation of this settlement is also impacted by rapid coastal erosion. In this sense, residents see Tiksi as one possible destination if resettling Bykovsky inland was not possible. Tiksi's economic profile is more diverse and as result, this settlement may have – a priori- a bigger adaptability to changes. However, there are some impacts that penetrate both communities with the same intensity, such as the accelerated degradation of ice-cellars, or the increasing challenges associated to practicing traditional activities (mainly fishing and hunting) and the consequent shortages of fish and meat at a local and regional scale.

The de-structuration of the Northern World as they knew refers, in other words, to the rapid transformation of the logic and relational framework of this complex system. This is where locals attribute meaning and sense to each of the elements of their World, as well as to the different

ties and bonds established between them. However, some of the elements and relationships have been preserved. This de-structuration is reflected in locals' narratives when the diverse and simultaneous impacts on every single dimension become overlaid. It is possible to conclude that:

- **this de-structuration is already forcing residents to find new ways of interacting, both in economical-productive and socio-cultural terms, with the elements of this system;**
- **the impacts of climate change and permafrost thaw in northern settlements like Tiksi and Bykovsky cannot be easily categorized within rigid conceptual definitions. This is mainly associated to the fact that changes impact multiple dimensions at the same time and therefore, choosing one unique category for each impact can be risky, especially as this could mean neglecting important relations.**

As suggested at the beginning of this research, it was desired to analyze the impact of climate change and permafrost thaw through the lenses of the inhabitants from Tiksi and Bykovsky. Encounters with the participants, and the subsequent analysis of the associated corpus, guided me towards the identification of locally-relevant concepts and processes. These were essential to understand each process and its consequences as experienced and valued by the local populations. Having the possibility to conduct face-to-face interviews allowed me, initially, to capture the multiplicity of experiences associated to climate change and permafrost thaw. It also permitted me to delve into the possible terminological gaps existing between the scientific and the local communities. Most of the times, it was possible to confirm that there are similar ways of conceiving processes, for example, how permafrost thaw is triggered by climate change. In other cases, local residents provided a detailed explanation of a process but used different words than those from science. For example, when addressing what western science knows as "reducing bearing capacity of the soil", was often perceived by locals as "the pillars of the buildings are collapsing because of permafrost thaw". In such cases, there are no contradictions, just different terminological formulations.

Collecting local narratives also enabled me to contrast the narratives from local residents with some widely spread assumptions about life in Russian Arctic settlements like Tiksi. During the fieldwork conducted in Yakutsk, some of the respondents demonstrated being astonished when we mentioned that we were interested in conducting fieldwork in Tiksi and Bykovsky. During informal exchanges after/before the interviews, they would mention that Tiksi will probably be a

ghost town in the near future because most people want to out-migrate. In spite of being formally part of the same region (Yakutia), some respondents – especially those who were born and lived in Yakutsk – seemed to be estranged from the reality of northern settlements and often reproduce this type of common sayings. But above all, using locals' narratives as an entry point allowed me to visualize the multiple and simultaneous interactions that nurture the Northern system as experienced in Tiksi and Bykovsky. It was always prioritized to reconstruct the order of processes and events as well as the causal relationships as described and perceived by local residents. The results successfully map out permafrost thaw and its impacts at a regional scale, using the narratives of people from different locations from the Republic of Sakha as an entry point. Furthering this analysis, outside of the capital city, more specifically in Tiksi and Bykovsky facilitated a much-needed finer analysis of the implications of permafrost thaw and climate change in smaller Arctic settlements. Information gathered during both fieldworks demonstrates that climate change and permafrost thaw are increasingly salient topics between residents from Tiksi and Bykovsky and are fully intermeshed with the socio-economic reality. As a result, northern communities are under supplementary pressure as they are facing new risks. This is a significant finding as it proves that any scientific or political attempt to divide this type of complex systems into smaller micro-systems in order to analyze them separately does not correspond to the way people experience it. By isolating parts of this system during the analysis, meaningful interrelationships are dismissed. The Northern World – as conceived by residents from Tiksi and Bykovsky – is a complex system of multiple elements, processes and stakeholders that constantly interact with each other within a feedback loop. This is reflected in the constant discursive overlap between the socio-economic, cultural and natural dimensions. These study cases also demonstrated that climate change and its consequent processes cannot be interpreted as isolated phenomena and need to be contextualized within a broader network of interactions.

The scientific challenges associated with capturing the essence and dynamics of the Northern World system can be seen – although at a different scale – as an analogy of the challenges that some interdisciplinary projects like Nunataryuk face too. Coordinating efforts between multiple epistemic cultures with different boundaries can be troublesome. Even if all WPs from Nunataryuk aim at obtaining a broader understanding of the implications of permafrost thaw in the Arctic and the global climatic system, each discipline has a particular scope and particular interest within the concept "permafrost". More specifically, trying to intertwine the contributions from each niche

of expertise within a framework of power relations and hierarchies can be a hard task and disciplines' endeavours might be diluted. This is particularly relevant for social sciences which are often perceived as subjective in their way of producing knowledge. Just like in interdisciplinary projects, trying to understand and to respect the particular interconnectedness existing between each of the elements, processes and stakeholders in the Northern World can be methodologically challenging. For example, in face of accelerated coastal erosion in Bykovsky, residents seem to agree that the settlement might have to be resettled in the future. Focusing only on the bio-physical implications of coastal erosion could lead to overlooking non material aspects like the psychological and emotional consequences of dramatic landscape modification and the degradation of meaningful places can produce on local residents. Similarly, considering the local concern about the decrease of fish over the years, it should not be underestimated the role that fishing has for locals' well-being and identity. The multiple examples from Tiksi and Bykovsky reaffirm the necessity of holistic and flexible approaches to analyze the new risk patterns associated to climate change and permafrost thaw in Russian Arctic settlements. This is also valid for policy-making and decision-making: the interconnectedness between the constitutive elements of the system and the impacts on the Northern World should be placed at the core as ignoring this could lead to overlooking meaningful ties and relations.

Taking into consideration the multiple recent documents and programs that the Russian Federation and the Yakutian regional government have recently signed and that science-based alternatives are deemed valuable and are encouraged by local residents, it would be pertinent to find ways to create multi-stakeholder dialogue spaces and exchange structures. Just like the impacts on the cultural and material dimensions cannot be fully interpreted separately, it is equally necessary to engage Indigenous, local and scientific forms of knowledge in the co-construction of a holistic understanding of aspects that shape local cultures, identities and the social configuration. This means, in other words, acknowledging that they are complementary forms of understanding complex systems like the Northern World and that even differences hold an enormous potential to enrich the overall state of knowledge. The new information obtained from these spaces can be useful to find better adapted and legitimate solutions for the multiple challenges of living in a de-structured World. This is valid not only for climate change and environmental issues, but also for policies aiming at promoting the socio-economic development in the region. It could also enhance the local applicability of laws and norms that are often

elaborated far from the region concerned the content. The main challenge remains to find practical ways to establish fluid channels of communication, as well as to integrate them into already existing policy (federal and regional). This is also aligned with the interdisciplinary spirit of the Nunataryuk Project, that aims at creating dialogue-spaces between natural and social scientists and between scientists and local populations in order to achieve deeper forms of understanding of the implications of permafrost thaw in the Arctic and the global climate.

Understanding the extent of impacts of climate change and permafrost thaw in Tiksi and Bykovsky naturally guided this research towards analyzing the existing ties between them and other neighbor settlements like Kyusyur or Taimylyr. Within this context, one of the most salient topics was mobility. Mobility nourishes human freedom and is culturally rooted among Yakutians. Tiksi's centrality within the District is also reflected in the regular movement of people originally born in neighbor settlements. Tiksi acts as:

- **an urban settlement that is often seen as a place that could provide villagers with more job opportunities and in some occasions, the possibility to go to continue their studies.**
- **A place where they can pursue administrative procedures, visit relatives (and distribute fish/meat), access some products that are not easily found in rural settlements, etc.**

Some residents from Bykovsky even identified it as a potential destination in case they were forcibly displaced in the future. These elements that emerged during interviews suggest that the future of Tiksi could also severely shape the mobility dynamics within the District. This is particularly relevant within the context of a de-structured Northern World where Indigenous peoples and those depending from traditional activities were identified as the most impacted by climate change and permafrost thaw. It is therefore valid to suggest that having the possibility to move between settlements, and particularly to Tiksi, adds an implicit form of stability to villagers. This is often seen as a first possible destination for those looking for better job prospects but do not want to go to distant urban centers like Yakutsk. Moving to Tiksi reduces the stress associated to out-migrating to distant destinations where they do not know anyone or where the lifestyle is too contrasting. It is equally valid to see villagers coming to Tiksi as stabilizing elements for the local lifestyle and social dynamics (for example, maintaining the share and support network). In this sense, it is important to highlight that these dynamics and interconnectedness between Tiksi and neighbor northern villages and settlements should also be taken into consideration in policy-

making and decision-making. Especially when it comes to adaptive strategies, for example, if there were future forced displacements in the Bulunsky District (associated to permafrost thaw or climate change) and the residents were resettled in Tiksi, what elements would be at stake for both populations and the local-regional dynamics?

Similarly, it is valid to question the possible implications of massive out-migration from Tiksi to other regions of the Republic of Sakha or the Russian Federation. Narratives gathered during the second fieldwork revealed that this is an option considered by some residents. However, it is important to highlight that the elements at stake when a northern resident decides to out-migrate strongly vary depending if it is a voluntary decision or if it is triggered by external stressors (such as the local socio-economic, climatic or environmental conditions). Northern residents interviewed during both fieldworks visualize that there is an important sector of the local population who desires to stay in their respective settlements. Taking into consideration their emotional ties and their will to stay in policy-making processes could, on the one hand, improve the lives of local inhabitants. On the other hand, this could lead to a general optimization of interregional efforts (for example, between the authorities from Tiksi and Bykovsky). Addressing the unmet needs of these residents (including infrastructure development, building maintenance, improve housing conditions and Internet connection, among others) can reinforce their well-being and personal fulfillment and therefore, actively contribute to reinforce their involvement at a community level. Being able to live in the places that allow them to lead meaningful lives and livelihoods while respecting their traditional lifestyle and worldviews will reinforce the emotional ties and therefore could reduce the out-migration in the region, especially of young people. On the long term, this could be reflected in a stabilized permanent northern population living in these settlements. Under these circumstances, the workforce required for the industrial development and the natural resources exploitation would be guaranteed and the expenses destined to import workers from other regions could also be reduced. Building capacity among Arctic populations is essential, especially when considering the difficulties that labor shortages may have in settlements where the socio-economic development is a priority.

Taking into consideration the multiple forms of interactions and dependence between northern settlements, it is here suggested that the de-structuration of the Northern World does not limit to the formal boundaries of Tiksi and Bykovsky. Instead, it is a process that - in alignment with the

broad notions of "here" and "locals" - extends to other settlements and regions too. This is particularly relevant if we consider the strong dependence of the Republic of Sakha on traditional food. Indigenous Peoples and people who practice traditional activities who provide these products to the urban settlements and cities are now experiencing increasing pressure on their environment and animals. A sharp reduction in any of these products will impact remote areas like Yakutsk. This does not only respond to the interconnectedness of the Northern World itself, but also to the nature of climate change that does not respect humanly-constructed boundaries.

This dissertation also revealed the relevance of history and ties with the territory within the de-structuration of the Northern World and how residents perceive it. Commonly-shared experiences (such as living in the North during the Soviet times), creates site-specific foundations that shape the way northern residents experience and value the impacts of climate change and permafrost thaw now. For example, even if many residents from Tiksi admitted that the degradation of buildings' pillars and infrastructure is associated to a lack of technical maintenance, having lived in this settlement during the Soviet times can also reinforce the negative valuation of these events. Having seen the "best days" of Tiksi in terms of development works now as a parameter of comparison to what they see and experience today. This was also observed in locals' narratives when addressing the future prospects for the settlement: they use once again this common past and this idea of developed settlement as a target for the future. Similarly, in Bykovsky, Soviet days were often associated to better days for the Kholkhos Arktika and fishermen. Living in a remote settlement where salaries are low, prices high and the possibility to save money is quite limited, climate change and permafrost thaw appear as supplementary stressors. In fact, locals mentioned that these processes might be involved in the changes of migration routes, spawning places and overall available fish. Once again, having experienced "better" days in the past may now reinforce the negative feeling that some residents have concerning the future prospects of the settlement.

It is possible to conclude that the complexity of the Northern World demonstrates that analyzing the impacts of climate change and permafrost thaw cannot disregard the social configuration of the settlements of interest as well as the local and regional dynamics. The social configuration is based on an extensive list of elements that are often overlooked in scientific projects aiming at addressing climate change and other physical processes associated to it such as permafrost thaw. Integrating these elements into science and policy-making is a concrete effort to increase the the

respect for locals' Worldviews and identity and the legitimacy of the strategies proposed. This also will contribute to formulate locally-relevant adaptive policies and strategies. Tiksi and Bykovsky are two relevant coastal study cases within the Republic of Sakha and more specifically within the Bulunsky District and northern Yakutia. The results presented in this dissertation provide visibility to the current situation of two coastal Arctic settlements where there is still scarce information concerning the social and cultural impacts of climate change and/or permafrost thaw. In this sense, it represents an important contribution to the overall state of the art of climate change and permafrost thaw in the Russian Arctic. It provides a starting point to promote the dialogue between science, civil society and governments.

As previously mentioned, Tiksi is an urban settlement that has a key role for local economies, mobility, food distribution, etc. Other previous projects (such as ARTisticc Project - Adaptation Research a Trans-disciplinary Transnational Community and Policy Centred Approach-) also tried to identify the impacts of climate change in Tiksi. However, incorporate Bykovsky into the analysis allowed to capture broader impacts that are associated to the interconnectedness of the elements, processes and stakeholders from the Northern World. This is particularly relevant considering the formal interest demonstrated by the Federal government in the Russian Arctic. Considering the multiple documents and programs recently formulated in order to foster the socio-economic development of the region, it is possible to conclude that this type of qualitative research can showcase the importance of other less visible – and often ignored elements – which are equally relevant for perpetuating their lifestyles and systems of values. However, further research is needed in order to identify concrete spaces where formal laws and programs can incorporate this type of qualitative information.

This research provides with concrete examples of how local impacts of climate change and permafrost thaw can also affect people living in distant settlements or regions (for example, through the share and support network). However, it is necessary to investigate other settlements within the Republic of Sakha or the Bulunsky District in order to identify possible similarities and differences with Tiksi and Bykovsky. It would also provide useful information to understand how different impacts associated to climate change and permafrost thaw can affect broader regional dynamics. For example, compare the level of dependence of these settlements from traditional activities or how these settlements are affected by the dynamics of the support and share network.

The mental map elaborated as a result of the first fieldwork could be completed with locally-relevant information concerning permafrost thaw and climate change in Tiksi and Bykovsky. Because of the amount of data gathered, it was decided not to do it as part of this dissertation. But it is here acknowledged the potential that doing so as part of a new research project could have: firstly, it could contribute to have a big picture of the situation in the Republic of Sakha as it would merge both regional and local experiences. Secondly, it could also contribute to identify any missing relationship between elements, processes and stakeholders that were unvoluntarily overlooked in this research. Elaborating this type of tool for other study cases can equally enrich the overall understanding of the particularities of each fieldwork.

This dissertation also demonstrates that history and ties with the territories have an interplay with the particular forms of valuating and addressing the effects of climate change and permafrost thaw. However, respecting the importance of events as expressed in locals' narratives, I limited myself to develop this analysis paying particular attention to Soviet days as a transcending point of reference. Local residents from Tiksi and Bykovsky also referred to perestroika, but during the fieldwork it was not possible to collect more information about it. It is therefore suggested that more in detail research could contribute to obtain a broader understanding of the implications of other historical processes/periods that can be equally important to understand the implications of climate change and permafrost thaw.

This research provided an initial point concerning locals' perception of climate change and its manifestations in terms of variations in snow, wind, temperature, rain, etc. Some differences might be identified within each community as a reflect of the different occupations, gender, age, level of mobility, among others. It is here acknowledged that further research would be extremely useful to capture the differences, similarities and gaps between scientific information (meteorologic information and future climatic projections) with locals' perception. More qualitative and quantitative research could contribute to complement the detail of the information here provided. Despite the challenges associated, it is key to create spaces where scientific and local and indigenous knowledge can debate and co-create new forms of knowledge. The outcome of these exchanges can be extremely useful. On the one hand, it will contribute to reinforce local agency and create more resilient societies within a de-structuring World. On the other hand, it can also improve the way authorities ascertain adaptive strategies and other policies associated to the

socio-economic development.

Because of the extense of the scope of this research, the impacts collected from narratives werenot disaggregated according to indigenusness. However, because of their strong symbolic and practical dependence on traditional knowledge, it is here proposed that conducting furtherresearch in Tiksi, Bykovsky and other settlements in the Bulunsky District is necessary. This would be highly beneficial in order to capture the specific ways in which climate change and permafrost thaw impact different Indigenous groups living in the area and therefore, the different necessities. During the scoping fieldwork conducted in Yakutsk, some respondents mentioned that there are now local and regional Indigenous groups that are currently trying to coordinate efforts to address the multiple changes that they are currently experiencing in their lands. It is highly recommended to elucidate the concrete efforts that have already been done from these associations as well as the information still needed for them.

It is equally important to find concrete ways to reduce the differences in time to respond to changes between northern communities and the regulatory frames. This appeared to be particular relevant for some sectors of the community such as fishermen from Bykovsky, reindeer herders and people involved in gathering mammoth tusks. Perpetuating such gaps can diminish the adaptive capacity of those who are rapidly and more severely impacted by climate change and permafrost thaw.

It is here proved that climate change and permafrost thaw are now triggering multiple changes. Locals identified some impacts associated to them that were deemed intrinsically "negative". But in other cases, it was harder for them to categorize them as either "positive" or "negative". Such was the case, for example, of mammoth tusks. Because of warmer temperatures, local residents mentioned that it is now possible to find an increasing amount of mammoth tusks in the coastal areas of the Bulunsky District. This is perceived as a threat for the local cosmovision by some traditional sectors of northern communities, but is also seen as a new economic possibility for others. However, it was not possible to enquire about the concrete consequences that practicing these activities might have for younger people within their communities.

We live in an globalized world where the inseparability of the effects of climate change becomes increasingly evident. In spite of the relevance and necessity of conducting research at a local scale,

these results should be contextualized within a broader scale. The Arctic is a clear example as, unlike other regions of the world, the changes in this region are occurring at a faster and more intense pace due to the positive feedback loops engaged. Similarly, taking into consideration the particular ties that northern residents establish with their surrounding natural environment highlights the necessity to conduct more research in the field of social sciences in order to capture those social and cultural aspects that interplay with locals' perceptions and responses to changes. Creating concrete channels of communication between authorities, local stakeholders and scientists still appears to be one of the biggest challenges at a regional scale that needs to be overcome. Similarly, the increasing interest in the region demonstrates the necessity to foster knowledge co-production between local, Indigenous and scientific communities. Achieving a more fluid dialogue between different forms of knowledge has the potential to increase the mutual trust and could lead to co-formulating better and more respectful adaptive strategies. This would also provide local residents with tools to create new structures and mechanisms of interaction within this de-structured World and therefore be translated into new forms of local agency. In spite of having solid elements that demonstrate the importance of the previously mentioned elements at a regional scale, it is still unclear how this could be achieved within the Republic of Sakha and therefore requires investing more efforts in it. However, it is acknowledged that conducting fieldworks in foreign countries and specially where power relations exert an influence might not always be an easy task. Such is the case, for example, when local communities see scientists as a threat or when scientists perpetuate – consciously or unconsciously – their biases about local knowledge. These implicit dynamics can undermine the outcomes of the fieldworks and need to be addressed from the very beginning by the scientific community.

This dissertation proved that northern residents can describe in great detail the wide range of modifications occurring in their environments and have a strong capacity to adapt on a daily basis. Science should avoid falling into the temptation of seeing or treating them as powerless victims as this diminishes their power of action. Since the first population established in the Arctic territories, they have been facing and coping with diverse stressors. This allowed them to install in territories characterized by an extreme and dynamic climate and environment that they now consider their homes. They were also capable to overcome the hurdles associated to political decisions which strongly impacted their livelihoods and worldviews throughout the history. Despite the multidimensionality and rapidity of the changes that they are currently experiencing,

it is here suggested that these pre-existent adaptive capacities should now, more than ever, be actively reinforced from different spheres. Despite the common challenges associated to interpreting and communicating the perception of people, researchers should actively avoid conceiving frameworks or methods that do not place local communities at the core of the research. This is also valid for any attempt to design and apply “magic external formulas” that disregard or neglect the key role of local and Indigenous forms of knowledge. Even if some progress has been achieved in terms of methodologies that increased local population’s participation in decision-making, it is still needed to continue creating new, innovative and multiparticipatory spaces. These places should provide the concerned stakeholders with the opportunity to openly express their capacities, needs and desires.

It is also important to acknowledge that even if climate change’s increasing visibility and importance in the Arctic, it is not the only concern. Locals’ narratives demonstrated that social, economic and political changes can be equally relevant in the destabilization (or destabilization) of their quality of life and how they conceive future perspectives. Therefore, adaptation policy-making should contemplate integrating the inseparability of these elements in northern residents’ daily life. In this sense, it is important to create more suitable methodological approaches that will be capable to capture the complexity of these types of systems. This could be a major input for worldwide research as it could facilitate conducting research in different regions, indistinctively of the topic of interest.

To conclude, it is important to mention that, from a moral perspective, more efforts should be made to promote a more active participation of native scientists and Indigenous Peoples within International Projects. Similarly, even if the topic of interest was essentially bio-physical (such as climate change or permafrost thaw), it is necessary to reinforce the presence of social sciences within interdisciplinary projects.

Little did I know at the beginning of this PhD about the Arctic. In this sense, conducting research in the Russian Arctic represented for me an opportunity to richness of this unique region in the World. One element that particularly caught my attention was the cultural diversity and more specifically, the numerous Indigenous groups living in this area. It was impossible not to draw a parallelism with the northeastern region in Argentina where I come from. The Andes is also characterized by

extense territories, with remote settlements and villages where different Indigenous groups live. Unlike other sectors of the population, they also live in close relation with the natural environment and are being severely affected by climate change. Conducting two fieldworks in the Republic of Sakha reinforced this initial interest for the region. Learning Russian was an undoubtedly useful tool to become closer to local residents. This dissertation was the opportunity to accomplish my desire to conduct interdisciplinary research while getting immersed in a distant – yet with familiar traits – culture. Many local residents that I encountered during both fieldworks openly manifested their strong appreciation for this type of qualitative research and demonstrated their interest in actively participating by sharing their experiences of life with me. In this sense, I would like to conduct future research in this region of the Russian Arctic. This could represent an opportunity to continue the rich analysis initiated for this dissertation and above all, to provide local residents with scientific information which is deemed necessary for action-taking. As an outcome of this long four-year PhD process, I am now convinced about my firm desire to continue delving into the complex social and cultural impacts of climate change and permafrost thaw in northern settlements from the Republic of Sakha. This dissertation is a kickstarter of the scientific understanding of the de-structuration of the Northern World through the lenses of local residents from Tiksi and Bykovsky. I would like, on the first place, to come back to Yakutsk and Tiksi (which was cancelled due to the Covid crisis of 2020) to share my results with local residents in order to validate my interpretation of their narratives and experiences of life. Translating the salient results from this research into Russian would be a major asset. Finally, I would like to pursue my research concerning the de-structuration of the Northern World in the Republic of Sakha.

APPENDICES

APPENDIX TO CHAPTER IV

Распоряжение Правительства РФ от 8 мая 2009 г. № 631-р Об утверждении перечня мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов РФ и перечня видов их традиционной хозяйственной деятельности

18 мая 2009

Справка

В соответствии с частью 2 статьи 5 Федерального закона "О гарантиях прав коренных малочисленных народов Российской Федерации " утвердить прилагаемые:

перечень мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов Российской Федерации;

перечень видов традиционной хозяйственной деятельности коренных малочисленных народов Российской Федерации.

Перечень

мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов Российской Федерации
(утв. распоряжением Правительства РФ от 8 мая 2009 г. N 631-р)

Республика Алтай

Кош-Агачский муниципальный район

Майминский муниципальный район (Кызыл-Озекское, Бирюлинское сельские поселения)

Турочакский муниципальный район

Улаганский муниципальный район

Чойский муниципальный район

Республика Бурятия

Баргузинский муниципальный район (Баргузинское, Сувинское, Юбилейное сельские поселения)

Баунтовский эвенкийский муниципальный район

Закаменский муниципальный район (улус Мыла сельского поселения Мылинское)

Курумканский муниципальный район (сельские поселения Дырен эвенкийское, Улюхан эвенкийское, Курумкан)

Муйский муниципальный район (сельское поселение Муйская сельская администрация)

Окинский муниципальный район

Северо-Байкальский муниципальный район

Республика Коми

Городской округ Воркута

Городской округ Инта (кроме г. Инты)

Городской округ Усинск (кроме г. Усинска)

Ижемский муниципальный район

Усть-Цилемский муниципальный район

Республика Карелия

Прионежский муниципальный район (Шокшинское вепское, Шелтозерское вепское, Рыборецкое вепское сельские поселения)

Республика Саха (Якутия)

Абыйский муниципальный район (улус) (с. Кебергене Майыарского национального сельского поселения (наслега))

Алданский муниципальный район (улус) (села Хатыстыр и Угаян Беллетского сельского поселения (наслега), с. Кутана Анаминского сельского поселения (наслега))

Аллаиховский муниципальный район (улус) (с. Оленегорск Юкагирского сельского поселения (наслега), с. Нычалах Быянггырского сельского поселения (наслега), с. Чкалов Берелехского сельского поселения (наслега), с. Русское Устье Русско-Устьинского сельского поселения (наслега), с. Ойотунг Ойотунгского сельского поселения (наслега))

Анабарский муниципальный район (улус) (с. Саскылах Саскылахского сельского поселения (наслега), с. Юрюнг-Хая Юрюнг-Хаинского сельского поселения (наслега))

Булунский муниципальный район (улус) (с. Быковский, с. Кюсюр Булунского сельского поселения (наслега), с. Намы Борогонского сельского поселения (наслега), с. Найба Хара-Улахского сельского поселения (наслега), с. Таймылыр Тюметинского сельского поселения (наслега), с. Сиктях Сиктяхского сельского поселения (наслега), с. Усть-Оленек Ыстаннахского сельского поселения (наслега))

Верхнеколымский муниципальный район (улус) (с. Нелемное Нелемнского сельского поселения (наслега), села Утая и Верхнеколымск Верхнеколымского сельского поселения (наслега), с. Усун-Кюель Арылахского сельского поселения (наслега))

Жиганский муниципальный район (улус) (с. Жиганск, с. Кыстатыам Ленского сельского поселения (наслега), с. Бахынай Линдинского сельского поселения (наслега), с. Бестях Бестяхского сельского поселения (наслега))

Кобяйский муниципальный район (улус) (с. Себян-Кюель Ламынхинского сельского поселения (наслега), с. Сегян-Кюель Кировского сельского поселения (наслега))

Мирнинский муниципальный район (улус) (с. Сюльдюкяр Садынского национального сельского поселения (наслега))

Момский муниципальный район (улус) (с. Сасыр Улахан-Чистайского национального сельского поселения (наслега), с. Кулун-Ельбют Чыбагалахского национального сельского поселения (наслега), с. Чумпу-Кытыл Тебюлехского национального сельского поселения (наслега), с. Буор-Сысы Индигирского национального сельского поселения (наслега), с. Хонуу Момского национального сельского поселения (наслега), с. Соболах Соболахского сельского поселения (наслега))

Нерюнгринский муниципальный район (улус) (с. Иенгра Иенгринского сельского поселения (наслега))

Нижнеколымский муниципальный район (улус) (с. Андрюшкино Олеринского сельского поселения (наслега), с. Колымское Халарчинского сельского поселения (наслега), с. Походок Походского сельского поселения (наслега))

Олекминский муниципальный район (улус) (села Токко и Уолбут Жарханского национального сельского поселения (наслега), с. Тяня Тянского национального

сельского поселения (наслега), с. Куду-Кюель Киндигирского национального сельского поселения (наслега), с. Бясь-Кюель Чаринского национального сельского поселения (наслега))

Оймяконский муниципальный район (улус) (с. Томтор II Борогонского сельского поселения (наслега), с. Орто-Балаган Сордоннохского сельского поселения (наслега), с. Ючюгей Ючюгейского сельского поселения (наслега))

Оленекский муниципальный район (улус) (с. Оленек Оленекского национального сельского поселения (наслега), с. Харыялах Кирбейского национального сельского поселения (наслега), с. Жилинда Жилиндинского национального сельского поселения (наслега), с. Эйик Шологонского национального сельского поселения (наслега))

Среднеколымский муниципальный район (улус) (села Березовка и Уродан Березовского национального (кочевого) сельского поселения (наслега))

Томпонский муниципальный район (улус) (с. Тополиное Томпонского сельского поселения (наслега))

Усть-Майский муниципальный район (улус) (с. Кюпцы Кюпского национального сельского поселения (наслега), с. Эжанцы Эжанского национального сельского поселения (наслега), села Петропавловск и Троицк Петропавловского национального сельского поселения (наслега), с. Тумул Кюпского национального сельского поселения (наслега))

Усть-Янский муниципальный район (улус) (с. Хайыр Омолуйского национального сельского поселения (наслега), с. Тумат Туматского национального сельского поселения (наслега), с. Сайылык Силяннихского национального сельского поселения (наслега), с. Казачье Казачинского национального сельского поселения (наслега), с. Усть-Янск Усть-Янского национального сельского поселения (наслега), с. Юкагир Юкагирского национального (кочевого) сельского поселения (наслега), с. Уянди Уяндинского национального сельского поселения (наслега))

Эвено-Бытантайский муниципальный район (улус) (с. Батагай-Алыта Тюгесирского сельского поселения (наслега), с. Кустур Нижнебытантайского сельского поселения (наслега), с. Дьаргалах Верхнебытантайского сельского поселения (наслега))

Верхоянский муниципальный район (улус) (с. Улахан-Кюель Табалахского сельского поселения (наслега))

Республика Тыва

Монгун-Тайгинский муниципальный район (кужуун) (сельские поселения (сумы) Моген-Буренский, Тоолайлыг)

Тере-Хольский муниципальный район (кужуун) (сельские поселения (сумы) Шынаанский, Каргынский, Балыктыгский, Эми)

Тоджинский муниципальный район (кужуун) (сельские поселения (сумы) Азасский, Ийский, Сыстыг-Хемский, Чазыларский)

Эрзинский муниципальный район (кужуун) (сельское поселение (сумон) Бай-Дагский)

Республика Хакасия

Аскизский муниципальный район (сельские поселения Бискамжинский поссовет, Балыксинский сельсовет)

Таштыпский муниципальный район (сельские поселения Анчулский, Матурский сельсоветы)

Алтайский край

Бийский городской округ (пос. Нагорный)

Красногорский муниципальный район

Солтонский муниципальный район

Забайкальский край

Каларский муниципальный район (с. Кюсть-Кемда сельского поселения Чарское, с. Чапо-Олого сельского поселения Чапо-Ологское, с. Неляты сельского поселения Куандинское, с. Средний Калар межселенной территории муниципального района)

Тунгиро-Олекминский муниципальный район (с. Тупик сельского поселения Тупикское, с. Заречное сельского поселения Зареченское, села Моклакан, Средняя Олекма, Гуля межселенной территории муниципального района)

Тунгокоченский муниципальный район (с. Верх-Усугли сельского поселения Верх-Усуглинское, с. Тунгокочен сельского поселения Тунгокоченское, с. Усть-Каренга сельского поселения Усть-Каренгинское, села Зеленое Озеро, Юмурчен, Красный Яр межселенной территории муниципального района)

Красноярский край

Енисейский район (сельское поселение Сымский сельсовет)

Северо-Енисейский муниципальный район

Таймырский Долгано-Ненецкий муниципальный район

Туруханский муниципальный район

Тюхтетский муниципальный район (сельское поселение Чиндатский сельсовет)

Эвенкийский муниципальный район

Камчатский край

Вилучинский городской округ

Городской округ пос. Палана

Петропавловск-Камчатский городской округ

Алеутский муниципальный район

Быстринский муниципальный район

Елизовский муниципальный район

Карагинский муниципальный район

Милюковский муниципальный район

Олюторский муниципальный район

Пенжинский муниципальный район

Тигильский муниципальный район

Соболевский муниципальный район

Усть-Большерецкий муниципальный район

Усть-Камчатский муниципальный район

Приморский край

Красноармейский муниципальный район

Лазовский муниципальный район

Ольгинский муниципальный район
Пожарский муниципальный район
Тернейский муниципальный район
Хабаровский край
Городской округ Хабаровск
Городской округ Комсомольск-на-Амуре
Амурский муниципальный район
Бикинский муниципальный район
Аяно-Майский муниципальный район
Ванинский муниципальный район
Верхнебуреинский муниципальный район
Вяземский муниципальный район
Комсомольский муниципальный район
Муниципальный район имени Лазо
Нанайский муниципальный район
Николаевский муниципальный район
Охотский муниципальный район
Муниципальный район имени Полины Осипенко
Советско-Гаванский муниципальный район
Солнечный муниципальный район
Тугуро-Чумиканский муниципальный район
Ульчский муниципальный район
Хабаровский муниципальный район
Амурская область
Зейский муниципальный район (сельское поселение Бомнакский сельсовет)
Мазановский муниципальный район (сельское поселение Майский сельсовет)
Селемджинский муниципальный район (сельское поселение Ивановский сельсовет)
Тындинский муниципальный район (сельские поселения Нюкжинский, Первомайский и Усть-Нюкжинский сельсоветы)
Вологодская область
Бабаевский муниципальный район (Куйское национальное вепское, Пяжозерское сельские поселения)
Вытегорский муниципальный район (Оштинское сельское поселение)
Иркутская область
Казачинско-Ленский муниципальный район (Казачинское, Магистральнинское сельские поселения и межселенные территории муниципального района)
Катангский муниципальный район
Качугский муниципальный район (Вершино-Тутурское сельское поселение)

Ки́ренский муниципа́льный райо́н (Алексеевское, Ки́ренское, Петропавловское сельские поселения)

Мамско-Чу́йский муниципа́льный райо́н (Горно-Чу́йское, Луговское, Мамское и Согдиондонское сельские поселения)

Ни́жнеуди́нский муниципа́льный райо́н (Верхнегутарское, Нерхинское и Тофаларское сельские поселения)

Усть-Ку́тский муниципа́льный райо́н (Ручейское сельское поселение и межселенные территории муниципального района)

Бо́дайби́нский муниципа́льный райо́н (Жуинское сельское поселение)

Ке́меровская о́бласть

Бело́вский городско́й о́круг (с. Заречное)

Бело́вский муниципа́льный райо́н (с. Новобачаты сельского поселения Новобачатское, села Беково, Челухоево, дер. Верховская сельского поселения Бековское)

Гу́рье́вский муниципа́льный райо́н (дер. Шанда сельского поселения Раздольное)

Ме́ждурече́нский городско́й о́круг (поселки Ильинка, Лужба, Ортон, Сливень, Студеный Плес, Теба, Трехречье, Учас)

Новоку́знецкий городско́й о́круг

Новоку́знецкий муниципа́льный райо́н (пос. Староабашево сельского поселения Атамановское, пос. Березовая Грива, с. Безруково сельского поселения Безруковское, пос. Верх-Кинерки сельского поселения Костенковское, поселки Кузедеево, Усть-Тала, Шартонка сельского поселения Кузедеевское, пос. Тайлеп сельского поселения Куртуковское, пос. Красный Калтан сельского поселения Орловское, с. Сары-Чумыш сельского поселения Сары-Чумышское, села Кругленькое, Сидорово сельского поселения Сидоровское, дер. Учул сельского поселения Сосновское)

Таштаго́льский муниципа́льный райо́н (пос. Тенеш Казского городского поселения, поселки Тарлашка, Турла, Усть-Уруш Спасского городского поселения, поселки Ближний Кезек, Верхний Анзас, Дальний Кезек, За-Мрассу, Парушка, Средний Чилей, Суета, Усть-Анзас, Чазы-Бук Шерегешского городского поселения, поселки Амзас, Базанча, Калары, Карагол, Кондома, Центральный, разъезд 538 км сельского поселения Каларское, поселки Алтамаш, Габовск, Чушла сельского поселения Коуринское, поселки Большой Лабыш, Верхний Таймет, Верх-Кочура, Камзас, Карбалык, Ключевой, Малый Лабыш, Мрассу, Сайзак, Сокушта, Чулеш сельского поселения Кызыл-Шорское, поселки Верхняя Александровка, Усть-Азас (Шортайга), Белка, Верхний Бугзас, Средний Бугзас, Джелсай, Усть-Кабырза, Усть-Карагол, Усть-Кезес, Верхние Кичи, Нижние Кичи, Средние Кичи, Усть-Пызас, Средняя Пурла, Кантус, Колхозный Карчит, Новый, Верхний Нымзас, Нижний Нымзас, Парлагол, Сарасет, Сензас, Таска, Узунгол, Эльбеза, Анзас, Чилису-Анзас, Верхний Алзак, Нижний Алзак сельского поселения Усть-Кабырзинское)

Мы́сковский городско́й о́круг (поселки Чувашка, Тоз, Казас, Бородино, Кольчезас, Чуазас, Усть-Мрас)

Ле́нинградская о́бласть

Подпоро́жский муниципа́льный райо́н (Вознесенское городское поселение, Винницкое сельское поселение)

Бокси́тогори́нский муниципа́льный райо́н (Радогощинское сельское поселение)

Ло́дейнопо́льский муниципа́льный райо́н (Алеховщинское сельское поселение)

Ти́хвинский муниципа́льный райо́н (Пашозерское сельское поселение)

Мурманская область
Городской округ Ковдорский район
Кольский муниципальный район
Ловозерский муниципальный район
Терский муниципальный район
Магаданская область
Ольский муниципальный район
Омсукчанский муниципальный район (городское поселение пос. Омсукчан, с. Меренга межселенной территории муниципального района)
Северо-Эвенский муниципальный район
Среднеканский муниципальный район (городское поселение пос. Сеймчан, сельское поселение с. Колымское)
Тенькинский муниципальный район (с. Оротук межселенной территории муниципального района)
Хасынский муниципальный район (городское поселение пос. Палатка)
Сахалинская область
Городской округ Александровск-Сахалинский район
Городской округ Ногликский район
Городской округ Охинский район
Городской округ Поронайский район
Городской округ Смирныховский район (с. Буюклы)
Городской округ Тымовский район
Городской округ г. Южно-Сахалинск
Свердловская область
Ивдельский городской округ
Томская область
Городской округ Стрежевой
Александровский муниципальный район
Верхнекетский муниципальный район
Каргасокский муниципальный район
Колпашевский муниципальный район
Молчановский муниципальный район
Парабельский муниципальный район
Тегульдетский муниципальный район
Тюменская область
Уватский муниципальный район
Ненецкий автономный округ

Муниципальный район Заполярный район (кроме городского поселения раб. пос. Искателей)

Ханты-Мансийский автономный округ - Югра

Белоярский муниципальный район (городское поселение Белоярский, сельские поселения Верхнеказымский, Казым, Лыхма, Полноват, Сорум, Сосновка, межселенная территория муниципального района)

Березовский муниципальный район (городские поселения Березово, Игрим, сельские поселения Саранпауль, Приполярный, Светлый, Хулимсунт, межселенная территория муниципального района)

Кондинский муниципальный район (городские поселения Кондинское, Мортка, сельские поселения Леуши, Мулымья, Шугур, Болчары, Половинка, межселенная территория муниципального района)

Нефтеюганский муниципальный район (сельские поселения Салым, Чеускино, Лемпино, межселенная территория муниципального района)

Нижневартовский муниципальный район (городское поселение Новоаганск, сельские поселения Аган, Ларьяк, Ваховск, межселенная территория муниципального района)

Октябрьский муниципальный район (городское поселение Октябрьское, сельские поселения Малый Атлым, Перегребное, Шеркалы, межселенная территория муниципального района)

Советский муниципальный район (пос. Тимкапауль городского поселения Таежный)

Сургутский муниципальный район (городское поселение Лянтор, сельские поселения Солнечный, Русскинская, Сытомино, Нижнесортымский, Угут, Ульт-Ягун, межселенная территория муниципального района)

Ханты-Мансийский муниципальный район (сельские поселения Выкатной, Горноправдинск, Кедровый, Красноленинский, Кышик, Луговской, Селярово, Сибирский, Согом, Цингалы, Шапша, с. Нялинское и пос. Пырях сельского поселения Нялинское, межселенная территория муниципального района)

Чукотский автономный округ

Городской округ Анадырь

Центральный муниципальный район

Билибинский муниципальный район

Восточный муниципальный район

Провиденский муниципальный район

Чаунский муниципальный район

Чукотский муниципальный район

Ямало-Ненецкий автономный округ

Городской округ Салехард

Красноселькупский муниципальный район

Надымский муниципальный район

Приуральский муниципальный район

Пуровский муниципальный район

Тазовский муниципальный район

Шурышкарский муниципальный район

Ямальский муниципальный район

видов традиционной хозяйственной деятельности коренных малочисленных народов Российской Федерации (утв. распоряжением Правительства РФ от 8 мая 2009 г. N 631-р)

1. Животноводство, в том числе кочевое (оленоводство, коневодство, яководство, овцеводство).
2. Переработка продукции животноводства, включая сбор, заготовку и выделку шкур, шерсти, волоса, окостенелых рогов, копыт, пантов, костей, эндокринных желез, мяса, субпродуктов.
3. Собаководство (разведение оленегонных, ездовых и охотничьих собак).
4. Разведение зверей, переработка и реализация продукции звероводства.
5. Бортничество, пчеловодство.
6. Рыболовство (в том числе морской зверобойный промысел) и реализация водных биологических ресурсов.
7. Промысловая охота, переработка и реализация охотничьей продукции.
8. Земледелие (огородничество), а также разведение и переработка ценных в лекарственном отношении растений.
9. Заготовка древесины и недревесных лесных ресурсов для собственных нужд.
10. Собирачество (заготовка, переработка и реализация пищевых лесных ресурсов, сбор лекарственных растений).
11. Добыча и переработка общераспространенных полезных ископаемых для собственных нужд.
12. Художественные промыслы и народные ремесла (кузнечное и железоделательное ремесло, изготовление утвари, инвентаря, лодок, нарт, иных традиционных средств передвижения, музыкальных инструментов, берестяных изделий, чучел промысловых зверей и птиц, сувениров из меха оленей и промысловых зверей и птиц, иных материалов, плетение из трав и иных растений, вязание сетей, резьба по кости, резьба по дереву, пошив национальной одежды и другие виды промыслов и ремесел, связанные с обработкой меха, кожи, кости и других материалов).
13. Строительство национальных традиционных жилищ и других построек, необходимых для осуществления традиционных видов хозяйственной деятельности.

Распоряжение Правительства РФ от 8 мая 2009 г. N 631-р

Текст распоряжения размещен на сайте Правительства РФ в Internet (<http://www.government.ru>)

Order of the Government of the Russian Federation of May 8, 2009 No. 631-r On approval of the list of places of traditional residence and traditional economic activities of the indigenous peoples of the Russian Federation and the list of their traditional economic activities

May 18, 2009

In accordance with part 2 of article 5 of the Federal Law "On guarantees of the rights of the indigenous peoples of the Russian Federation" to approve the attached: a list of places of

traditional residence and traditional economic activities of the indigenous peoples of the Russian Federation; list of types of traditional economic activities of the indigenous peoples of the Russian Federation. Prime Minister. Russian Federation V. Putin

Places of traditional residence and traditional economic activities of the indigenous peoples of the Russian Federation (approved by the order of the Government of the Russian Federation of May 8, 2009 N 631-r):

Altai Republic

Kosh-Agach municipal district

Mayminsky municipal district (Kyzyl-Ozekskoye, Biryulinskoye rural settlements)

Turochaksky municipal district

Ulagan municipal district

Choysky municipal district

The Republic of Buryatia

Barguzinsky municipal district (Barguzinskoe, Suvinskoe, Jubilee rural settlements)

Bauntovsky Evenki municipal district

Zakamensk municipal district (Myla ulus of the rural settlement of Mylinskoye)

Kurumkansky municipal district (rural settlements Dyren Evenki, Ulyukhan Evenki, Kurumkan)

Muisky municipal district (rural settlement of Muysky rural administration)

Okinsky municipal district

Severo-Baikalsky municipal district

Komi Republic

Vorkuta urban district

Inta urban district (except for Inta)

Usinsk city district (except for Usinsk)

Izhemsky municipal district

Ust-Tsilemsky municipal district

Republic of Karelia

Prionezhsky municipal district (Shokshinskoe Vepsian, Sheltozersky Vepsian, Ryboretsky Vepsian rural settlements)

The Republic of Sakha (Yakutia)

Abyisky municipal district (ulus) (Kebergene village of Mayyar national rural settlement (nasleg))

Aldan municipal district (ulus) (Khatystyr and Ugayan villages of Belletsky rural settlement (naslega), Kutana village, Anaminsky rural settlement (nasleg))

Allaikhovsky municipal district (ulus) (Olenegorsk village, Yukagirsky rural settlement (naslega), Nychalakh village, Byyangnyrsky rural settlement (nasleg), Chkalov village,

Berelekhsky rural settlement (nasleg), Russkoye Ustye village, Russko-Ustinsky rural settlement (naslega), Oyotung village of Oyotung rural settlement (nasleg)

Anabar Municipal District (ulus) (Saskylakh village, Saskylakh rural settlement (naslega), Yuryung-Khaya village, Yuryung-Khainsky rural settlement (nasleg)

Bulunsky municipal district (ulus) (Bykovsky village, Kyusyur village, Bulunsky rural settlement (nasleg), Namy village, Borogonsky rural settlement (nasleg), Naiba Khara-Ulakhsky rural settlement (nasleg), Taimylyr village, Tyumetinsky rural settlement (nasleg), Siktyakh village, Siktyakh rural settlement (naslega), Ust-Olenek village, Ystannakh rural settlement (nasleg)

Verkhnekolymsky municipal district (ulus) (Nelemnoye village, Nelemnsky rural settlement (nasleg), Uta and Verkhnekolymsk villages, Verkhnekolymsky rural settlement (naslega), Usun-Kyuel village, Arylakhsky rural settlement (nasleg)

Zhigansky municipal district (ulus) (Zhigansk village, Kystatyam village, Lensky rural settlement (nasleg), Bakhynay village, Lindinsky rural settlement (nasleg), Bestyakh village, Bestyakhsky rural settlement (nasleg)

Kobyai municipal district (ulus) (Sebyan-Kyuel village of Lamynkhinsky rural settlement (nasleg), Segyan-Kyuel village of Kirovsky rural settlement (nasleg)

Mirny municipal district (ulus) (Syuldyukar village of Sadymsky national rural settlement (nasleg)

Momsk municipal district (ulus) (Sasyr village of Ulakhan-Chistaysky national rural settlement (nasleg), Kulun-Elbyut village, Chybagalakhsky national rural settlement (naslega), Chumpu-Kytl village, Tebyulekh national rural settlement (nasleg), Buor-Sys of the Indigirsky national rural settlement (naslega), the village of Khonuu, the Momsky national rural settlement (nasleg), the village of Sobolokh, the Sobolokhsky rural settlement (nasleg)

Neryungrinsky municipal district (ulus) (Iengra village of Iengrinsky rural settlement (nasleg)

Nizhnekolymsky municipal district (ulus) (village Andryushkino, Olerinsky rural settlement (nasleg), village Kolymskoe, Halarchinsky rural settlement (naslega), village Pokhodok, Pokhodsky rural settlement (nasleg)

Olekminsky municipal district (ulus) (Tokko and Walbut villages of Zharkhan national rural settlement (nasleg), Tyanya village Tyansky national rural settlement (nasleg), Kudu-Kyuel village, Kindigir national rural settlement (nasleg), Byas-Kyuel village, Charinsky national rural settlement (nasleg)

Oymyakonsky municipal district (ulus) (village Tomtor II Borogonsky rural settlement (naslega), Orto-Balagan village Sordonokhsky rural settlement (nasleg), Yuchyugey village Yuchyugeysky rural settlement (nasleg)

Olenek municipal district (ulus) (Olenek village of Olenek national rural settlement (naslega), Kharyyalakh village, Kirbei national rural settlement (naslega), Zhilinda village, Zhilinda national rural settlement (naslega), Eyik village, Shologon national rural settlement (nasleg)

Srednekolymsky municipal district (ulus) (Berezovka and Urodan villages of Berezovsky national (nomadic) rural settlement (nasleg)

Tomponsky municipal district (ulus) (Topolinoye village of Tomponsky rural settlement (naslega))

Ust-Maisky municipal district (ulus) (village of Kyuptsy, Kyup national rural settlement (naslega), village Ezhantsy, Ezhansky national rural settlement (nasleg), villages of Petropavlovsk and Troitsk of Petropavlovsk national rural settlement (nasleg), village Tumul, Kyupsky national rural settlement (naslega))

Ust-Yansky municipal district (ulus) (Khayr village of Omoloy national rural settlement (naslega), Tumat village, Tumat national rural settlement (nasleg), Sayylyk village Silyannyakhsky national rural settlement (nasleg), Kazachye village Kazachinsky national rural settlement (nasleg), Ust-Yansk village, Ust-Yanskiy national rural settlement (naslega), Yukagir village, Yukagir national (nomadic) rural settlement (naslega), Uyandi village, Uyandinsky national rural settlement (nasleg))

Eveno-Bytantayskiy municipal district (ulus) (Batagai-Alyta village of Tyugesirskiy rural settlement (naslega), Kustur village of Nizhnebytantayskiy rural settlement (nasleg), D'argalakh village of Verkhnebytantayskiy rural settlement (nasleg))

Verkhoyansk municipal district (ulus) (Ulakhan-Kyuel village of Tabalakh rural settlement (nasleg))

Types of traditional economic activities of the Indigenous Peoples of the Russian Federation (approved by the order of the Government of the Russian Federation of May 8, 2009 N 631-r)

1. Livestock breeding, including nomadic (reindeer breeding, horse breeding, yak breeding, sheep breeding).
2. Processing of animal products, including collection, preparation and dressing of hides, wool, hair, ossified horns, hooves, antlers, bones, endocrine glands, meat, offal.
3. Dog breeding (breeding of reindeer herding, sled and hunting dogs).
4. Breeding of animals, processing and sale of fur products.
5. Horticulture, beekeeping.
6. Fishing (including marine hunting) and the sale of aquatic biological resources.
7. Commercial hunting, processing and sale of hunting products.
8. Agriculture (horticulture), as well as the cultivation and processing of medicinally valuable plants.
9. Procurement of timber and non-timber forest resources for own needs.
10. Gathering (harvesting, processing and sale of food forest resources, collection of medicinal plants).
11. Extraction and processing of widespread minerals for their own needs.
12. Artistic crafts and folk crafts (blacksmithing and iron-making craft, making utensils, implements, boats, sledges, other traditional means of transportation, musical instruments, birch bark products, stuffed animals and birds, souvenirs made of deer fur and game animals and birds, etc. materials, weaving from herbs and other plants, knitting of nets, bone carving, wood carving, sewing national clothes and other types of crafts and crafts related to the processing of fur, leather, bone and other materials).

13. Construction of traditional national dwellings and other buildings necessary for the implementation of traditional economic activities.

Order of the Government of the Russian Federation of May 8, 2009 N 631-r

The text of the order is posted on the website of the Government of the Russian Federation on the Internet (<http://www.government.ru>)

**ФЗ "О гарантиях прав коренных малочисленных народов Российской Федерации".
Федеральный закон от 30 апреля 1999 г. N 82-ФЗ "О гарантиях прав коренных
малочисленных народов Российской Федерации" Версия 25 мая 2014**

Принят Государственной Думой 16 апреля 1999 года

Одобен Советом Федерации 22 апреля 1999 года

Настоящий Федеральный закон в соответствии с Конституцией Российской Федерации, общепризнанными принципами и нормами международного права и международными договорами Российской Федерации устанавливает правовые основы гарантий самобытного социально-экономического и культурного развития коренных малочисленных народов Российской Федерации, защиты их исконной среды обитания, традиционного образа жизни, хозяйствования и промыслов.

Статья 1. Основные понятия

В настоящем Федеральном законе применяются следующие основные понятия:

1) коренные малочисленные народы Российской Федерации (далее - малочисленные народы) - народы, проживающие на территориях традиционного расселения своих предков, сохраняющие традиционные образ жизни, хозяйствование и промыслы, насчитывающие в Российской Федерации менее 50 тысяч человек и осознающие себя самостоятельными этническими общностями.

Единый перечень коренных малочисленных народов Российской Федерации утверждается Правительством Российской Федерации по представлению органов государственной власти субъектов Российской Федерации, на территориях которых проживают эти народы.

ГАРАНТ:

См. также перечень коренных малочисленных народов Севера, Сибири и Дальнего Востока РФ, утвержденный распоряжением Правительства РФ от 17 апреля 2006 г. N 536-р

Учитывая уникальность этнического состава населения Республики Дагестан по числу проживающих на ее территории народов, Государственный Совет Республики Дагестан определяет количественные и иные особенности ее коренных малочисленных народов, а также устанавливает перечень этих народов с последующим включением его в Единый перечень коренных малочисленных народов Российской Федерации;

2) традиционный образ жизни малочисленных народов (далее - традиционный образ жизни) - исторически сложившийся способ жизнеобеспечения малочисленных народов, основанный на историческом опыте их предков в области природопользования, самобытной социальной организации проживания, самобытной культуры, сохранения обычаев и верований;

3) **исконная среда обитания малочисленных народов** - исторически сложившийся ареал, в пределах которого малочисленные народы осуществляют культурную и бытовую жизнедеятельность и который влияет на их самоидентификацию, образ жизни;

4) **общины и иные формы общественного самоуправления (далее - общины малочисленных народов)** - формы самоорганизации лиц, относящихся к малочисленным народам и объединяемых по кровнородственному (семья, род) и (или) территориально-соседскому принципам, создаваемые в целях защиты их исконной среды обитания, сохранения и развития традиционных образа жизни, хозяйствования, промыслов и культуры;

5) **уполномоченные представители малочисленных народов** - физические лица или организации, которые в соответствии с законодательством Российской Федерации представляют интересы этих народов;

6) **этнологическая экспертиза** - научное исследование влияния изменений исконной среды обитания малочисленных народов и социально-культурной ситуации на развитие этноса.

Статья 2. Законодательство Российской Федерации о гарантиях прав малочисленных народов

Законодательство Российской Федерации о гарантиях прав малочисленных народов основывается на соответствующих нормах Конституции Российской Федерации и состоит из настоящего Федерального закона, других федеральных законов и иных нормативных правовых актов Российской Федерации, а также законов и иных нормативных правовых актов субъектов Российской Федерации.

Статья 3. Сфера действия настоящего Федерального закона

1. Действие настоящего Федерального закона распространяется на лиц, относящихся к малочисленным народам, постоянно проживающих в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов, ведущих традиционный образ жизни, осуществляющих традиционное хозяйство и занимающихся традиционными промыслами.

Действие настоящего Федерального закона распространяется также на лиц, которые относятся к малочисленным народам, постоянно проживают в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов и для которых традиционное хозяйство и занятие традиционными промыслами являются подсобными видами деятельности по отношению к основному виду деятельности в других отраслях народного хозяйства, социально-культурной сфере, органах государственной власти или органах местного самоуправления.

2. Действие настоящего Федерального закона распространяется на органы государственной власти Российской Федерации, органы государственной власти субъектов Российской Федерации, органы местного самоуправления, должностных лиц.

3. Положения настоящего Федерального закона могут распространяться на лиц, не относящихся к малочисленным народам, но постоянно проживающих в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов, в порядке, установленном законами субъектов Российской Федерации.

Статья 4. Утратила силу с 1 января 2005 г.

Статья 5. Полномочия федеральных органов государственной власти по защите исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов

1. Федеральные органы государственной власти в целях защиты исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов имеют право:

1) принимать федеральные законы и иные нормативные правовые акты Российской Федерации о защите исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов.

К разработке и экспертизе проектов указанных федеральных законов и иных нормативных правовых актов Российской Федерации могут привлекаться уполномоченные представители малочисленных народов;

2) принимать федеральные программы социально-экономического и культурного развития малочисленных народов, развития, сохранения и возрождения их языков, защиты их исконной среды обитания, традиционных образа жизни, хозяйствования, использования и охраны земель и других природных ресурсов.

Осуществление указанных программ обеспечивается за счет средств федерального бюджета и внебюджетных источников.

К реализации указанных программ могут привлекаться органы государственной власти субъектов Российской Федерации, органы местного самоуправления с передачей им необходимых материальных и финансовых средств, а также уполномоченные представители малочисленных народов;

3) оказывать малочисленным народам в установленном Правительством Российской Федерации порядке целевую поддержку за счет средств федерального бюджета, направленную на социально-экономическое и культурное развитие малочисленных народов, защиту их исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов, осуществлять контроль за использованием указанных средств;

4) устанавливать порядок создания, реорганизации и ликвидации организаций, находящихся в федеральной собственности, в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

5) устанавливать по согласованию с органами государственной власти субъектов Российской Федерации и уполномоченными представителями малочисленных народов ограничения нетрадиционной для малочисленных народов хозяйственной деятельности организаций, находящихся в федеральной собственности, в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

6) решать вопросы возмещения убытков, причиненных им в результате нанесения ущерба исконной среде обитания малочисленных народов деятельностью организаций, находящихся в федеральной собственности;

7) устанавливать ответственность органов государственной власти Российской Федерации и их должностных лиц за нарушение законодательства Российской Федерации о гарантиях прав малочисленных народов;

8) обеспечивать совместно с органами государственной власти субъектов Российской Федерации соответствие Конституции Российской Федерации и федеральным законам о малочисленных народах законов и иных нормативных правовых актов субъектов Российской Федерации о защите исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов;

9) совершенствовать законодательство Российской Федерации о мерах по недопущению действий органов государственной власти субъектов Российской Федерации, органов местного самоуправления, физических и юридических лиц, направленных на

насилованную ассимиляцию, геноцид и этноцид малочисленных народов, экоцид их исконной среды обитания;

10) утратил силу с 1 января 2005 г.;

11) проводить единую политику в области разработки и реализации федеральных и региональных программ использования и охраны земель традиционного природопользования малочисленных народов, оценки природных ресурсов, ведения землеустройства и мониторинга указанных земель;

12) утратил силу.

2. Правительство Российской Федерации в целях защиты исконной среды обитания, традиционного образа жизни, хозяйствования и промыслов малочисленных народов утверждает:

1) перечень мест традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов Российской Федерации по представлению органов государственной власти субъектов Российской Федерации, на территориях которых проживают эти народы;

2) перечень видов традиционной хозяйственной деятельности коренных малочисленных народов Российской Федерации.

Статья 6. Полномочия органов государственной власти субъектов Российской Федерации по защите исконной среды обитания, традиционного образа жизни, хозяйствования и промыслов малочисленных народов

Органы государственной власти субъектов Российской Федерации в целях защиты исконной среды обитания, традиционного образа жизни, хозяйствования и промыслов малочисленных народов имеют право:

1) утратил силу с 1 января 2005 г.;

2) участвовать в реализации федеральных программ социально-экономического и культурного развития малочисленных народов и принимать региональные программы социально-экономического и культурного развития малочисленных народов, а также использования и охраны земель традиционного природопользования малочисленных народов и других природных ресурсов;

3) в пределах своих полномочий ограничивать хозяйственную деятельность организаций всех форм собственности в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

4) участвовать в регулировании отношений между бюджетами субъектов Российской Федерации и бюджетами органов местного самоуправления по выделению средств на социально-экономическое и культурное развитие малочисленных народов, защиту исконной среды обитания, традиционного образа жизни, хозяйствования и промыслов малочисленных народов;

5) регулировать порядок передачи собственности субъектов Российской Федерации общинам малочисленных народов и лицам, относящимся к малочисленным народам;

6) утратил силу с 1 января 2005 г.;

7) утратил силу;

8) создавать на общественных началах при органах исполнительной власти субъектов Российской Федерации советы представителей малочисленных народов для защиты прав и законных интересов указанных народов;

9) утратил силу с 1 января 2005 г.;

10) наделять органы местного самоуправления отдельными полномочиями по защите исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов с передачей указанным органам необходимых материальных и финансовых средств;

11) утратил силу с 1 января 2005 г.;

12) утратил силу с 1 января 2005 г.

Статья 7. Полномочия органов местного самоуправления по защите исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов

Органы местного самоуправления в соответствии с федеральным законодательством, законодательством субъектов Российской Федерации и в пределах своих полномочий вправе:

1) утратил силу с 1 января 2005 г.;

принимать участие в реализации федеральных и региональных программ социально-экономического и культурного развития малочисленных народов и в осуществлении контроля за использованием материальных и финансовых средств, выделяемых в соответствии с указанными программами, а также за использованием и охраной земель в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

3) осуществлять контроль за предоставлением, использованием и охраной лицами, относящимися к малочисленным народам, земель, необходимых для ведения традиционного образа жизни и занятия традиционными промыслами малочисленных народов;

4) утратил силу с 1 января 2005 г.;

5) утратил силу с 1 января 2005 г.;

6) устанавливать общие принципы организации и деятельности территориального общественного самоуправления малочисленных народов в местах их традиционного проживания и традиционной хозяйственной деятельности.

Статья 8. Права малочисленных народов, объединений малочисленных народов и лиц, относящихся к малочисленным народам, на защиту их исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов

1. Малочисленные народы, объединения малочисленных народов в целях защиты их исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов имеют право:

1) безвозмездно пользоваться в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов землями различных категорий, необходимыми для осуществления их традиционного хозяйствования и занятия традиционными промыслами, и общераспространенными полезными ископаемыми в порядке, установленном федеральным законодательством и законодательством субъектов Российской Федерации;

2) участвовать в осуществлении контроля за использованием земель различных категорий, необходимых для осуществления традиционного хозяйствования и занятия традиционными промыслами малочисленных народов, и общераспространенных полезных ископаемых в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

3) участвовать в осуществлении контроля за соблюдением федеральных законов и законов субъектов Российской Федерации об охране окружающей среды при

промышленном использовании земель и природных ресурсов, строительстве и реконструкции хозяйственных и других объектов в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

4) получать от органов государственной власти Российской Федерации, органов государственной власти субъектов Российской Федерации, органов местного самоуправления, организаций всех форм собственности, международных организаций, общественных объединений и физических лиц материальные и финансовые средства, необходимые для социально-экономического и культурного развития малочисленных народов, защиты их исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов;

5) участвовать через уполномоченных представителей малочисленных народов в подготовке и принятии органами государственной власти Российской Федерации, органами государственной власти субъектов Российской Федерации и органами местного самоуправления решений по вопросам защиты исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов;

6) участвовать в проведении экологических и этнологических экспертиз при разработке федеральных и региональных государственных программ освоения природных ресурсов и охраны окружающей среды в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов;

7) делегировать уполномоченных представителей малочисленных народов в советы представителей малочисленных народов при органах исполнительной власти субъектов Российской Федерации и органах местного самоуправления;

8) на возмещение убытков, причиненных им в результате нанесения ущерба исконной среде обитания малочисленных народов хозяйственной деятельностью организаций всех форм собственности, а также физическими лицами;

См. Методику исчисления размера убытков, причиненных объединениям коренных малочисленных народов Севера, Сибири и Дальнего Востока РФ в результате хозяйственной и иной деятельности организаций всех форм собственности и физических лиц в местах традиционного проживания и традиционной хозяйственной деятельности коренных малочисленных народов РФ,

утвержденную приказом Минрегиона России от 9 декабря 2009 г. N 565

9) получать от государства помощь для реформирования всех форм воспитания и обучения подрастающего поколения малочисленных народов с учетом традиционных образа жизни и хозяйствования малочисленных народов.

2. Лица, относящиеся к малочисленным народам, в целях защиты исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов имеют право:

1) безвозмездно пользоваться в местах традиционного проживания и традиционной хозяйственной деятельности малочисленных народов землями различных категорий, необходимыми для осуществления их традиционного хозяйствования и занятия традиционными промыслами, и общераспространенными полезными ископаемыми в порядке, установленном федеральным законодательством и законодательством субъектов Российской Федерации;

2) участвовать в формировании и деятельности советов представителей малочисленных народов при органах исполнительной власти субъектов Российской Федерации и органах местного самоуправления;

3) на возмещение убытков, причиненных им в результате нанесения ущерба исконной среде обитания малочисленных народов хозяйственной деятельностью организаций всех форм собственности, а также физическими лицами;

- 4) пользоваться необходимыми малочисленным народам для защиты их исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов льготами по землепользованию и природопользованию, установленными федеральным законодательством, законодательством субъектов Российской Федерации и нормативными правовыми актами органов местного самоуправления;
- 5) на первоочередной прием на работу по своей специальности в организации традиционных отраслей хозяйствования и традиционных промыслов малочисленных народов, создаваемые в местах их традиционного проживания и традиционной хозяйственной деятельности;
- 6) в порядке, установленном гражданским законодательством, создавать хозяйственные товарищества и общества, производственные и потребительские кооперативы, осуществляющие традиционное хозяйствование и занимающиеся промыслами малочисленных народов совместно с лицами, не относящимися к малочисленным народам, при условии, что в создаваемых организациях не менее половины рабочих мест будет предоставляться лицам, относящимся к малочисленным народам;
- 7) на первоочередное приобретение в собственность организаций традиционных отраслей хозяйствования и традиционных промыслов малочисленных народов в местах их традиционного проживания и традиционной хозяйственной деятельности;
- 8) получать социальное обслуживание в порядке, устанавливаемом законодательством Российской Федерации;
- 9) получать бесплатную медицинскую помощь в государственных и муниципальных учреждениях здравоохранения в рамках Программы государственных гарантий обязательного медицинского страхования.

Статья 9. Право лиц, относящихся к малочисленным народам, на замену военной службы альтернативной гражданской службой

Лица, относящиеся к малочисленным народам, ведущие традиционный образ жизни, осуществляющие традиционное хозяйствование и занимающиеся традиционными промыслами, имеют право на замену военной службы альтернативной гражданской службой в соответствии с Конституцией Российской Федерации и федеральным законом.

Статья 10. Права лиц, относящихся к малочисленным народам, на сохранение и развитие своей самобытной культуры

Лица, относящиеся к малочисленным народам, объединения малочисленных народов в целях сохранения и развития своей самобытной культуры и в соответствии с законодательством Российской Федерации вправе:

- 1) сохранять и развивать родные языки;
- 2) создавать общественные объединения, культурные центры и национально-культурные автономии малочисленных народов, фонды развития малочисленных народов и фонды финансовой помощи малочисленным народам;
- 3) создавать в соответствии с законодательством Российской Федерации и со своими материальными и финансовыми возможностями учебные группы, состоящие из лиц, относящихся к малочисленным народам, для их обучения традиционному хозяйствованию и промыслам малочисленных народов;
- 4) получать и распространять информацию на родных языках, создавать средства массовой информации;

5) соблюдать свои традиции и совершать религиозные обряды, не противоречащие федеральным законам, законам субъектов Российской Федерации, содержать и охранять культовые места;

6) устанавливать и развивать связи с представителями малочисленных народов, проживающих на территориях других субъектов Российской Федерации, а также за пределами территории Российской Федерации.

Статья 11. Территориальное общественное самоуправление малочисленных народов

В целях социально-экономического и культурного развития, защиты исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов, а также для самостоятельного и под свою ответственность осуществления собственных инициатив по вопросам местного значения лица, относящиеся к малочисленным народам, в местах их компактного проживания вправе в соответствии с федеральными законами осуществлять территориальное общественное самоуправление малочисленных народов с учетом национальных, исторических и иных традиций.

Статья 12. Общины малочисленных народов и иные объединения малочисленных народов

1. Лица, относящиеся к малочисленным народам, вправе создавать на добровольной основе общины малочисленных народов и иные объединения малочисленных народов в соответствии со своими национальными, историческими и культурными традициями в целях социально-экономического и культурного развития малочисленных народов, защиты их исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов.

2. Особенности организации и деятельности общин малочисленных народов и иных объединений малочисленных народов регулируются федеральными законами и законами субъектов Российской Федерации.

Статья 13. Утратила силу с 1 января 2005 г.

Статья 14. Судебная защита прав малочисленных народов

Лица, относящиеся к малочисленным народам, а также объединения малочисленных народов имеют право на судебную защиту исконной среды обитания, традиционных образа жизни, хозяйствования и промыслов малочисленных народов, осуществляемую в порядке, предусмотренном федеральными законами.

При рассмотрении в судах дел, в которых лица, относящиеся к малочисленным народам, выступают в качестве истцов, ответчиков, потерпевших или обвиняемых, могут приниматься во внимание традиции и обычаи этих народов, не противоречащие федеральным законам и законам субъектов Российской Федерации.

В целях эффективной судебной защиты прав малочисленных народов допускается участие в указанной судебной защите уполномоченных представителей малочисленных народов.

Статья 15. Приведение правовых актов в соответствие с настоящим Федеральным законом

Предложить Президенту Российской Федерации и поручить Правительству Российской Федерации привести свои правовые акты в соответствие с настоящим Федеральным законом.

Статья 16. О вступлении в силу настоящего Федерального закона

Настоящий Федеральный закон вступает в силу со дня его официального опубликования.

**Federal Law "On guarantees of the rights of the Indigenous Peoples of the Russian Federation".
Federal Law of April 30, 1999 N 82-FZ "On guarantees of the rights of the Indigenous Peoples
of the Russian Federation"**

Version May 25, 2014

Adopted by the Duma State on 16th April, 1999

Approved by the Federation Council on 22nd April, 1999

This Federal Law, in accordance with the Constitution of the Russian Federation, generally recognized principles and norms of international law and international treaties of the Russian Federation, establishes the legal basis for guarantees of the original socio-economic and cultural development of the Indigenous Peoples of the Russian Federation, protection of their original habitat, traditional way of life, management and crafts.

Article 1. Basic concepts

In this Federal Law, the following basic concepts are applied:

1) indigenous small-numbered peoples of the Russian Federation (hereinafter referred to as small-numbered peoples) - peoples living in the territories of the traditional settlement of their ancestors, preserving their traditional way of life, farming and crafts, numbering less than 50 thousand people in the Russian Federation and realizing themselves as independent ethnic communities.

The unified list of indigenous small-numbered peoples of the Russian Federation is approved by the Government of the Russian Federation on the submission of state authorities of the constituent entities of the Russian Federation, in whose territories these peoples live.

Guarentees:

See also the list of indigenous small-numbered peoples of the North, Siberia and the Far East of the Russian Federation, approved by the order of the Government of the Russian Federation of April 17, 2006 N 536-r

Taking into account the uniqueness of the ethnic composition of the population of the Republic of Dagestan in terms of the number of peoples living on its territory, the State Council of the Republic of Dagestan determines the quantitative and other characteristics of its indigenous minorities, and also establishes a list of these peoples with its subsequent inclusion in the Unified List of Indigenous Minorities of the Russian Federation;

2) the traditional way of life of small peoples (hereinafter referred to as the traditional way of life) - a historically established way of life support for small peoples, based on the historical experience of their ancestors in the field of environmental management, the distinctive social organization of living, distinctive culture, the preservation of customs and beliefs;

- 3) the original habitat of small peoples - a historically formed area, within which small peoples carry out cultural and everyday life activities and which affects their self-identification, way of life;
- 4) communities and other forms of public self-government (hereinafter referred to as communities of small peoples) - forms of self-organization of persons belonging to small peoples and united by consanguinity (family, clan) and (or) territorial-neighborly principles, created in order to protect their original habitat, preservation and development of traditional way of life, management, crafts and culture;
- 5) authorized representatives of small-numbered peoples - individuals or organizations who, in accordance with the legislation of the Russian Federation, represent the interests of these peoples;
- 6) ethnological expertise - a scientific study of the impact of changes in the original habitat of small peoples and the socio-cultural situation on the development of an ethnic group.

Article 2. Legislation of the Russian Federation on guarantees of the rights of Indigenous Peoples

The legislation of the Russian Federation on guarantees of the rights of Indigenous Peoples is based on the relevant norms of the Constitution of the Russian Federation and consists of this Federal Law, other federal laws and other regulatory legal acts of the Russian Federation, as well as laws and other regulatory legal acts of the constituent entities of the Russian Federation.

Article 3. Scope of this Federal Law

1. The operation of this Federal Law applies to persons belonging to small peoples, permanently residing in places of traditional residence and traditional economic activities of small peoples, leading a traditional way of life, carrying out traditional economic activities and engaged in traditional crafts.

This Federal Law also applies to persons who belong to small peoples, permanently reside in places of traditional residence and traditional economic activities of small peoples and for whom traditional farming and traditional crafts are subsidiary types of activity in relation to the main type of activity in other branches of the national economy, social and cultural sphere, government bodies or local government bodies.

2. The effect of this Federal Law shall apply to government bodies of the Russian Federation, government bodies of the constituent entities of the Russian Federation, local government bodies, and officials.

3. The provisions of this Federal Law may apply to persons who do not belong to small peoples, but permanently reside in places of traditional residence and traditional economic activity of small peoples, in the manner prescribed by the laws of the constituent entities of the Russian Federation.

Article 4. Abolished from January 1, 2005.

Article 5. Powers of federal government bodies to protect the original habitat, traditional way of life, economic activity and crafts of Indigenous Peoples

1. Federal bodies of state power in order to protect the original habitat, traditional way of life, economic activity and crafts of Indigenous Peoples have the right:

1) to adopt federal laws and other regulatory legal acts of the Russian Federation on the protection of the primordial habitat, traditional way of life, management and crafts of Indigenous Peoples.

Authorized representatives of Indigenous Peoples may be involved in the development and examination of draft federal laws and other regulatory legal acts of the Russian Federation;

2) adopt federal programs for the socio-economic and cultural development of small peoples, the development, preservation and revival of their languages, the protection of their original habitat, traditional way of life, management, use and protection of lands and other natural resources.

The implementation of these programs is provided at the expense of the federal budget and extra-budgetary sources.

Bodies of state power of the constituent entities of the Russian Federation, local self-government bodies with the transfer of the necessary material and financial resources to them, as well as authorized representatives of small peoples may be involved in the implementation of these programs;

3) provide targeted support to small peoples in the manner established by the Government of the Russian Federation at the expense of the federal budget, aimed at the socio-economic and cultural development of small peoples, protection of their original habitat, traditional way of life, management and crafts, to exercise control over the use of these funds ;

4) establish the procedure for the creation, reorganization and liquidation of organizations that are in federal ownership in places of traditional residence and traditional economic activity of small peoples;

5) establish, in agreement with the state authorities of the constituent entities of the Russian Federation and authorized representatives of small peoples, restrictions on the non-traditional economic activities of organizations that are in federal ownership in places of traditional residence and traditional economic activities of small peoples;

6) resolve issues of compensation for losses caused to them as a result of damage to the original habitat of small peoples by the activities of organizations that are in federal ownership;

7) establish the responsibility of the bodies of state power of the Russian Federation and their officials for violation of the legislation of the Russian Federation on guarantees of the rights of Indigenous Peoples;

8) ensure, together with the state authorities of the constituent entities of the Russian Federation, the compliance of the Constitution of the Russian Federation and federal laws on small peoples with laws and other normative legal acts of constituent entities of the Russian Federation on the protection of the original habitat, traditional way of life, management and crafts of small peoples;

9) improve the legislation of the Russian Federation on measures to prevent actions of state authorities of the constituent entities of the Russian Federation, local governments, individuals and legal entities aimed at forcible assimilation, genocide and ethnocide of Indigenous Peoples, ecocide of their original habitat;

10) became invalid as of January 1, 2005;

11) pursue a unified policy in the field of development and implementation of federal and regional programs for the use and protection of lands of traditional nature management of small peoples, assessment of natural resources, land management and monitoring of these lands;

12) is no longer valid.

2. The Government of the Russian Federation, in order to protect the original habitat, traditional way of life, economic activity and crafts of Indigenous Peoples, approves:

1) a list of places of traditional residence and traditional economic activity of the Indigenous small-numbered peoples of the Russian Federation, as submitted by the state authorities of the constituent entities of the Russian Federation, in whose territories these peoples live;

2) a list of the types of traditional economic activities of the Indigenous Peoples of the Russian Federation.

Article 6. Powers of the state authorities of the constituent entities of the Russian Federation to protect the primordial habitat, traditional way of life, management and crafts of Indigenous Peoples

State authorities of the constituent entities of the Russian Federation, in order to protect the primordial habitat, traditional way of life, economic activity and crafts of small peoples, have the right:

1) became invalid as of January 1, 2005;

2) participate in the implementation of federal programs for the socio-economic and cultural development of Indigenous Peoples and adopt regional programs for the socio-economic and cultural development of Indigenous Peoples, as well as the use and protection of lands of traditional nature management of small peoples and other natural resources;

3) within the limits of their powers, limit the economic activities of organizations of all forms of ownership in places of traditional residence and traditional economic activities of small peoples;

4) participate in the regulation of relations between the budgets of the constituent entities of the Russian Federation and the budgets of local self-government bodies for the allocation of funds for the socio-economic and cultural development of indigenous peoples, protection of the original habitat, traditional way of life, management and crafts of Indigenous Peoples;

5) regulate the procedure for transferring the property of the constituent entities of the Russian Federation to communities of small peoples and persons belonging to small peoples;

6) became invalid as of January 1, 2005;

7) has become invalid;

8) create, on a voluntary basis, under the executive authorities of the constituent entities of the Russian Federation, councils of representatives of small peoples to protect the rights and legitimate interests of these peoples;

9) became invalid from January 1, 2005;

10) to endow local self-government bodies with separate powers for the protection of the original habitat, traditional way of life, management and crafts of small peoples with the transfer of the necessary material and financial resources to the said bodies;

11) became invalid from January 1, 2005;

12) became invalid on January 1, 2005.

Article 7. Powers of local self-government bodies to protect the original habitat, traditional way of life, economic activity and crafts of Indigenous Peoples

Local self-government bodies, in accordance with federal legislation, the legislation of the constituent entities of the Russian Federation and within the limits of their powers, are entitled to:

1) became invalid as of January 1, 2005; take part in the implementation of federal and regional programs for the socio-economic and cultural development of small peoples and in control over the use of material and financial resources allocated in accordance with these programs, as well as over the use and protection of lands in places of traditional residence and traditional economic activities of small people peoples;

3) to exercise control over the provision, use and protection by persons belonging to small peoples, of lands necessary for conducting a traditional way of life and engaging in traditional crafts of small peoples;

4) became invalid from January 1, 2005;

5) became invalid as of January 1, 2005;

6) establish general principles for the organization and activities of territorial public self-government of small peoples in places of their traditional residence and traditional economic activity.

Article 8. The rights of Indigenous Peoples, associations of Indigenous Peoples and persons belonging to small peoples to protect their original habitat, traditional way of life, economic activity and crafts

1. Small peoples, associations of small peoples in order to protect their original habitat, traditional way of life, economic activity and crafts have the right:

1) use, free of charge, in places of traditional residence and traditional economic activity of small peoples, lands of various categories necessary for the implementation of their traditional

management and engaging in traditional crafts, and common minerals in the manner established by federal legislation and the legislation of the constituent entities of the Russian Federation;

2) participate in exercising control over the use of lands of various categories, necessary for the implementation of traditional farming and traditional crafts of Indigenous Peoples, and common minerals in places of traditional residence and traditional economic activities of Indigenous Peoples;

3) participate in exercising control over the observance of federal laws and laws of the constituent entities of the Russian Federation on environmental protection in the industrial use of land and natural resources, construction and reconstruction of economic and other facilities in places of traditional residence and traditional economic activities of small peoples;

4) receive from the bodies of state power of the Russian Federation, bodies of state power of the constituent entities of the Russian Federation, bodies of local self-government, organizations of all forms of ownership, international organizations, public associations and individuals, material and financial resources necessary for the socio-economic and cultural development of small peoples, protection of their original habitat, traditional way of life, economic activity and crafts;

5) to participate through authorized representatives of small peoples in the preparation and adoption of decisions by the state authorities of the Russian Federation, state authorities of the constituent entities of the Russian Federation and local self-government bodies on the protection of the original habitat, traditional way of life, management and crafts of the small peoples;

6) participate in carrying out environmental and ethnological examinations in the development of federal and regional state programs for the development of natural resources and environmental protection in places of traditional residence and traditional economic activities of small peoples;

7) delegate authorized representatives of small peoples to councils of representatives of small peoples under the executive authorities of the constituent entities of the Russian Federation and local self-government bodies;

8) for compensation for losses caused by them as a result of damage to the primordial habitat of small peoples by the economic activities of organizations of all forms of ownership, as well as by individuals;

See the Methodology for calculating the amount of losses caused to associations of Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation as a result of economic and other activities of organizations of all forms of ownership and individuals in places of traditional residence and traditional economic activities of the Indigenous Peoples of the Russian Federation, approved by order of the Ministry of Regional Development of Russia from December 9, 2009 N 565

9) receive help from the state for reforming all forms of education and training of the younger generation of small peoples, taking into account the traditional way of life and management of small peoples.

2. Persons belonging to small-numbered peoples, in order to protect the original habitat, traditional way of life, economic activity and crafts of small-numbered peoples have the right:

1) use, free of charge, in places of traditional residence and traditional economic activity of small peoples, lands of various categories necessary for the implementation of their traditional management and engaging in traditional crafts, and common minerals in the manner established by federal legislation and the legislation of the constituent entities of the Russian Federation;

2) participate in the formation and activities of councils of representatives of small peoples under the executive authorities of the constituent entities of the Russian Federation and local self-government bodies;

3) to compensate for losses caused by them as a result of damage to the original habitat of small peoples by the economic activities of organizations of all forms of ownership, as well as by individuals;

4) use the privileges for land use and nature management established by federal legislation, the legislation of the constituent entities of the Russian Federation and regulatory legal acts of local self-government bodies, necessary for small peoples to protect their ancestral habitat, traditional way of life, management and crafts;

5) for priority recruitment in their specialty in the organization of traditional industries and traditional crafts of small peoples, created in places of their traditional residence and traditional economic activity;

6) in accordance with the procedure established by civil legislation, create economic partnerships and societies, production and consumer cooperatives that carry out traditional economic activities and engage in the trades of small peoples together with persons who do not belong to small peoples, provided that in the organizations created at least half of the jobs will be provided to persons belonging to small peoples;

7) for the priority acquisition of the ownership of organizations of traditional economic sectors and traditional crafts of small peoples in places of their traditional residence and traditional economic activity;

8) receive social services in the manner prescribed by the legislation of the Russian Federation;

9) receive free medical care in state and municipal health care institutions within the framework of the Program of State Guarantees of Compulsory Medical Insurance.

Article 9. Right of persons belonging to small peoples to replace military service with alternative civilian service

Individuals belonging to small peoples, leading a traditional way of life, carrying out traditional economic activities and engaged in traditional trades, have the right to replace military service with alternative civilian service in accordance with the Constitution of the Russian Federation and federal law.

Article 10. Rights of persons belonging to small peoples to the preservation and development of their original culture

Persons belonging to small peoples, associations of small peoples in order to preserve and develop their original culture and in accordance with the legislation of the Russian Federation have the right:

- 1) preserve and develop native languages;
- 2) to create public associations, cultural centers and national and cultural autonomies of small peoples, funds for the development of small peoples and funds for financial assistance to small peoples;
- 3) create, in accordance with the legislation of the Russian Federation and with their material and financial capabilities, study groups, consisting of persons belonging to small peoples, for their training in traditional farming and crafts of small peoples;
- 4) receive and distribute information in native languages, create mass media;
- 5) observe their traditions and perform religious rituals that do not contradict federal laws, the laws of the constituent entities of the Russian Federation, maintain and protect places of worship;
- 6) to establish and develop ties with representatives of small peoples living in the territories of other constituent entities of the Russian Federation, as well as outside the territory of the Russian Federation.

Article 11. Territorial public self-government of minority peoples

For the purposes of socio-economic and cultural development, protection of the original habitat, traditional way of life, management and crafts of small-numbered peoples, as well as for the independent and under their responsibility to carry out their own initiatives on issues of local importance, persons belonging to small-numbered peoples in places of their compact residence has the right, in accordance with federal laws, to exercise territorial public self-government of small peoples, taking into account national, historical and other traditions.

Article 12. Communities of small peoples and other associations of small peoples

1. Persons belonging to small peoples have the right to create, on a voluntary basis, communities of small peoples and other associations of small peoples in accordance with their national, historical and cultural traditions for the purpose of socio-economic and cultural development of small peoples, protection of their original habitat, traditional way of life, management and crafts.
2. The peculiarities of the organization and activities of communities of small peoples and other associations of small peoples are regulated by federal laws and laws of the constituent entities of the Russian Federation.

Article 13. Abolished from January 1, 2005.

Article 14. Judicial protection of the rights of Indigenous Peoples

Persons belonging to small peoples, as well as associations of small peoples, have the right to judicial protection of the primordial habitat, traditional way of life, management and crafts of small peoples, carried out in accordance with the procedure provided for by federal laws.

When considering in courts cases in which persons belonging to small peoples act as plaintiffs, defendants, victims or accused, the traditions and customs of these peoples may be taken into account, which do not contradict federal laws and laws of the constituent entities of the Russian Federation.

For the purpose of effective judicial protection of the rights of Indigenous Peoples, authorized representatives of Indigenous Peoples may participate in this judicial protection.

Article 15. Bringing legal acts in compliance with this Federal Law

Propose to the President of the Russian Federation and instruct the Government of the Russian Federation to bring their legal acts in line with this Federal Law.

Article 16. On the entry into force of this Federal Law

This Federal Law shall enter into force on the day of its official publication.

ГОСУДАРСТВЕННЫЙ КОМИТЕТ РОССИЙСКОЙ ФЕДЕРАЦИИ ПО РЫБОЛОВСТВУ ПРИКАЗ от 11 апреля 2008 г. N 315 ОБ УТВЕРЖДЕНИИ ПОРЯДКА ОСУЩЕСТВЛЕНИЯ РЫБОЛОВСТВА В ЦЕЛЯХ ОБЕСПЕЧЕНИЯ ТРАДИЦИОННОГО ОБРАЗА ЖИЗНИ И ОСУЩЕСТВЛЕНИЯ ТРАДИЦИОННОЙ ХОЗЯЙСТВЕННОЙ ДЕЯТЕЛЬНОСТИ КОРЕННЫХ МАЛОЧИСЛЕННЫХ НАРОДОВ СЕВЕРА, СИБИРИ И ДАЛЬНЕГО ВОСТОКА РОССИЙСКОЙ ФЕДЕРАЦИИ

В целях реализации части 3 статьи 25 Федерального закона от 20 декабря 2004 г. N 166-ФЗ "О рыболовстве и сохранении водных биологических ресурсов" (Собрание законодательства Российской Федерации, 2004, N 52, ст. 5270; 2006, N 1, ст. 10; N 23, ст. 2380; N 52, ст. 5498; 2007, N 1, ст. 23; N 17, ст. 1933; N 50, ст. 6246), в соответствии с пунктом 5.3.17 Положения о Государственном комитете Российской Федерации по рыболовству, утвержденного Постановлением Правительства Российской Федерации от 1 ноября 2007 г. N 733 (Собрание законодательства Российской Федерации, 2007, N 46, ст. 5574, 2008, N 2, ст. 79), приказываю:

1. Утвердить прилагаемый Порядок осуществления рыболовства в целях обеспечения традиционного образа жизни и осуществления традиционной хозяйственной деятельности коренных малочисленных народов Севера, Сибири и Дальнего Востока Российской Федерации.
2. Контроль за исполнением настоящего Приказа оставляю за собой.

Руководитель
А.КРАЙНИЙ

Приложение

ПОРЯДОК ОСУЩЕСТВЛЕНИЯ РЫБОЛОВСТВА В ЦЕЛЯХ ОБЕСПЕЧЕНИЯ ТРАДИЦИОННОГО ОБРАЗА ЖИЗНИ И ОСУЩЕСТВЛЕНИЯ ТРАДИЦИОННОЙ ХОЗЯЙСТВЕННОЙ ДЕЯТЕЛЬНОСТИ КОРЕННЫХ МАЛОЧИСЛЕННЫХ НАРОДОВ СЕВЕРА, СИБИРИ И ДАЛЬНЕГО ВОСТОКА РОССИЙСКОЙ ФЕДЕРАЦИИ

1. Настоящий Порядок регулирует осуществление деятельности по добыче (вылову) водных биоресурсов в целях обеспечения традиционного образа жизни и осуществления традиционной хозяйственной деятельности коренных малочисленных народов Севера, Сибири и Дальнего Востока Российской Федерации (далее - традиционное рыболовство).
2. Действие Порядка распространяется на лиц, относящихся к коренным малочисленным народам Севера, Сибири и Дальнего Востока Российской Федерации (далее - малочисленные народы) в соответствии с Единым перечнем коренных малочисленных народов Российской Федерации, утвержденным Постановлением Правительства Российской Федерации от 24 марта 2000 г. N 255 (Собрание законодательства Российской Федерации, 2000, N 14, ст. 1493, 2000, N 41, ст. 4081), и Перечнем коренных малочисленных народов Севера, Сибири и Дальнего Востока Российской Федерации, утвержденным распоряжением Правительства Российской Федерации от 17 апреля 2006 г. N 536-р (Собрание законодательства Российской Федерации, 2006, N 17, ст. 1905), и их общины.
3. При осуществлении традиционного рыболовства лица, относящиеся к малочисленным народам, и их общины имеют право применять традиционные методы добычи (вылова) водных биоресурсов, если такие методы прямо или косвенно не ведут к снижению биологического разнообразия, не сокращают численность, устойчивое воспроизводство объектов животного мира, не нарушают среду их обитания и не представляют опасности для человека.
4. Традиционное рыболовство осуществляется в соответствии с правилами рыболовства отдельных рыбохозяйственных бассейнов в пределах квот добычи (вылова) водных биоресурсов, выделенных субъектам Российской Федерации для обеспечения традиционного рыболовства малочисленных народов и распределяются между пользователями органами исполнительной власти субъектов Российской Федерации.
5. Традиционное рыболовство осуществляется лицами, относящимися к малочисленным народам, в целях обеспечения традиционного образа жизни и осуществления традиционной хозяйственной деятельности в местах их традиционного проживания с предоставлением рыбопромыслового участка или без его предоставления.
6. Рыбопромысловые участки предоставляются в пользование малочисленным народам по договору о предоставлении рыбопромыслового участка, по которому орган государственной власти обязуется предоставить юридическому лицу или индивидуальному предпринимателю право на добычу (вылов) водных биоресурсов на рыбопромысловом участке в порядке, установленном Правительством Российской Федерации.
7. Традиционное рыболовство без предоставления рыбопромыслового участка осуществляется без разрешения на добычу (вылов) водных биоресурсов, за исключением добычи (вылова) редких и находящихся под угрозой исчезновения (занесенных в Красную книгу Российской Федерации) видов водных биоресурсов.

8. Добыча (вылов) редких и находящихся под угрозой исчезновения (занесенных в Красную книгу Российской Федерации) видов водных биоресурсов в целях обеспечения традиционного рыболовства допускается только на основании разрешений на добычу (вылов) водных биоресурсов в порядке, установленном Правительством Российской Федерации.

Order of the State Fishery Committee of the Russian Federation 11.04.2008 N 315 on the approval of the procedure for fishing to ensure the traditional way of life and the implementation of the traditional economic activities of the Indigenous small-numbered peoples of the North, Siberia and the Far East of the Russian Federation

In order to implement part 3 of Article 25 of the Federal Law of December 20, 2004 N 166-FZ "On fishing and conservation of aquatic biological resources" (Collected Legislation of the Russian Federation, 2004, N 52, Art. 5270; 2006, N 1, Art. 10; N 23, Art. 2380; N 52, Art. 5498; 2007, N 1, Art. 23; N 17, Art. 1933; N 50, Art. 6246), in accordance with clause 5.3.17 of the Regulation on the State Committee of the Russian Federation for Fisheries, approved by Decree of the Government of the Russian Federation of November 1, 2007 N 733 (Collected Legislation of the Russian Federation, 2007, N 46, Art. 5574, 2008, N 2, Art. 79), I order:

1. To approve the attached Procedure for the implementation of fishing in order to ensure the traditional way of life and the implementation of traditional economic activities of the Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation.
2. I reserve the control over the execution of this Order.

Director

A. KRAYNIY

IMPLEMENTATION OF FISHING FOR THE PURPOSES OF PRESERVING TRADITIONAL LIFESTYLE AND IMPLEMENTATION OF THE TRADITIONAL ECONOMIC ACTIVITIES OF SMALL-NUMBERED INDIGENOUS OF THE NORTH, SIBERIA AND THE FAR EAST OF THE RUSSIAN FEDERATION

1. This procedure regulates the implementation of activities for the extraction (catch) of aquatic biological resources in order to ensure the traditional way of life and the practice of traditional economic activities of the indigenous small-numbered peoples of the North, Siberia and the Far East of the Russian Federation (hereinafter - traditional fishing).

2. The Procedure applies to persons belonging to the Indigenous small-numbered peoples of the North, Siberia and the Far East of the Russian Federation (hereinafter referred to as the small-numbered peoples) in accordance with the Unified List of Indigenous Minorities of the Russian Federation, approved by the Resolution of the Government of the Russian Federation of March 24, 2000 No. 255 (Collected Legislation of the Russian Federation, 2000, N 14, Art. 1493, 2000, N 41, Art. 4081), and the List of Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation, approved by the order of the Government of the Russian Federation dated April 17, 2006 . N 536-p (Collected Legislation of the Russian Federation, 2006, N 17, Art. 1905), and their communities.

3. In the implementation of traditional fishing, individuals belonging to indigenous small-numbered peoples and their communities have the right to use traditional methods of harvesting (catching) aquatic biological resources- if such methods do not directly or indirectly lead to a decrease in biological diversity, do not reduce the number, sustainable reproduction of wildlife, do not violate their habitat nor pose a danger to humans.
4. Traditional fishing is carried out in accordance with the fishing rules of individual fishery basins within the quotas for the extraction (catch) of aquatic biological resources allocated to the constituent entities of the Russian Federation to ensure the traditional fishing of Indigenous Peoples and are distributed among users by the executive authorities of the constituent entities of the Russian Federation.
5. Traditional fishing is carried out by persons belonging to indigenous small-numbered peoples in order to ensure their traditional way of life and carry out traditional economic activities in the places of their traditional residence with a fishing area or without it.
6. Fishing plots are provided for the use of small peoples under an agreement on the provision of a fishery plot, according to which the state authority undertakes to provide a legal entity or individual entrepreneur with the right to procure (catch) aquatic biological resources in a fishing plot in the specific way established by the Government of the Russian Federation.
7. Traditional fishing practiced without the provision of a fishing area can be carried out without a permit for the extraction (catch) of aquatic biological resources, except for the extraction (catch) of rare and endangered (listed in the Red Book of the Russian Federation) species of aquatic biological resources.
8. Harvesting (catching) rare and endangered (listed in the Red Book of the Russian Federation) types of aquatic biological resources for the purpose of ensuring traditional fishing is allowed only on the basis of permits for the extraction (catch) of aquatic biological resources according to what the Government of the Russian Federation stipulate.

APPENDIX TO CHAPTER VI

Learning Russian language

Since the very beginning, learning Russian became an unquestionable requirement for me. In spite of acknowledging the difficulties that this could represent, I was fully conscious of the invaluable benefits that this could signify for both my individual development as a person but also as a social researcher in Russia. I considered that learning the native language of the people I wanted to meet and interview was essential for several reasons. Firstly, because it would reduce the communicational gaps. Not because I could achieve the complete fluency before finishing my dissertation, but because it could reduce the distance with the interviewees and contribute to create a relationship where the researcher represents a dominant figure or “authority” of any type. Moreover, being interested in learning from the local culture, I realized that the language – as already described – was the medium that could give me access to the world described and experienced by my interviewees in a more authentic way, including how they elaborate and interconnect concepts, feelings, experiences, places and worldviews. Being able to capture the subtleties of the language (for example, untranslatable words) could also foster understanding the local’s culture and identity particularities.

With the agreement of my supervisor, I started taking private lessons of Russian three weeks before travelling for the first time to Yakutsk in June 2018. In September the same year, I started taking Russian lessons at the University. This gave me the possibility (although still restrained) to establish longer informal exchanges with local inhabitants and my interviewees. Showing interest in communicating in the local language was appreciated and However, the biggest contribution was obtained during the translation (from Russian to English) of my interviews from the second fieldwork. During this process, having elementary notions of Russian was extremely helpful to refine Google’s translations. In this sense, due to Russian’s grammatical particularities, some phrases required being reorganized, which lead to obtaining a completely different meaning than those provided by the automatic translating system. This thorough work also allowed me to delve into the contents of the interviews and carry a first analysis of the data simultaneously.

During the last stage of my PhD, I focused my efforts in having weekly informal conversations with my Russian colleague, Marina Antonova, to increase oral fluidity. This was complemented

with daily lectures in Russian social media.

APPENDIX TO CHAPTER VIII

VIII.A) LIFE IN NORTHERN SETTLEMENTS: PUTTING LOCAL UTTERANCES IN PERSPECTIVE

VIII.A.1) Cultural challenges

INTERVIEW 21 QUOTE 5-6 K: "Now we do not have enough young specialists, there is a lack of young reindeer herders. Nowadays the average age of a reindeer herder is 50-55 years. There are no young ones."

INTERVIEW 21 QUOTE 6-8 K: "When I was studying, starting from the 9th grade we were already divided [in specializations]: some were choosing reindeer husbandry, some – "tractor husbandry", mechanized specializations. And so we studied reindeer husbandry and we were going on spring vacations to reindeer herds. Now there is no such thing; or maybe there is and I do not know. But there is no such thing, as attracting children – not only from reindeer herder families but from any family – since their childhood. In order to attach it since the early ages."

INTERVIEW 21 QUOTE 5-9 K: "And now it's such a time – modern. Now there are all kinds of Internet-dishes. There is a need to buy these for reindeer herds, so that the youth could come out. [So they can] communicate with relatives on WhatsApp, so that they can see. Otherwise, they spent too much time far away from the development in the taiga/tundra. Maybe they haven't engage in herding, will not engage just because of that (...) Of course! They are all the time [far from their families]. For example, nowadays, the wife will not go there with her husband like before. The wife and children stay in a village or town. A person yearns for his/her family. In such case, he would see [his family] all the time, speak or send photos, [the wife] would too. If so, the person would behave more calmly, and not like: "How is my family doing?" – he would not worry."

VIII.A.2.1) Climate

VIII.A.2.1.1) Summer became warmer and longer

INTERVIEW 25 QUOTE 8-5 K: "And summer became warmer and a little bit longer. Children can bathe when the weather is warm."

INTERVIEW 33 QUOTE 20 E: "Well, we have a noticeable warming. Because, while I was studying, in September, in the middle of September, it was already snowing. And now the snow is finally in

the month of October.”

VIII.A.2.1.2) Winter became colder

INTERVIEW 20 QUOTE 2-5 CA: “I cannot say that the temperature is very low – it’s not like in the settlements of the central Yakutia. But when we speak with local elders, they say that earlier, the winter used to be even warmer and the duration of winds was longer. The blizzards, winds were during the temperature of -10-15 degrees. Nowadays, it is, contrary, more freezing in winter, it can drop to -40/-45 degrees. And the winds, consequently, are blowing not only when it’s -15°C, but also on -30°C. And wind [speed] is 30-35 m/s (...) These people are my acquaintances that have been living here for 40-50 years. They told me that before, the blizzards were a lot milder due to the higher temperatures. But the duration of winds was longer, and they were snowier.

INTERVIEW 26 QUOTE 4-1 P: “Climate change, of course, there is. When we were little, we always walked in a snowstorm in winter, we always played: it was very warm. And now it’s unbearably cold outside - in general! I am afraid to get out! I’m sitting at home for three days, for example, and if there is a snowstorm, I’m afraid of the cold.”

INTERVIEW 25 QUOTE 4-17 K: “Climate has definitely changed in comparison with our childhood. March is still cold here. In winter it is up to -40 now. It used to be -21/-24 in below. Blizzard was different too. It used to bring warmth before. Now if there is a blizzard you cannot get out because it is -30°C or below and winds are very strong. ”

VIII.A.2.1.3) Changes in snow & lower average winter temperatures

INTERVIEW 20 QUOTE 2-7 CA: “Nowadays, it is, contrarily, more freezing in winter, it can drop to -40°C/-45°C. And the winds, consequently, are blowing not only when it’s -15°C, but also on -30°C. And wind [speed] is 30-35 m/s. Last winter [in Tiksi], there was less snow, but more frost. ”

INTERVIEW 22 QUOTE 5-2 PE: “There hasn't been much snow in recent years. It is already 5 years as we have less snow. Now cars pass everywhere in the taiga, before they could not pass like this. Even hunters could not drive though, but now they pass easily. At the place where my hunting grounds are, before we could not go there by car in the winter, but now it is easily possible. ”

INTERVIEW 7 QUOTE 60 A: "But of course it changed. Even when the fall comes, yes. Before, we used to have snow [as a cover lying on the ground] in the beginning of September. But in recent years, there is no [snow lying on the ground at this time]. Yes, normally it happens in September. Normally, on the 10th of September the snow was covering the ground and it was lying [on the ground, not melting]. And now, it might snow [as a precipitation] on the 5- 10 of September and [this snow will] melt [right away]. So now [the snow cover lays] slightly later."

INTERVIEW 21 QUOTE 14-2 KK: "In our district as well, many horses perished. Because it snowed, then it rained, and then it became frosty. Because of it, the horses could not reach their food. Yes, there was a [layer of] ice-crust... Maybe because of that, because of the warming."

VIII.A.2.1.4) Earlier opening & later closing of the navigation season

INTERVIEW 22 QUOTE 7-4 PE: "PE: Regarding this issue [podledka] - yes. If you compare it with old times, with the seventies-eighties, now autumn fishing starts later. In the end of October, it used to freeze in the end of September. There is such change – yes (...) The fish always comes to rivers in September. In the end of September or October – it varies. Sometimes, it happens that the river ices in the 25th October. But before the ice was already forming in the end of September, and on the 1st October people were already fishing. Now, even on October 10th, you cannot put the nets, because the ice is too thin. It's warm – you cannot fish, and during this moment you miss the time of catch (...) It is a danger: every year, people disappear on snowmobiles because they are not careful. Young guys... Some weren't found. Young people, who don't know, they rush right away. I never risk, I drive upstream. There was a case, I barely remained alive – it happened five times with me."

INTERVIEW 25 QUOTE 8-1 K: "Autumn has become much longer. It is warm until September. It starts to be cold in October. The sea starts freezing. "Shuga" appears only in October. It used to appear in the end of September when the motor boat arrived. We had "shuga" already by this time. September is getting warmer and warmer now, that's is good."

INTERVIEW 26 QUOTE 8-4 V: "We are waiting for the ice to appear to go fishing. In October it was already possible. Somewhere around 15th October. And now it is only possible in November. By the end of October."

INTERVIEW 31 QUOTE 6-4 E: "(...) autumn became longer. This season became longer. That is, before the sea used to get frozen in September, and now we see this happen in October. How? - Well, the ships navigate for longer periods. "

VIII.A.2.1.5) Cyclical changes

INTERVIEW 14 QUOTE 54 AI: "In the past - I also said it now, now, probably, I will also repeat that there are no major such changes - with the climate. Most ... periods go by, a period of cold - two years can be cold, two years can be then very warm. As in the summer, as in the winter. Yes, there is such a cycle. And so, perhaps, the polar night became smaller, shorter. Yes, yes, shorter. In this, maybe there is the influence of warming."

VIII.A.2.1.6) No changes

INTERVIEW 8 QUOTE 50 Sh: "No, climate is not changing. That is my opinion (...) In the past, snow fell heavily, but this year there was not much snow. In the mountains, black lands looked in the mountains. This has never happened before."

INTERVIEW 24 QUOTE 7-28 K: "Winters didn't become warmer in any case. It was 45 in below and it is still the same. We cannot say that there are some sharp fluctuations, like today is ice and tomorrow palm - trees are growing. "

VIII.A.2.2) PERMAFROST

INTERVIEW 7 QUOTE 79 A: "Well, permafrost - well, there everything is ice, right? This lensor how it's called..."

INTERVIEW 8 QUOTE 62 S: "It (permafrost) is underground, it is impossible to dig there - pits, all that. Permafrost is not particularly visible from outside."

INTERVIEW 17 QUOTE 5-11 T: Permafrost was always here. For example, in the forest-tundra area, the ground was thawing for 0.5-1 meter at maximum. Here, turfy layer is very thin. [Below that] is only ice. "

INTERVIEW 17 QUOTE 5-2 T: "T: Since I am living here constantly, I have an opportunity to

observe. In the recent years very much has changed towards the warming. Very much: the coasts are falling, eroding. In 2016 I was travelling around the Lena Delta (there are no rocks, everything is on the permafrost). There are a lot of places where the coast collapses every year. Even here, right here (shows), if you go there you will see that every year it is collapsing: 1-1.5 meters. It is being washed away and thawing."

INTERVIEW 21 QUOTE 8-3 KK: "In my opinion, "permafrost thaw" is... For example, for us it's like: a meter [of ground] then - ice. I used to think, at ours, it is getting warmer, and there it's getting warmer too. And so - you don't have to go far - for example, in Bykovsky the coast is collapsing, it gets warmer."

INTERVIEW 18 QUOTE 5-2 S: "The permafrost thaw. I already watched the science-movies about thawing ground ice. I watched and I think that the thawing of ground-ice affects it, the global warming. In other words, the warming affects the ground-ice."

INTERVIEW 24 QUOTE 12-1 IK: "It should be observed and we don't do any observations. You should address these questions to the specialists."

INTERVIEW 20 QUOTE 9-2 CA: Well, I am not conducting any research. But based on my work in the North, [I can say that] throughout the summer the ground with permafrost is started to thaw deeper. "

INTERVIEW 29 QUOTE 58-2 "E: Everything is thawing and falling apart. It can destroy all the Bulunsky District"

INTERVIEW 24 QUOTE 15-1 IK: "If it goes fast [permafrost thaw] the village will disappear. If a land fall happens somewhere in the middle, Bykovskiy will no longer be a peninsula, it will be an island. If the thawing takes place in the middle it may happen without doubts. If a summer happens to be warm and rainy, water is warm and therefore can make the ice thaw."

INTERVIEW 29 QUOTE 26-1 "E: Of course, changes have an influence. If permafrost thaws, the village (Bykovskiy) will go under the water."

INTERVIEW 5 QUOTE 6-17 S: "Well, this permafrost is starting to thaw. If industrialists come

- you yourself understand this - they will plow the entire tundra. And, again, if all the ground falls with us, everything - the settlements will disappear."

INTERVIEW 18 QUOTE 5-2 S: "(...) I think, in Tiksi it is impossible, because Tiksi stands on rocks. It is on a stone, not on ice. Yes. That's why it is, probably, it is not threatened by anything (...) Look: for example, in Tyumeti, when we were living there, we had a lasting ice- cellar. Since it [the land] stands on the lens, it is possible to drill an ice-cellar of any depth you want; and there, the ice will anyway be all around. A bit of ground, soil, clay, but it will mostly be the ice. And there it will have very much [impact]... The landscape will change a lot, I think."

INTERVIEW 1 QUOTE 180 K: "Well, if you look carefully, you'll see that this problem exists here (Tiksi) as well. Probably, it's connected with the housing system itself. Of course, each building has problems with the melting ground, but here we have a rocky terrain. So the problem is not as big here, but if a utility company from year to year does nothing to fix sewage spills under the stilts of a building, we're going to lose the building sooner or later. Right outside the administration building you can see a construction with a support that's been damaged not because of permafrost, but due to water leakage..."

VIII.A.2.2.1) Coastal erosion

INTERVIEW 24 QUOTE 22-1 K: "If we had a good and functional port in Tiksi it would have affected it for sure. There are 2-3 ships per year. There is no influence. But it affects the aerodrome, of course. The runway needs to be maintained (...) Because they (the airport and port) are in lowlands and Tiksi is situated on the hard rocks. Yes, it is on the hard rock and it is not affected by thawing that much. The airport is much more affected. If it thaws a little bit there can be a land fall."

INTERVIEW 28 QUOTE 12-1 S: "No. The climate is not changing. Anyway, in hundred years this will repeat. It's a cyclic process – it always comes back. The nature is defending itself. Therefore, when they say "global warming" – it's a lie. The nature regulates itself. But (got interrupted) (...) The warming will come, likewise the cooling will come too – there're such periods indeed."

INTERVIEW 24 QUOTE 7-18 IK: "The old cemetery there is all upside down. When I arrived here 30 years ago the cape was 150 meters farther. This distance has been destroyed."

INTERVIEW 25 QUOTE 16-3 K: "The cape is becoming shorter and shorter. We had some old cemeteries on the cape. They all are falling in the sea now. It is not so far from the first line of the houses. It may take 5- 10 years to approach us. I think so. It can be sooner or later meanwhile."

INTERVIEW 27 QUOTE 39-1 Ya: "For two years in a row they gave us money, 300 thousand each. They collected the remains and were buried in a mass grave under one tablet with no names. And the old coffins were burned on the shore. But they say that this wood, which has come out of the ground, is almost impossible to burn. They made very large bonfires and threw them [old coffins]. And still this wood did not completely burn out."

INTERVIEW 25 QUOTE 29-2 K: "The shore is falling, and our cape becomes smaller and smaller. It is becoming more narrow but the problem that it is already quite narrow. It is very possible that Bykovskiy will be an island one day. There is one place which is very narrow. Most probably it has become narrower now. There is an isthmus there. And Mamontovaya is opposite. There are landslides on the both sides there. It is growing bigger every year. The water is fresh in the bay. It is a fisheries protection zone. If the isthmus falls no one knows what may happen. Fish may choose the other way to go. If it becomes an island it is bad for us. We have no idea where fish might go. If it goes away, we will have nothing to do here."

INTERVIEW 29 QUOTE 58-19 "F: it will take us too soon, probably. It seems to me that we will be "cut off" in 50 years."

INTERVIEW 29 QUOTE 58-20 "Ya: in 100 years."

INTERVIEW 29 QUOTE 58-23 "E: 50 years, I think. It is going fast now. It is going very fast. It was not so noticeable before."

INTERVIEW 29 QUOTE 58-24 "Ya: Two meters are taken away every year. There are just 450 meters there."

INTERVIEW 17 QUOTE 8-4 T: "Along the Lana Delta, there are many hunting cabins, fishing cabins. They are always built on the shoreline. Annual erosion is getting to them, and many [collapse]. There are many cabins, that have been washed away."

INTERVIEW 29 QUOTE 50-2 "F: My husband's fishing house has already been washed away. The shore got destroyed there (...) Landslides. He built a new house in tundra, much farther."

INTERVIEW 21 QUOTE 8-5 KK: "Maybe not because of the warming, but maybe because of the river, [it happens] in Namy too. The coast of Borogon is also falling, it has already got closer to the houses. Maybe the river washes off the shore, or maybe it's because of the heat

- I don't know."

INTERVIEW 29 QUOTE 58-26 "E: I think that we contribute into this process too with our garbage deposits. This thawing goes faster."

INTERVIEW 26 QUOTE 49-25 P: "Ah. In our country, in short, here every summer ice is filled from the other side of the coast. Here I stand on the shore, upstairs. And when the ice leaves, it turns out yes, it began to hammer exactly on one bank. This was already like three years ago."

VIII.A.2.2.2) Changes in lakes

INTERVIEW 22 QUOTE 5-9 Pe: "(...) Some lakes, which are closer to the river, fall and disappear: the water flows away like this (shows). But the lakes in the inaccessible places remain." This could be explained by two different reasons: If the lake is close to the coast and the ground between them is somehow eroded, then the water of the lake eventually will run into the river. It could also be related to underground channels situated under the lake and therefore this water flows into the river."

VIII.A.2.2.3) Mammoth tusks

INTERVIEW 2 QUOTE 203-4 A: "It means that the shore is falling apart and these (carcasses and tusks) are being exposed. When you go by boat from Taimylyr to Tiksi, when you go by motorboat you can see that shores have collapsed. Every year. It is from his personal observations."

INTERVIEW 15 QUOTE 15-2 S: "You have the opportunity to see [maps / archives]. Suppose the archipelago of the Novosibirsk islands, the same Big and Small Lyakhovsky [islands]. 1900 [archives / maps] please see if you have such an opportunity. Historically. These islands were much larger. And if there is a possibility, per years [look]: 1920, 1930, 1940, 1950, and you will

see that they have been decreasing gradually every year since 1900. No matter how sharp this [thaw / decrease] is.

VIII.A.2.2.4) Thermokarst

INTERVIEW 27 QUOTE 35-2 Y: "(...) Because anyway, the earth's crust cannot increase, because under it there is only ice. If this ice thaws, then the earth's crust fails. Marshy puddles form in these places."

VIII.A.2.2.5) Naled on the crack ("trashina")

INTERVIEW 29 QUOTE 55-20 "Ya: you are in the sea and you cannot see that naled is around. Everything is white around. It can be covered with snow"

VIII.A.2.2.6) Winter roads ("Zimnik")

INTERVIEW 19 QUOTE 18-4 K: "In the last 2-3 years, it became more frequent that winter roads open much later. I will not say that food shortages begin, but it is problematic to import some fresh products. Mostly in the villages."

INTERVIEW 4 QUOTE 5-4 A: "Hard (laughs). We have conditions related to work and stores prices. The salary is low, and the prices in stores are high. [products] are expired, no one controls, no bodies.

VIII.A.2.2.7) Roads

INTERVIEW 22 QUOTE 11-5 PE: "Concerning the roads. The roads will break too, of course. They mostly hold on the permafrost. Houses will collapse. There will be no roads."

INTERVIEW 26 QUOTE 26-1 V: "Well yes. The roads are falling too. The condition of the roads is terrible. This has never happened before. Previously, the roads did not deteriorate so much. Well, due to thawing, I guess."

VIII.A.2.2.8) Buildings/houses detrimental

INTERVIEW 13 QUOTE 35 SP: "Of course, there are cracks (on the buildings). There are soil

depressions, and they move...Of course they do (represent a risk)."

INTERVIEW 12 QUOTE 13-4 D: " I lived in the house on 19 Leninska street, when I still had only two children. My third child was just born. When I was cooking in the kitchen, I had the baby sleeping in a crib. And I heard such a terrible noise! I run into the living room, into the room where the child was lying in the crib. Such a cobblestone fell straight from above, from the ceiling on the floor right next to the crib! I immediately panicked: "Oh God! What's going on ?!" I went to neighbors'. It turns out that everyone got a crack like this (showing). The apartment that is in the corner had a closet in the corner. The corner of the cabinet and everything around was covered with frost everywhere - everything was covered in snow. And you could see the street from the apartment (...) There are a lot of such houses."

VIII.A.2.2.9) Ice cellars ("lidniki")

INTERVIEW 25 QUOTE 18-1 K: "It is not ok for us for sure. We have our houses, facilities, farm units, ice -cellars here. It is difficult to move all this stuff. Everyone has his own ice -cellar."

INTERVIEW 1 QUOTE 144 K: "K: Well, in fact, I don't often see private ice-cellars. We have ice-cellars that belong to the Ministry of Agriculture and we support them. We have powerful industrial ice-cellars. If you come here in winter, I'll try to show you a two-storey ice-cellar facility in Tit-Ary, it even has a small tractor that works inside and transports loads to the pockets. Every storey can hold up to three hundred tons of fish. It's a storage facility for fish. We should understand that it's not so easy to maintain them. It should be frozen, cleaned, glazed and so on, in winter it has to have ventilation, that brings in cold air flow, quite a fast stream of air. Then it freezes up to 10-12 meters into the depth, because it's artificial ice, you know, it's minus 5-7 degrees, even if outside it's minus 40. So we have to freeze fish, shock- freeze it, every storage has shock-freezing now. Then the ice storage facility is efficient, and we've got a big catch, then it helps a lot."

INTERVIEW 19 QUOTE 14-7 K: "If before, in order to preserve fish on fishing, we were digging approximately half a meter on the ground, and there already was a [ice-] lens [of permafrost]. You put fish there, and it was lying cool - roughly speaking - until the morning. But now we need to dig a little bit [deeper]. It is again because of the thawing. Because of the economic situation,

they [people] in the villages cannot stop using the ice-cellars. They [ice-cellars] thaw, need to be cleaned and so on. In Tiksi, almost everyone switched to the refrigerators [freezers], in order to not bother with all that."

INTERVIEW 29 QUOTE 28-10 "F: The second ice-cellar of Raipo fell. Everything is falling. It is the influence. The warming is coming. The collective farm made its own ice-cellar and they are taking care of it. But everything can fall at any time. This is global".

VIII.A.2.3) FLORA & FAUNA

VIII.A.2.3.1) Fauna

INTERVIEW 23 QUOTE 6-12 Sh: "Sh: We've got some bees and hornets too. We've never seen them before. I have been living here for a while but it is the first time I saw a bee. This is something very new for me."

INTERVIEW 29 QUOTE 18-34 "F: Ringed seals are moving after fish and bears are moving after ringed seals. It seems to be like that."

INTERVIEW 27 QUOTE 23-5 Y: "The hare feeds on this shrub [called "willow"]. Therefore, we have a hare. And due to the fact that there were hares - we got sables. Everything is interconnected."

INTERVIEW 5 QUOTE 17-7 S: "Ways of migration began to change. Ways of migration of animals, birds, and arrival time of birds. Mammals appeared on our sea that didn't even live here. Last year we opened a new rookery, here in the Lena Delta. Walruses (...) Since 2014, I noticed that belugas appeared here. Well, beluga whales swam to us through the Kara Strait, went around the Taimyr Peninsula and went into our Laptev Sea (...) We looked, and it turned out that these were belugas! They were standing near the ice, and at this time, just on the ice there was omul. And they [omul] stand at the edge of the ice and ate what fell from the ice - zooplankton. They eat them. And these belugas stand as nets and eat them [omuls]. And since that time, I began to see them every year. 200, 300 belugas. On each of the distributaries (...) But in Bykovskiy, I saw up to 150 pieces. Then they appeared in June, when the ice was standing. It turns out that they hibernated with us! They come in and then should leave us, [they should not be here constantly]. They must have come from the Kara Sea, and stayed for the winter (...) We found ten orcas here. We never had them before. And they already ate belugas, seals, walruses [and others]. So we got

a predator. Because of this, our omul last year, just the same, did not come up. Three years before that, he did come up tous."

INTERVIEW 2 QUOTE 20-1 A: "Wild reindeer migration [changed]. They were used to go to the Laptev Sea straight through Taimyir. In June, July. Now it passes upper [of the river]. It might even not come at all. Same in autumn. Here there is the Anabarskiy reindeer population Lena-Anabar which is located there. Well, the time has changed. They might go earlier. Because the snow fell very late, and the reindeer has already left (...) Well, to be exact, it (permafrost thaw) affects the migration of reindeer. It's interconnected, it seems to me. There...somewhere, swamps appeared, for example."

INTERVIEW 21 QUOTE 3-7 KK: "Last year, the Artel "Kolkhoz Arktika" didn't fulfill the [fishing] plan. And the scientists came to them too. They stayed on the site and studied. They said that the volume of water in the Lena increased, and the fish feeds on the border of salty and fresh water. And due to the fact that the volume of water in Lena increased, this border has moved 10-15 kilometers from the [usual] fishing grounds - they said so. Where [fishermen] were used to put the nets, there is fewer [fish]. But when they go further into the sea, there is already a little more [fish]."

INTERVIEW 21 QUOTE 17-13 KK: "Not the river fish, but its prey, its feeding ground. It is found on the border of the salty and fresh water - the fish feed. The fish goes further away from these places, where it was before. They leave the places where people were used to put the nets."

INTERVIEW 29 QUOTE 18-8 "Ya: The Northern wind brings the rise of the tide water and it becomes salty. The level of water is rising, I mean. If the water [becomes] fresh, the fish goes to the salty water area - and vice versa. And since there's no high tide even with the northern wind - the water here is always fresh. That's why fish is disappearing."

INTERVIEW 12 QUOTE 14-10 D: The only thing I can say is about fish. For us, when my husband became a pensioner, in 2015, he decided to engage in fishing. It was a very profitable business. Many of our fishermen, well, literally are (interrupted). They were really rich - yes. Because there was a great unmeasurable amount of fish! And in 2015, he went to the fishing ground - Nothing! At all! Nothing! The fish disappeared. And it appeared only in the winter of 2018-2019. Yes (for

several years the fish did not enter these waters). Therefore, my husband already, kind of... I became the only one that earned money, as it turned out. In urge, he got a job at the airport. He thought that he could earn money on fishing. But no!No, it didn't work out - there was no fish at all. Many people think, and wonder what this is about. Someone said that somewhere there is a large barge standing, that [catches] all the fish. And also the fishermen began to suffer a lot from the belugas. They say that Beluga eats several tons of this fish per day. They became numerous - these belugas."

INTERVIEW 26 QUOTE 4-6 P: "There was always a fish! Al-ways! And recently, in recent years, it's immediately noticeable that there are no fish! Well, everyone says that the oil wasdripping there, then something, some networks were installed - I do not know. This is all rumored - we don't know anything. They say it began in 2012".

INTERVIEW 27 QUOTE 4-10 Y: "But no matter how many ichthyologists study, and people themselves do not observe ... [nothing]. If we take the previous periods, the previous century even, then there were also times when the fish disappeared for 3-4 years. And we hope that this period, when the fish disappears, this is a repeat of those events. That is, the cyclical nature of this period."

VIII.A.2.3.2) Flora

INTERVIEW 19 QUOTE 9-4 K: "(...) Look: earlier, for example, I'll tell you that the tundra was brownish-yellow. Now it is green! Ordinary herbs begin to grow even more. That is, before it was moss, lichens and something else, but now it's real grass."

INTERVIEW 23 QUOTE 6-5 Zh: "Caspian willow has never grown like that. There are some bushes now that are as tall as a man. We got some eglantine (species of a wild rose) this year in the village. We have never seen that. We've got some bees and hornets too. We've never seen them before. I have been living here for a while but it is the first time I saw a bee. This is something very new for me."

INTERVIEW 25 QUOTE 8-17 K: "Plants? Yes! Arctic birch started to grow here nearby. We didn't have it before. There are some birch boletus too. There are russala, yellow boletus (slippery jack) and birch boletus. We didn't have them before on our cape. The birch boletus has always been

in Tiksi. There are russala, yellow boletus (slippery jack), girolles, milkmushrooms. There is a kind of the button mushroom here. Red bilberry started to be ripe. In the end of the summer, in August and September it is almost red.”

INTERVIEW 17 QUOTE 5-7 T: “T: (...) Maybe it is because of warming, or maybe because of a machinery. If some time ago, a vegetation layer has been damaged, then a stream has washed it – that’s it! – a gully was formed. If erosion already started, you cannot restore it.”

INTERVIEW 27 QUOTE 6-4 Y: “Shrubs have grown, which previously were not here either. This, I think, it is due to climate change.”

VIII.A.2.4) CHANGES IN LANDSCAPE

INTERVIEW 15 QUOTE 15-6 CM: “It is very upsetting that the tundra is all covered in garbage. The barrels, metals - all this is just around. I just want this to not to be there. It’s just that earlier, some attention was paid to this. As if we were looking after all of this. And now it’s just as simple as that: no one thinks about it. You see, these landfills are everywhere: there is a dump, here is a dump.”

INTERVIEW 29 QUOTE 47-7 E: “Look! Tundra is covered with garbage. It contributes with thawing and causes a lot of ecological harm.”

APPENDIX TO CHAPTER IX

IX.A) INTRODUCTION

The Russian government identifies two different types of Northern regions: The Far North {Kraynyy Sever) and regions equivalent to the Far North {mestnostipriravnennoye k rayonam Kraynego Severa). These categories were created mainly for planning and economic development purposes. Heleniak (1999) details that "the designation of these administrative regions was for the purpose of setting coefficients for wages and other entitlements as part of a program to recruit workers for tours of northern duty and stimulate economic development of some of the less developed Northern regions".

The Far North and regions equivalent to the Far North includes 16 regions: The Karelian Republic, Murmansk Oblast, Arkhangel'sk Oblast, the Nenets Okrug, the Komi Republic, the Yamal-Nenets and Khanty-Mansiysk okrugs, the Taymyr and Evenki okrugs, the republic of Sakha, Magadan Oblast, the Chukotka and Koryak okrugs, Kamchatka and Sakhalin oblasts, and the Tuva Republic.

One of the principle difficulties with definitions of the North is that most economic and social statistics information is published at the oblast level. Therefore, using definitions of the North based on physical or climatic conditions do not converge with the administrative boundaries (Heleniak, 1999).

INTERVIEW 15 QUOTE 17-15 T: "So we can say that the light of the Soviet Union, the best representatives were here (...) The best doctors, the best teachers. To solve some health issue was not a problem at all. The doctors were just magicians. The best! The teachers were the best. My child understands it now, and we, of course, recognize the contributions they made. The food was the best! Here we were getting the best products. The food was better. Here we were receiving the best products. Here they were available to everyone. We were the most beautiful and fashionable women (laughs). With that, we were helping our girlfriends, sisters, were sending all this in packages. This is also important. For young people, this, of course, was important: to come here and get dressed, when everywhere there was a limited supply."

INTERVIEW 15 QUOTE 37-2 T: "I also want to add, that, before, we were not at all afraid to be here with children, with families, we knew that any help would be provided. I mean medical help.

There were medical flights, or doctors - it was the highest caste here. And now, after arriving here, we are turning to doctors because of our age, and we are disappointed. It is very important. Because when the children were small, we absolutely did not worry about their health. And now I would not let my grandchildren live here. It is very important. Now, God forbid, to get sick - we immediately fly to Yakutsk (...) Of course!

Absolutely. This is a very important factor - nostalgia, memories of youth. An excellent standard of living in young years compared to what it is now. Of course."

INTERVIEW 15 QUOTE 12-19 CM: "Earlier, the seaport worked all year-round. And so there were many ships. Therefore, many people were coming here. Because of this, kind of, the seaport worked at 100%. Then in the 1990s, the people decided to change it to the shift working method. In other words, work only in the summer. Therefore, it was unprofitable for people and families to stay here, and they were leaving. And so the city, the village, went into the state of neglect."

INTERVIEW 22 QUOTE 7-4 PE: "Regarding this issue [podledka] - yes. If you compare it with old times, with the seventies-eighties, now autumn fishing starts later. In the end of October, it used to freeze in the end of September. There is such change - yes (...) The fish always comes to rivers in September. In the end of September or October - it varies. Sometimes, it happens that the river ices in the 25th October. But before the ice was already forming in the end of September, and on the 1st October people were already fishing. Now, even on October 10th, you cannot put the nets, because the ice is too thin. It's warm - you cannot fish, and during this moment you miss the time of catch (...) It is a danger: every year, people disappear on snowmobiles because they are not careful. Young guys... Some weren't found. Young people, who don't know, they rush right away. I never risk, I drive upstream. There was a case, I barely remained alive - it happened five times with me."

INTERVIEW 15 QUOTE 13-1 T: "Of course, nature, tundra, field, sea, and rare meetings with friends of my youth are making me happy more than anything now here. Because there are very few of my friends stayed, most of them left. That's all. Unfortunately, the salary does not please me here. It is not higher than on the continent. Living conditions are not cheering either. They are no better than on the continent. Let's say, these are romantic feelings that are defined there during the period of living. We have a certain goal, that has a timeframe. This calms us down

and gives an opportunity to be joyful about everything.”

INTERVIEW 13 QUOTE 12 SP: “Well, the main thing with us (Tiksi) is the sea. Which has led and is leading so far. All sorts of cargo. Now there are less, there are less now. Earlier in Soviet times, there was generally beauty. We had everything. And now, look, everything is somehow not very ... And there were a lot of ships, and now there is not a single ship. Everything was cheaper here.”

INTERVIEW 7 QUOTE 35 A: “Before, everything was fine, they lived - there were a lot of people. The population was, well, as they say ... Supply was everything ... Well, it is now as well. But before, there was the Union, now it’s businessmen. Before it was the State, now it’s commercial. (...) Well this ... as they say ... It was immediately noticeable when the Union collapsed. And then I will not say anything. Well, of course, it changed. I used to work here, there were constructions in the village every day, and now there is nothing there. Some repairs were still there. The cooperatives did, and still do now. But less and less.”

INTERVIEW 34 QUOTE 9 E: “Earlier in Soviet times everything was good. Provisions came from Moscow and from St. Petersburg, Leningrad. First priority. The food was very good. Clothes, everything. The seaport worked well. Then, during perestroika, in the 90s, when everything came to ruin and the seaport was closed. People began to leave, experts left.”

IX.B) PAST MOBILITY TRENDS

IX.B.I) Locals who left Tiksi and came back

INTERVIEW 15 QUOTE 14-3 T: “We, when we moved out from here in 1996, our child was 12 years old, probably. We had to turn to a psychologist. Because we were from a place with the highest culture, and we ended up in a simpler Russian city. And the child had problems with adaptation. Because we, adults, went to work and plunged, but it was difficult for the child.”

INTERVIEW 15 QUOTE 17-2 T: “[we were missing], precisely, the cultural development of Tiksi. Firstly, a lot of ethnicities lived here, we all were here: Ukrainians, Russians, Jews, Azerbaijanis, Yakuts. And we were all together - literally. Intellectuality. The people with whom we were talking here. After moving to the Russian bottom-province, we no longer had such comrades, friends. Calm in raising a child. That is, we could let our child go out and not worry about it. It is very

important. (...) Yes. Criminality is very low here. This is due to the state border [regime]."

INTERVIEW 22 QUOTE 21-2 PE: "No, we don't plan (to leave). I left once to Moscow and I didn't like it. 10 years ago I was offered to move and work in Moscow. I stayed there for two years and I didn't like it. I cannot adapt, sleep calmly. This [constant] movement [around]... I cannot adapt (...) [concerning the future of my children after they finish their studies] It will be their choice. I'll just teach them everything that I know. It is like this (sighs). Everybody disappears. I am concerned. But it doesn't depend only on us".

IX.B.II) Those who came to Tiksi (comers) and left

INTERVIEW 21 QUOTE 16-5 KK: "Here we have expensive food - yes. For example, people come from the central districts. And it's hard for them to adapt, because it's expensive. And we are locals, we fish and hunt. The main products - meat, fish - we get them ourselves.

And they have to buy it. Because of it... some [comers] cannot withstand it. Even at the Veterinary Department of our district, several good young specialists left. They arrived and left. They left for the central districts. They are finishing school, arriving here because they were directed here or whatever. They work here for some time. But then they can't withstand. They leave for their central districts."

IX.B.III) Those who came (comers) and stayed

INTERVIEW 7 QUOTE 9 A: "I have been living in Tiksi since the year 83 all the time. I came from Baku, Azerbaijan. I arrived with three children, two more were born here. Two children are here, three in St. Petersburg. I came here for seasonal work in the 80s. Looked like it. In general, here I worked on rafting. Seasonally, there used to be a lot of people here. And the port worked, and rafting worked (...) I worked in "Tiksi Building" here. They built houses, they built a village.

INTERVIEW 24 QUOTE 26-1 IK: It is a difficult question. I am going to leave on my own. [I will wait for] The retirement and so on. I will come back to Crimea. My elder daughter lives in Yakutsk with her husband. It is ok so. They are there and me too (...) Why didn't she [my daughter] stay? She studied there [Yakutsk] at the university. She found a job there and got married. There is no way to find any job here [Bykovskiy]. There are no jobs. There are no jobs in Tiksi neither. This is

the problem of small villages. There are no enterprises. I would say that educated people have no jobs here. Well, just a few."

IX.C) CURRENT CONCERNS AND FUTURE PROSPECTS

INTERVIEW 29 QUOTE 5-5 F: "Until we have fish in the waters here and there is a collective farm our village will exist."

INTERVIEW 29 QUOTE 63-1 "E: If the infrastructure keeps existing, the village will be succeeding."

INTERVIEW 29 QUOTE 63-3 F: "The village will exist until the collective farm is working."

INTERVIEW 29 QUOTE 63-5 "F: I am going to stay. My elder son lives in Pokrovsk. The youngest daughter started 9th grade. I think she will stay in Yakutsk. There is no future for the young in the village."

INTERVIEW 31 QUOTE 23-4 E: "He is studying at the philosophical department - what would he do here?! (laughs) Of course [he will] not [return]! I offered him – but he doesn't want to. He does not want not because he does not want to see me or nature. But there is no social circle here, maybe that's why he doesn't want to come back. Although I can't say that he felt bad here: he graduated from the high school, the Arctic Gymnasium with a silver medal, he was a social activist."

INTERVIEW 28 QUOTE 4-43 SE: "My daughter is now in the city too; she is working. She graduated from a Technical School – she is a land surveyor."

INTERVIEW 25 QUOTE 36-1 K: "If I move my children will move with me. My daughter lives with me. She has just started 8th grade. My son is a student (in Yakutsk). He will not come back here. He may go to Tiksi if he finds a job there."

INTERVIEW 18 QUOTE 11-4 S: "Yes, I have children. But as I understand, now everybody stays there, try to stay there, [for example] in Yakutsk; those, who studied in Moscow – try to stay in Moscow. (quietly) No one wants to...I don't think it's a problem. Everybody wants to... It's their own choice. It's a choice." When this same person was asked if he was planning to leave or to stay in Tiksi he admitted: "Well, I am, kind of, between two fires: I want and I don't want. (laughs)"

INTERVIEW 31 QUOTE 4-2 E: "E: I can't say that this is a problem, because there are not so many jobs. And, of course, young people want to make a career, they want to have a prosperous life. That's why fish goes where sea is deeper and humans go where it is better. If there was a rapid development, perhaps they would return here. Meanwhile, it doesn't even make sense to miss here, in such offices (laughs)"

INTERVIEW 20 QUOTE 6-3 CA: Yes, it is a problem because [they are the] people who could come back and work. Thus, they would be at their home, it would be easier for them. For instance, the problem with my employees is that I cannot find specialists here, therefore I take people from Russia. But now, in the last two years, I was trying with young people. In this year, I trained someone local. He is also working at the navigation period. But at least, he knows that when he comes here and he has a job."

INTERVIEW 15 QUOTE 36-2 L: "Yes (it is a problem). Because we need young specialists, but there are none. Nothing can attract them to come here: neither salary, nor housing. What are they to do here?"

INTERVIEW 21 QUOTE 19-2 KK: "Not [only] from Tiksi, they also leave the villages and don't come back. But this problem is... is not a problem actually, but... How was it before: you finish studying – you go to the herd. He knows it and that's all - he stays there. And now, from one hand, one goes to study – there, there is civilization and all of it. He does not want to go the herd. I don't mean that it's bad, but there is nothing... Therefore, I say: "To attract young specialists we need Internet, and all those. So he can stay informed about what is happening in the world, in his settlement. Even to speak with his friends. For example, let's say, a student graduated the specialization of a veterinary or similar. So that he could talk also to his course-mates, maybe consult each other [regarding work]. So there will be communication – so to speak. Not like, that you go, and it's like if you were in the exile. If one wants to stay, he will stay, the one who wants. Everyone has to have his own choice. Can't say that very (abrupt) (...) And here is my opinion: this has to be done... For example, the doctors. There is a number of students, children, who want to become a doctor – they will be sent to study. Even if they don't have enough exam-points, but to send them anyway. Because, for example, if a non-local doctor comes - he will leave in a couple of years. But the local one will stay here anyway, no matter if

he is from Tiksi or Bykovsky, or Kyusyur; but he will stay here anyway. The same for teachers. As for teachers: in anyway, when children are studying at school, the teachers notice who of the kids has a talent, who is showing a desire to become a doctor or a teacher. Such people [children] have to be supported. Because when they (for example, a doctor) will arrive from central districts or not even from Yakutia, but from Russia, he will eventually go back to his home. He will get old – will go there. Well, it's not about getting old, but an example. But anyway, one always has ties back home."

INTERVIEW 21 QUOTE 6-8 KK: "When I was studying, starting from the 9th grade we were already divided [in specializations]: some were choosing reindeer husbandry, some – "tractor husbandry", mechanized specializations. And so we studied reindeer husbandry and we were going on spring vacations to reindeer herds. Now there is no such thing; or maybe there is and I do not know. But there is no such thing, as attracting children - not only from reindeer herder families but from any family - since their childhood. In order to attach it since the early ages. In Borogon (Namy) there is an agricultural school, but in Kyusyur only the children of reindeer herders go to the herds. But ordinary children could go too, if they have an interest."

INTERVIEW 1 QUOTE 102 K: "My eldest daughter has not returned. She's very clever and beautiful, like her father. She has her projects there, her own dance school, and also she's a manager of the fourth floor in a trade centre – where they have cinemas, studios of arts and so on – she's an artistic person. So the district cannot satisfy her requirements, what she wants to do... She lives in Moscow and Tambov. Her studio is in Tambov, her grandmother lives there, and she supports her. But mainly she works in Moscow. And the middle son lives here in Tiksi. He's stayed here, he's got a communication project, and he works here. What will become of the youngest, he doesn't know himself and neither do I."

INTERVIEW 39 QUOTE 1-13 D: "I love climate in Tiksi because it's not cold, not hot. Because it's always normal climate. And I live in Tiksi because I am working. I don't know, maybe in two years I will go away (...) I love Tiksi very much. It is so exotic, different, buildings, and people are very warm and kind (...) Well, I don't know, I didn't think about it [where to go]. Well, but if will not like it there, I can come back (laughs). Nothing opposes – right? (laughs) I don't have children, nor a husband – I have absolutely nothing."

INTERVIEW 19 QUOTE 32-8 K: "K: Yes, many (students who are abroad) do not return. There is a problem. Young people now have one criterion: somewhere there (let's take the same Yakutsk) – where the Internet is better. And due to such small pluses - children make their choice, let's say so. (giggles) Well, they're coming back little by little anyway. The very outflow, mass migration, has stopped. In recent years, according to statistics, the number of "arrivals" and "departures" is the same. "Arrivals» are even a little more. So to speak about migration. I think that over the past 5 years, the situation has stabilized a little."

INTERVIEW 2 QUOTE 218-1 A: "I think, most (students) don't come back. Because of better conditions. Even if you look at Tiksi. Our housing problem is very complicated. They are abandoned. Everything is bureaucratized. Those apartments belong to someone, but they left. They left but we cannot use the flats because of the registration. Moreover, now the military is returning. Some kind of development is visible in the future, and therefore no one wants to sell, unregister; they preserve their real-estate so that in the future they can sell in the future."

INTERVIEW 26 QUOTE 35-1 P: "They will go. Of course they are (an abrupt thought). I think there's nothing to do (chuckles). They will flourish somewhere else."

INTERVIEW 14 QUOTE 82 AI: "Since we live on the shore of the Laptev Sea, if thawing begins, we will probably all go down, right? This is probably the problem. Yes, we are afraid of this. Ah, well, actually when the river is opening, it's... (you know, all villages and settlement are located on the coast). And sometimes they also have a problem with flooding. It's kinda interrelated too."

INTERVIEW 19 QUOTE 26-2 K: "Well ... In principle, I think it will be the same as in Soviet times. In other words, we will return to what we had left during the collapse of the country: It will be the transportation hub, which will be supporting the Northern Sea Route."

INTERVIEW 15 QUOTE 34-2 T: "We love this settlement very much! And we believe very much that... ...it will revive! The building "Baghead" There, the beautiful building. The red tower is standing there. It's standing there as it's new. They were building so well! It was a plant. What were they processing the coal. Well, it's believed that here the oil is of the highest quality. Well, [I am saying this] meaning that the history of the village is not collapsing. And for sure it will be reborn like a phoenix. I really hope for it."

INTERVIEW 13 QUOTE 77 SP: "Well, if you try, people can lift up Tiksi, I guess. If you invest some kind of ... how can I say ... well, if you would help with money, to build all these ... So that the management here worked well. Depending on our top Russia's authorities. Before, we used to have a port here. We have an international port. Now everything is closed, so we have nothing. There is no good. If it was restored, there could be an improvement."

INTERVIEW 18 QUOTE 8-9 S: "Well, we are hoping for the best. That it will get better. But we also fear that it will get worse. (laughs). Well, I don't know. But if I speak as an acting head of Agriculture [department], I fear that it will be impossible for reindeer to feed themselves. Because if it will rain after the heavy snowfall, it will be a death, so to say, for reindeer – no way to nurse them."

IX.C.I) People willing to stay

INTERVIEW 8 QUOTE 105 S: "Well, the maximum (I would go) only to Yakutsk. And there, in the summer, the climate has a bad effect, it's too warm. (I would go) I don't know if there is an opportunity, of course, but right now there is no possibility. And so everything suits. In Tiksi, on the contrary, it's better, sort of. "

INTERVIEW 15 QUOTE 16-3 L: "And always, when I go on vacation, I am always in a hurry to be back. Because it's cool and good here (they laugh). When I go to my grandmother to Ukraine on vacations - it's a nightmare! There is such a heat! Horrible!"

INTERVIEW 5 QUOTE 42-2 S: "No, no (I'm not willing to move). My wife says: "let's go, let's move to Yakutsk." And I say: "You know, let's get divorced and you leave. And I can stay here alone." (jokes, laughs). Because my father, my grandfather, were born here. Although my mother is not from here. She was [born] near Yakutsk. There [they] have trees - I cannot stand these trees. (laughs) Tundra is dearer. (There is) Space, visibility - you can see far!"

INTERVIEW 15 QUOTE 17-2 T: "[we were missing], precisely, the cultural development of Tiksi. Firstly, a lot of ethnicities lived here, we all were here: Ukrainians, Russians, Jews, Azerbaijanis, Yakuts. And we were all together - literally. Intellectuality. The people with whom we were talking here. After moving to the Russian bottom-province, we no longer had such comrades, friends. Calm in raising a child. That is, we could let our child go out and not worry about it. It is very

important. (...) Yes. Criminality is very low here. This is due to the state border [regime]."

INT 12 QUOTE 5-1 D: "It's hard to live here. It's difficult, but we obviously love our district, the settlement. We don't even want to move anywhere." She then added QUOTE 18-5 "D: No. (I will) Never (leave)! Of course, we want to have a real estate. We want it in many places, just to travel during the summers. Just for the summer, for children. Maybe the kids will want [to move]. There are not many things that children can afford. Well, I mean- There is, of course, a cultural and sports complex, various study clubs, a cinema, a gym - but this is very few. How can it be developed? - there is no pool, there are not some sports classes, or something scientific, there are no interesting quests [escape games]. Children are very interested in these."

INTERVIEW 1 QUOTE 98 K: "(...) And of course, I cannot picture myself here as a pensioner at 80 years old. I don't have any plans in this direction. But in the near future I'm not going to move from here. It's my home place, I was brought here when I was eight, where shall I go from here?"

INTERVIEW 28 QUOTE 38-1 S: "It's no fun to be old (laughs). You can only go to your children, where else would you go? If the health is allowing it - you should live in your birthplace till the end. We are both from here: me and my wife. My wife is also from here; she is a native dweller too. We cannot separate from our homeland."

INTERVIEW 33 QUOTE 72 N: "We want to leave due to my illness in the near future. But my children do not want because here everything is familiar to them (...) Of course (I will miss Tiksi). Already when we are on vacation, we already miss."

INTERVIEW 24 QUOTE 26-1 IK: It is a difficult question. I am going to leave on my own. [I will wait for] The retirement and so on. I will come back to Crimea. My elder daughter lives in Yakutsk with her husband. It is ok so. They are there and me too (...) Why didn't she [my daughter] stay? She studied there [Yakutsk] at the university. She found a job there and got married. There is no way to find any job here [Bykovskiy]. There are no jobs. There are no jobs in Tiksi neither. This is the problem of small villages. There are no enterprises. I would say that educated people have no jobs here. Well, just a few."

INTERVIEW 26 QUOTE 68-14 P: "In general, they are disgusting - everything is terrible! (with

disgust). Even when we go on vacation, we take meat, wildfowl and fish with us.”

INTERVIEW 29 QUOTE 65-18 “E: As we say in Yakutian: “Do we have our black food? – We do! So what else is needed?” That’s it. As you have the black food – you are alive” – so to say. You are replete.”

INTERVIEW 2 QUOTE 105-1 A: “I myself do not plan to move. Here, there is a lot of ... Well, firstly, will be here the next 5-10 years, working in the district administration. Since childhood, I always dreamed that I would have my own farm. I have always dreamed of having my own farming, hunting farm or some traditional activity. Yes, to be a free person. Now I’m not a free person, sort of. I am like a service person, government official. I have a path. At the end of this path of mine (working for the government), I want to calmly work in my farm. At the end of this government path, I would like to work for myself.”

INTERVIEW 15 QUOTE 34-2 T: “We love this settlement very much! And we believe very much that... ...it will revive! The building “Baghead” There, the beautiful building. The red tower is standing there. It’s standing there as it’s new. They were building so well! It was a plant. What were they processing the coal. Well, it’s believed that here the oil is of the highest quality. Well, [I am saying this] meaning that the history of the village is not collapsing. And for sure it will reborn like a phoenix. I really hope for it.”

IX.C.II) People willing to leave

INTERVIEW 14 QUOTE 92 AI: “Oh, I myself ... Personally, I would like to leave here. Well, even if it gets warmer, it seems to me that there will still be effects on human health. So it will be necessary to leave somewhere anyway.”

IX.A.1.1) Inner mobility

INTERVIEW 31 QUOTE 21-3 E: “My parents have already left, now they live in the Tula Region. My mom is from Kyrgyzstan, and my dad from the Ivanovo region. They, as before under socialism, built a cooperative and live there. I live here because my son is a graduate student at Leningrad University. Therefore, I support him financially. In a year or two I plan to leave. My accommodation is located in the city of Veliky Novgorod. I want to return to my historical

homeland. Tiksi has a very poor health care. And when the years pass, it is better to think about yourself - to be safe. Because there are not many doctors. In addition, even if something happens, we are in a limited space. In winter, sometimes for weeks planes cannot leave. So, if something happens, then many people here are simply doomed. Here, frankly speaking, the possibilities of medicine are rather limited. Therefore, we must think about the future. It is necessary to get where the logistics are better - to such areas (...) [I will miss] nature - of course. Naturally, I will not see such a thing in the Middle lane. The forest does not bother me anymore. It is precisely the greatness of nature that I feel here. I feel, but there – I don't. Well, and people. I lived here for many years. Left, but nonetheless, anyway ... Although now this, of course, is a trend - people are trying to leave. Especially Slavic nationality."

INTERVIEW 11 QUOTE 133 SD: "Yes, I would like to move to my homeland."

IX.D) QUALITY OF LIFE

INTERVIEW 15 QUOTE 26-1 We plan to leave from here because we have certain plans. We like it in the south, we live in the Krasnodar Krai. But with pleasure I would (in any case, I'm talking about myself) come every two years for 2-3 weeks for excursions. Well, it makes no sense for longer. Because the standard of living ... how to say ... communal, security. We have just very poor supplying here. I believe that they do not give the opportunity to enjoy every year of life here – such is my opinion. My husband and I retired according to our Northern work-experience. But we did not have the required 15 years for the Northern pension, and we have a very small pension. In order to somehow raise it, not by much, we need to work 2 years more. And I would not want my grandchildren to get a life experience here, to see in their development this surrounding environment, ruined houses, poor shop windows, lack of activity clubs/sections, and some kind of entertainment facilities."

INTERVIEW 19 QUOTE 30-4 K: "Someday, yes (I plan to leave Tiksi). Because... I have a dream to live on the lake in Karelia and fish. It's just a dream (laughs) Well ... There, there is a more complex transport infrastructure. There is no year-round opportunity to go somewhere, except for flights. It's difficult to say (if I will do this). My son is 5 years old. I need to teach him, educate him, and then with a clear conscience ... (laughs) ... already pay attention to myself. "

INTERVIEW 23 QUOTE 23-2 B: "All this story with climate change doesn't affect my move. If I am going to move it is because of... how to say it? [What really matters to me] is job, salary, infrastructure, accessibility. There is no leisure here. I cannot say anything bad about education here. My children can go to a local school. How can climate influence my move? If it will be warmer here soon I would rather stay. Why not?" However, he then added: QUOTE 25-6 B: "I am going to move to Yakutsk. For my career. I would like to move forward with youth policy. I would like to develop youth policy, find new prospects."

INTERVIEW 27 QUOTE 43-1 Y: "Regarding the departure. Yes, I plan to move from here, but it does not depend on the climate. My wife now lives in Yakutsk, she works there, she's got a job. When we came here, we thought that we would work here for three years, we would gain experience and move. But it happened that we stayed here a bit, for six years now. Last year, we finally bought an apartment in Yakutsk. And it turns out that our plans are still being implemented slowly. This may happen this year, because this year I will receive a new diploma. And I plan to try to get a job there (Yakutsk) after graduation."

INTERVIEW 26 QUOTE 30-1 P: "So we were told a long time ago that it was Tiksi and Bykovsky who would soon be given to the Russian Federation. That we will fly to Yakutsk through Moscow. We were told something like this. And they also said that [because] they are looking for oil. [And therefore] soon we can either be closed or relocated. But we have already planned. We are doing something. That our children will grow up and somehow...Already have to go somewhere. Because, it seems to me, here either everything will melt, or everything will be closed, everything will be dug up. They said they would probably move to the city, Yakutsk."

INTERVIEW 26 QUOTE 66-1 P: "Of course, it is hard! But it is desirable, of course, if everything is standing, we will live, but I already start sending the children there. We will live here as long as we can live here! And if living here becomes impossible, then we are forced to leave. (If we moved) I would miss meat and fish. The way food is! Basically, we eat it – fish – all year round. For example, in the summer now, we basically get sturgeon – and there are few white fish. And in winter there are more white fish. We eat stroganina year-round! We are used to it – we can't live without it!"

IX.D.I) High prices

INTERVIEW 15 QUOTE 30-4 CM: "Before, 30 years ago, there were greenhouses – the [vegetables] were grown. And dairy products – there was [an animal] farm. And there was a household plot (small private farm from Soviet times)."

INTERVIEW 13 QUOTE 129 SP: "Yes (food became more expensive) due to transportation. They bring it on planes. And during winter in cars. A lot of transport. Especially on airplanes. Fruit vegetables are very expensive. It used to be cheaper, before. There was sea delivery (...) Compare with prices, an apple costs 300 rubles, 400 rubles a kilogram. The potato now costs 120-130-150. Somewhere cheaper, but somewhere more expensive. We have golden vegetables!"

INTERVIEW 15 QUOTE 31-3 L: Previously, we brought groceries directly from Moscow by air. And at there, apparently, prices for transportation were lower and, consequently, there wasn't such a thing, that it was very expensive. And now they are brought from Yakutsk in the winter with winter roads. And in the summer by water. There, by the way, it is inexpensive too, it's cheaper than an airplane. It's just that the entrepreneurs are driving up the prices. Before, the shops were state-owned (...) Of course, before there were subsidies for all prices. Like, the oranges were for the same price as on the mainland. They were not [in shops] there, but here they were. For the residents of the Arctic districts. There was no coffee, but here it was. For 6-7 rubles - I remember. Oranges cost 2.20 rubles. And condensed milk was [in shops] here, but not there. Prices were exactly the same as on the mainland. There couldn't be a difference, otherwise it was a crime. Yes, there were no entrepreneurs. There was another political, economic regime. And now we are buying at prices that are not regulated by anyone."

INTERVIEW 29 QUOTE 65-7 "F: Prices are scary here! One kilo of potatoes is 200 rubles. Apples are 300 or 400 rubles per kilo. The box of eggs is 600 or 700 rubles. What can we do with such prices?"

INTERVIEW 29 QUOTE 67-10 "E: We come here and have to pay high prices. You can only buy one or two things. We cannot afford more."

INTERVIEW 15 QUOTE 29-7 CM: "In the store we may buy only cereals, milk. Although, cereals - we also sometimes order to be brought from Yakutsk. For it to be much cheaper. Because here

the groceries are very expensive and the prices are driven up very much. As for fruits, we also look to ensure that they are slightly lower in price. Because here the prices really do not correspond to our wages."

INTERVIEW 12 QUOTE 5-2 D: "Well, it's hard here. The prices are very expensive here: for food, for flight tickets. For example, for us, for a multi-child family, it is very difficult to travel, like, for vacation or somewhere else."

INTERVIEW 12 QUOTE 20-5 D: "Well, fish – yes (can be affected by climate change and permafrost thaw). And even the reindeers, somehow. It was very difficult with meat - there was nowhere to buy even reindeer. We live here, but couldn't find the reindeer meat. And when they started bringing it from the villages, it was at a very high price. We, for example, are among low-income families. In social security, we are registered as a low-income family. Of course, we are lacking [money]. Because the prices are expensive. There was such case, that potatoes were sold for 250 rubles per kilogram. A dozens of eggs, for example, was 250 rubles, now they have decreased it to 170, because many [shops] have begun to import it."

INTERVIEW 21 QUOTE 16-5 KK: "Here we have expensive food - yes. For example, people come from the central districts. And it's hard for them to adapt, because it's expensive. And we are locals, we fish and hunt. The main products - meat, fish - we get them ourselves. And they have to buy it. Because of it... some [comers] cannot withstand it. Even at the Veterinary Department of our district, several good young specialists left. They arrived and left. They left for the central districts. They are finishing school, arriving here because they were directed here or whatever. They work here for some time. But then they can't withstand. They leave for their central districts."

IX.D.II) Salaries

INTERVIEW 22 QUOTE 27-2 PE: "It is not enough. Everything is expensive here. [For example], our machinery, the snowmobiles cost millions. Those Yamaha snowmobiles cost a million rubles, the cheapest one costs 800 thousand, even 900 thousand rubles with the delivery. Food and gasoline are expensive. 200 thousand rubles are spent on gasoline for one season. In addition, we pay taxes: for the farm, for the licenses, for the weapons. The Northern residents, don't pay transport tax for cars and snowmobiles since this year. Earlier, we were and since this year we

do not pay the transport tax. Almost everything is spent. What we earn, all this money is spent on survival.”

INTERVIEW 23 QUOTE 27-7 B: “The salary is very small. I can start with that. Administrative workers have a small salary. Meat is expensive here. Fish we can take on our own but still you have to buy the fish from people who caught it. It is so called prime cost. I can say it has an influence. I rent a small flat in Tiksi. I pay 15 000 rubles every month, plus utility bills 18.000. Basically I have to pay everything what I have earned. [I earn] 38 000. I have to pay everything. I have no savings.”

INTERVIEW 21 QUOTE 23-2 KK: “Housing expenses are around 10 thousand. I have 17 thousand to pay for bank loan – I bought a snowmobile. And the rest is... I guess, 2500 for the kindergarten. And the rest is anyway spent on food. In short, you can't really make savings – so to say.”

INTERVIEW 2 QUOTE 118-2 A: “About expenses ... My salary is 80,000 at minimum, 35,000 goes to a mortgage for an apartment in Yakutsk (...)”

INTERVIEW 18 QUOTE 14-3 S: “Well, I can say now that anything is left. Nothing of income is left. The family is big – so to say. Yes, there are more expenditures than income.”

INTERVIEW 26 QUOTE 64-1 P: “Yes. We began to work more. For example, when I spent all these 4 years or 5 years at home [on a maternity leave], it turns out that he [Vladimir] earned one salary. And somehow, it turns out, we almost had enough. After all, I also got my feet in, and we started working together. Together. But this is not enough: children are growing, there are many needs, prices are rising. Salary is not rising - only prices are rising. Even on flights, prices are rising by leaps and bounds.”

INTERVIEW 33 QUOTE 83 N: “Well, right now I'm living with my husband. Although he works, our son lives with us. I work, my salary is normal, I get a pension, I think it's enough. So it's enough in terms of income, but actually ... Basically, everything goes to buy products. Well, and to help the children. Help grandchildren.”

IX.D.III) Financial support

INTERVIEW 31 QUOTE 21-3 E: "I live here because my son is a graduate student at Leningrad University. Therefore, I support him financially. In a year or two I plan to leave."

INTERVIEW 31 QUOTE 24-5 E: My salary here is (I don't know whether I can say this or not)

- 50 thousand. Then, when the lunch break is also on Saturday, I give lessons at the Tiksi versatile lyceum. I am a teacher of biology, chemistry, and I also conduct geography there. This is a dozen. I'm also a pensioner. This is 20 thousand. But my son doesn't work. And, despite the fact that he is a graduate student with a budget (he has a stipend), I have to help him, because I pay a mortgage for an apartment, I pay loans. I help, give him life. Even if he moonlights. Parents live on their own, they have enough Northern pension. But I want to tell you that we have enough for food, for clothes, but, for example, there is already not enough for repairs. Here it is very expensive. And there it is expensive. We cannot make [money] for repairs anywhere. We have more or less there, but here the apartment is in a decadent state, to be honest. No household appliances. And all this is expensive."

IX.D.IV) Traditional activities

INTERVIEW 13 QUOTE 120 SP: "Fish, meat, (I obtain it) on my own, and the rest which is fruit and vegetables from the stores."

INTERVIEW 2 QUOTE 118-2 A: About expenses ... My salary is 80,000 at minimum, 35,000 goes to a mortgage for an apartment in Yakutsk. Then here it will already be more. Every day, probably, a thousand will be spent in Tiksi. In Taimylyr I was buying and sending supplies for about 100,000, products like pasta, canned food because there is meat, fish of our own. And in Tiksi there is nothing of our own."

INTERVIEW 27 QUOTE 45-1 Y: "Food production by traditional means - hunting - reduces the expenses of the family budget by almost the half. Because meat, for example, in Yakutsk is very expensive. Not only in Yakutsk, but everywhere meat is very expensive. Here you can get this

meat yourself. For the whole winter stock up on him. Meat, poultry, fish - this is all, firstly, its own - a natural, environmentally friendly product, everything is dietary. But it is not completely free, because in order to get it, you still need to have expenses. But at the same time, it covers all these expenses many times. Yes, this is my traditional food. By this, I can say, I live."

INTERVIEW 29 QUOTE 63-21 "F: yes! We depend on fish. This is our main economic sector."

INTERVIEW 24 QUOTE 28-2 IK: "I can say that they [local resources] are quite helpful [for my economy]. Yes, I eat fish and meat every day. Vegetables are all imported, so they are very expensive. There is no wide choice here. Food ration consists of fish and meat mainly. The locals don't eat lots of vegetables. They are not accustomed to it. It has never been the part of the food ration."

INTERVIEW 25 QUOTE 6-18 K: "Domestic reindeer is sold by people from Khara-Ulakh (Naiba) or Borogon (Namy). We buy it. Sometimes we buy wild reindeer."

INTERVIEW 24 QUOTE 31-1 IK: "Yes, of course [it helps make some economies]. If you hunt the reindeer, for example, you don't have to pay much. You just have to buy a license. You can make some economies, so. If you go fishing you don't need a net license. You can have the same net for one year. I have a net and go fishing. Go hunting is a bit too far for me."

INTERVIEW 28 QUOTE 8-3 SE: "If the fish will be - everything will be."

INTERVIEW 21 QUOTE 22-5 KK: "More than 50% - this I know for sure. It's meat and fish."

INTERVIEW 2 QUOTE 122-2 A: "If there is no fish, then... No fish (we cannot catch it) - we cannot live without it. If there is no reindeer... No reindeer - we cannot live without it. We eat reindeer meat every day. Fish ... In winter, stroganina is also eaten every day. But in overall, all meals are with fish and meat."

INTERVIEW 21 QUOTE 16-4 KK: "I am all of that (reindeer herder, fisher, veterinary), in all categories, as they say. I am closely connected with the agriculture. Because without reindeer, without meat, without fish in our northern district, in Arctic Districts, it is difficult."

INTERVIEW 29 QUOTE 69-13 E: "I am often asked if the fishermen deliver all fish that they caught."

(we talked about it yesterday). They deliver the part of fish according to the plan. They keep part of fish for their families. It is not only for food. They can exchange it for something, for example. Their salaries are too small. Fish is not only the basis of the salary. It is the basis of well-being. It is for food and other things."

INTERVIEW 29 QUOTE 69-2 "E: We talked about it already. We know that farm -gate price for fish is 60 rubles per kilo. The collective farm sells it 260 rubles per kilo. The price in Yakutsk is 500 -600 rubles. In the eve of the New Year it can reach 1000 rubles. On the other hand, it is understandable. It includes storage and transportation price and other costs that influence price setting. I mean, I don't want to cause any harm to Kolkhoz in anyway. This economic sector is the only one here. It is like reindeer breeding in Kyusyur and Borogon."

INTERVIEW 24 QUOTE 20-9 IK: "I think that this thawing can affect reindeer – breeding in Taymir. Swamps and holes can appear because of that. It affects reindeer more than fish. They can only change the migration paths. In any case the reindeer goes to the sea in summer. Fish and reindeer are the main food supplies. (laughs) There are no cows, no pigs and no sheep here."

IX.D.V) Share and support network

INTERVIEW 2 QUOTE 6-1 A: "Life in the village is like this: calm and even. In fact, all people support each other. Because they are separated from everything (...) These are the ones ... [mumbling] Human qualities are very much appreciated. Helping each other. Well, the life of residents is directly dependent on natural conditions."

INTERVIEW 24 QUOTE 31-7 IK: "K: We go fishing and treat each other, yes, we share it. Sometimes we buy it."

INTERVIEW 29 QUOTE 72-1 "F: You know what? Our people live in the old good times. We help each other. We support newcomers and treat them well. We can just give it to him. We will not sell it. We will just give it. Yes, this is a kind of tradition (...) All people provide each other and so."

INTERVIEW 2 QUOTE 246-1 A: These type of relations is the specifics of the north. Yes. because the distances are so big here. We cannot live without mutual support. For example, the distances

people from Churapchinsky district (when there was a massive resettlement). They mostly died at the time when they were sailing. And when they arrived here, all of them were ... supported by locals. Everyone supported, they all lived. Locals taught them everything and everything was fine."

INTERVIEW 25 QUOTE 38-1 K: "There are only women in our household now. There is no man. My brother brings us some fish. He goes fishing and he leaves us some. Some people treat us from time to time. They treat us with meat sometimes, but it is not enough. We buy meat too. We buy meat for sure (...) We don't spend much on fish and meat. It makes some economies on the one hand. It is good that the brother visits us from time to time. He makes a stock of firewood for us. If he didn't help us we would have to buy it all. We would have to make an arrangement with someone about firewood."

INTERVIEW 15 QUOTE 29-2 L: "I never buy meat and fish. Because I am a local person. They send me meat and fish. Also the berries, jams. Well, all that is needed. Even sour cream and cottage cheese –there are cows in Borogon. Here I may buy only fruits and vegetables."

INTERVIEW 18 QUOTE 12-4 S: "I don't hunt because I don't have a rifle, I didn't do the licenses, I didn't buy a rifle. Meat and fish we, kind of, get from our relatives." He estimated that he buys only 25% of the total products that they consume in their household while the remaining 75% is obtained through their social network – mainly relatives-.

INTERVIEW 11 QUOTE 149 SD: "Well, relatives send us meat and fish. Nothing bothers us in this sense. "

INTERVIEW 14 QUOTE 138 AI: "Fish and meat, of course - because we have a lot of relatives here ... And my brother is also a reindeer herder, he can at least send meat and fish there from the lodge. So we do eat, of course. Well, he was a reindeer herder, but there, too, the reindeer herders had a small salary, so he left and went fishing now."

INTERVIEW 39 QUOTE 6-2 D: "Relatives in the villages - probably. I have only mother, I don't have a dad. [My relatives] from the father's side are all in the village; and everyone from the mother's side has moved to Yakutsk. [Relatives] from my father's side they help: they send fish.

Just like that.”

INTERVIEW 31 QUOTE 25-5 E: “I don’t have anyone in the village. Therefore, we buy in stores. But, since I am one woman, I do not go much for this. I am not obsessed with meat. And the fish is like for periods: probably, in the polar winter you want it, because there is not enough vitamin D, you need fish oil. Therefore, you want it. And there are other periods when I am completely indifferent to it, for example, at the moment (...) Moreover, if possible, we take them in bags. That is, we agree with someone on Whatsapp in the buy- sell groups and that's it. They offer fish there, I called, the delivery came and I paid. Not even from the store. It is profitable and they brought me fresh fish that floated there yesterday. We have such groups.”

INTERVIEW 18 QUOTE 15-4 S: “No, they don’t sell. There, you can buy it only from a private [trader], that deals with it. Because nobody wants to (buy in a shop) ... well, nobody would buy it in Taimylyr, they will rather ask somebody to get it in debt, kind of, or for free.”

INTERVIEW 21 QUOTE 20-5 KK: “We have, well ... everywhere probably there is a barter [exchange] anyway. For example, the businessmen come from Yakutsk. For example, they bring furniture or something like that; and they exchange it for fish. Or on machinery, on snowmobiles. Barter.”

INTERVIEW 8 QUOTE 117 S: “Well, we obtain meat, fish in advance every summer - friends give it to us. And so from the store you can buy pasta, fruit, butter.”

INTERVIEW 15 QUOTE 29-5 LM: “For example, meat, fish, berries - like Lyubov – we buy everything that is brought from the villages. As if, we order in the village and it is delivered here. In the store we may buy only cereals, milk. Although, cereals -we also sometimes order to be brought from Yakutsk. For it to be much cheaper. Because here the groceries are very expensive and the prices are driven up very much. As for fruits, we also look to ensure that they are slightly lower in price. Because here the prices really do not correspond to our wages.”

INTERVIEW 28 QUOTE 34-25 SH: “We (Association of the Indigenous Peoples of the North of Republic of Sakha), like a public organization sometimes we can have contacts with University, with Instituted, with authorities. And we can represent our people and can defend their rights or

their interests. And sometimes we can make some arrangement and we can make some decisions. With a help of the Indigenous People's (Association), the children can study. Because we are too far. And also, our children they are not used to the difficulties. Once they go to Yakutsk, when they are in difficulties, even when they are nearit, they just slowpoke (laughs). They run back home. Probably their behavior of running away in tundra settled firmly in them. Also, they are in the "greenhouse conditions" here. Their parents are here and help them".

IX.D.VI) Forced displacement

INTERVIEW 1 QUOTE 148 K: "We will not take any measures about Bykovsky, it's not practicable in economic terms. The fact is that all the buildings there are wooden. You know, wooden building last for 25 years only. The rate of erosion allows us to move the village away from the sea, deeper and deeper into the land (...) You know, here ice doesn'tmelt, it gets carried away. And if we put a barge, it's nothing – like a small piece of wood. Next year you won't see this barge – it'll be carried away to the sea as well. There is an anchorage there, you should see, and it was all fortified with barges on barges, but everything got lost..."

INTERVIEW 28 QUOTE 26-2 S: "It can happen [that the settlement will disappear]. If there will be no fish, it can happen. We will be relocated to Tiksi. For people with children it could be good. Their children will study there and so on. And where else? If nearly 40 children willstay, they will enroll them anyway. For example, in Tumat, Tumat was closed and in 1975 people were relocated to Bykovsky. But the eldest stayed. My parents and others stayed there, around 30-40 people stayed. And we studied in the boarding school. The last ones tomove out from Tumat were my parents, after the 80s because they were not hunting anymore. They were hunting polar foxes there. They all aged and got mentally and physically tired. They could not keep it up anymore. So they moved here to their children.

The same will happen to Bykovsky too. In case of the displacement, people with children will move out, and some locals will have to stay and will die out here (...) I don't have feelings [about it]. It doesn't depend on one person. It is a pace of life. If they close the school, the kindergarten, people will leave without asking it from you. Some will move tothe city, to their relatives. Some to Kyusyur, some to Tiksi. A few will stay here. Of course (traditions could be somehow lost). It

would be like this. Here, before us, Yukagirs were living, they say. Like people from Tymeti and others (say). They also moved out. It will be similar”.

INTERVIEW 24 QUOTE 17-1 IK: “It [displacement] is possible. Tundra is big, they will move there. The south part of it is a trash deposit. Well, you can move behind the trash deposit, it is not the only one direction. You can just replace the village 3 km away. It is not attached to highways or something like that. Ships from Lena go along this river bank to Yakutsk.

There is an anchor hold over there. But when it is not navigation time they [cargos] are delivered by ice roads. There is no highway service here. Winter roads are on the ice of the bay. The river is navigable here up to Tiksi. Ships enter from the river and they go through Neelov up to Tiksi. They can take a detour on the sea side and go to Tiksi. The principle is the same. There is no change for Bykovsky (...) There is not such a huge volume of cargo that village would be so much dependent on it. The ships go by Northern Sea Route to Tiksi. They are unloaded there. You can bring whatever you want by ice roads. Mainly goods go to Tiksi, and after that they can wait for the ice-road to open and bring goods through the ice-road.”

IX.D.VII) Investments for developing Northern settlements

INTERVIEW 34 QUOTE 15 E: “Well, with us, as you say, all the same, these sectors have maintained their development - they are developing, fishing is developing, and reindeer husbandry are developing. Everything is supported by the government.”

INT 25 QUOTE 20-1 K: “I’m not very sure [that we can do something about coastal erosion] On our own? I don’t think so (...) Yes, there are some things that they do but the authorities often say that they don’t have enough funds for it. There are just 500 inhabitants here, so the government will not grant millions.”

INTERVIEW 15 QUOTE 39-7 T: “Moreover, unfortunately, little depends on the population. Only some kind of state programs, some kind of exploration of the subsoils - this is the only thing that can help our wonderful settlement.”

INTERVIEW 21 QUOTE 1-5 KK: “Two years ago, the financing of domestic reindeer breeding had changed. It used to be given for a type of herd, they gave money for the whole herd.

And due to the fact that we did not have 1000 reindeers... It was in the zone tundra, forest-tundra, taiga. I guess, our district was part of the tundra zone. Due to this, we had to have 1,100 deer to receive this subsidy. And two years ago, financing has changed, and the structure has changed. Because of this, they subsidize for each deer. Well, I mean, now they give a subsidy for the 1 reindeer. And because of this, it has become more convenient: small farms can receive this subsidy. Three years ago, after the financing changed, in my village, in Kyusyur, there were three Indigenous family communes, that engaged in reindeer husbandry. Earlier, they could not create a farm - there was no support, funding. And now there is support, the structure has changed and it has become good [for them]."

INTERVIEW 17 QUOTE 12-2 T: "Concerning reindeer herding, I think, there should be such measure, with which the reindeer herding will be fully taken under the budget of Russia. There are just a few people, a few of us. Even all around Northern Russia, there are so few of our people, who herd reindeer. And our reindeer herding has no economic effect for the budget of Russia. It has nothing at all! It can only be as a preservation of us, of people, of ethnicity. Yes. It is mainly needed for the improve of Russia's image. Like, they have such people, preserve them and sustain them in the same way as they used to be some time ago. So they would not speak of us as we went extinct. For example, in New Zealand there were some, which [went extinct]]. By paying money. [If they could do something] by paying lots of money. But of course it has been thought over."

INTERVIEW 21 QUOTE 4-5 KK: "We had a flood, I guess 4 years ago. In the area slightly downstream from Kyusyur was a flood - in Yute-Khaya. It didn't get to Tit-Aryy. Tit-Ara had an ice-clogging. And in these fishing grounds of MUP "Bulunsky": houses, snowmobiles, quadricycles - everything went under water. They [the Government] also allocated funds for that. An ice-cellar for 500 tons was built (the old ice-cellar was also taken by water). The Ministry of Agriculture also gave money for the reconstruction of the ice-cellar.

IX.D.VIII) Adaptation

INTERVIEW 25 QUOTE 22-3 SH: "She says: "what do you mean by 'to adapt'?" It didn't happen, for example, today unexpectedly - it is happening very slowly, step-by-step, not so unexpectedly for them. For example, they don't think about replacing it today or tomorrow - maybe it will

happen 10-20 years later. That is why we can't say that it possible to be adapted to it. Because it takes more time."

IX.D.VIII.I) Best adapted

INTERVIEW 13 QUOTE 161 SP: "Impossible (to adapt), probably. If the ice thaws, then what will you do? This is not a refrigerator ... There is no freezer."

INTERVIEW 13 QUOTE 7 PS: "I am local, Evenki, Indigenous. I was born here. During childhood I was in the herds. I grew up there. I studied in the school of Kyusyur from which I graduated. And I graduated from the agricultural college, the veterinary department (...)"

INTERVIEW 8 QUOTE 88 S: "Well, here the northern ones probably. They will not be cold. Heat too could probably be better. Well, reindeer herders in the first place. They live therein yurts, not in houses. Everything is manual. Everything is developed from improvised means.

INTERVIEW 12 QUOTE 17-5 D: "Well, I will do well, because I have a husband who grew up in the village, lived on the fishing-ground and fished. He knows everything: fishing, hunting, and so on. We will have no problems with this, I believe. And those who are accustomed to comfort, constant life in apartments with modern amenities and so on. It seems to me that they will have something, you know, something like ... It will be more difficult for them. And for those who came here – who are not natives, nor locals. There are many comers who live and work here. I think it will be more difficult for them. "

INTERVIEW 15 QUOTE 24-11 L: "It seems to me that locals will still adapt better than comers. Because someone's health is not very good, someone is affected: issues with blood pressure before the blizzard. Well, maybe there are people with meteosensitivity."

IX.D.VIII.II) Traditional activities and animals

INTERVIEW 17 QUOTE 3-2 T: "T: Well, it's also that traditionally, maybe genetically, the local Indigenous People, they cannot be like Europeans, like people from Central Russia, even like people from Central Yakutia. A very big difference is among them. Even inside of Yakutia people are very different: we can misunderstand, reject each other. A person from over there might not

fit in well. A reindeer herder that worked all his life, he [cannot] become a cattle-breeder, or someone else, over there. It is a very difficult question, that requires research. I don't know now, how it [adaptation] will possibly be done. Therefore, I think that the same 40 thousand reindeers won't be restored. Maybe it will be possible to buy reindeer, but people, who work with reindeer – reindeer herders – you cannot find them. You cannot accustom reindeer herding like driving. It's not some sort of specialization, it is just a lifestyle."

INTERVIEW 25 QUOTE 48-1 K: "Yes, for sure (it can affect the culture). If people move to Tiksi they will find that working there is different. You have to work by the hour there.

Fishermen cannot work like that. They work during fishing season and then they come back. This is their working arrangement. They go to winter fishing, they come back. I always mention our hunters. They can literally work three months in a year. If we speak about hunting zibeline. But just imagine. In spite of the temperature – 40, -50 or -60, storms, blizzards, whatever – you have to go and check the traps. And just think about these traps. They are made of steel. They are frozen – it is 50 in below. They have to fix them anyway.

They get cold injuries and so on. Afterwards, they come to a cabin, which is totally frozen -all the way through. During blizzards they can fall into ice field (naled) – everything may happen."

INTERVIEW 21 QUOTE 17-3 KK: And about (the future of) reindeer herding, it is a difficult question. I already said before: the average age of a reindeer herder is 55 years. There are no young specialists. This structure ... well, how to say – is under [threat]. If there is no youth, then there will be nobody to take care of [reindeer]... Well, there will be no one, there will be no reindeer."

INTERVIEW 28 QUOTE 14-3 SE: "Us, we continue to live following what type of environment occurs: maybe it will snow, maybe we could even live in an eternal winter –we, the inhabitants, don't care about it. We care of course, but you cannot do anything with what nature does – no way you can stand in front of it and dispute. Like our ancestors, we should continue living in way that it is suitable for the period that comes. You continue adapting."

INTERVIEW 18 QUOTE 9-2 S: "I don't know. Only if to have the forage reserves. Make reserves

for future. For animals. Because I think that animals will, probably, not be able adapt to this ice-crust in the near future. Well, I don't know. I don't think there will be such a big change that it will be impossible to adapt. Everybody will adapt, probably. Even the urban population – everybody will."

INTERVIEW 21 QUOTE 15-8 KK: "When it is too warm they feel bad. They can't breathe. The[skin] is not letting [the heat] out. Because their skin is all closed. So when it is too warm... If it is too warm... We have tall mountains, there is snow on top. There is snow, for example. So they go there to cool down, they lay down there – mostly young reindeer do so. And so little reindeer suffer from bronchopneumonia in summer. It happens. It is not something critical, but... If it is too warm, the morbidity will increase anyway."

INTERVIEW 22 QUOTE 19-5 PE: "It's likely, that people will quickly adapt to changes. I don't know how animals will. Due to climate change, maybe they will not have food, maybe the reindeer-lichen will finish, maybe there will be the heat, some epidemic might start. And they can disappear. The reindeer, if they won't have reindeer-lichen. [Or if] the reindeer-lichen changes."

INTERVIEW 8 QUOTE 43 S: "(...) They say now something has changed. They (reindeerherders) can now even watch TV. They have satellite phone. Previously, they had big radios."

IX.D.VIII.III) Technical and material adaptive strategies

INTERVIEW 1 QUOTE 176 K: "I had a proposal – why can't we include the airstrip maintenance in the cost of contracts with road builders. For them it'll be really easy, and won't cost a lot of money. It will be less problematic than concluding a contract for 500,000 rubles with contractors who don't even have a tractor. They won't carry earth in pales, right? But if you give just 150,000 rubles to road builders, it's no big money for them, but they will maintain the airstrip. It would be a good solution, but... We were trying to pass the proposal on this strategy through the State Duma, but it's not been considered yet."

INTERVIEW 21 QUOTE 5-15 KK: I asked (we are losing reindeer), for example, reindeers are getting lost. Here, the migration of wild reindeer is studied by Innokenty Mikhailovich Okhlopkov. I talked with him about these electronic GPS-collars so that we could see reindeer from a satellite. It turns out that this collar itself costs something like 70-80 thousand rubles. And as he said - its

battery does not change, you have to buy a new one. Because of this, it turns out to be very costly for us. We cannot afford to buy these collars. But if there were such [with changing batteries], we would always know where our reindeers are, where in which area they are."

INT 19 QUOTE 14-9 K: "Again, because of this thawing, in the villages now, because of the economic component, they cannot abandon ice cellars. They thaw, it's necessary to clean them. In Tiksi, everyone basically switched to refrigerators in order not to bother with all this (...) Well, let's say so (it is possible to adapt). Depends on the economic condition of each person or their economy. Either they will also switch to refrigerators. Or they will have a more laborious deepening, cleaning, primary freezing, glazing of this ice cellars. Or all the large farms - I think - will nevertheless move over time (we have already begun partially. In Tit-Ary, we already have, let's say) shock freezing. It immediately freezes the fish at -20 degrees."

INTERVIEW 21 QUOTE 5-22 KK: "And I asked him: "Why we don't have such thing, like in Finland, why can't we watch?!" But it turns out that we do not have [sufficient] mobile coverage in the Republic (of Sakha). And in Finland you can make calls through a cell phone everywhere. The SIM-card is put in each reindeer and they can watch like this - as he explained to me. If there would be a coverage, it would even be possible to call from a cell phone [to your reindeer?]. Sometimes, even in the settlement, we can't call sometimes, [for example] if it rains or something. Needless to say about the Internet: there is no Internet. Mobile internet is slow."

INTERVIEW 25 QUOTE 33-1 K: "They set more nets. They increase the amount of work. If there is lots of fish, they set 50 nets. If there is a little of fish, they set 200 nets. I have something to add about this. Ten years ago a group of 3 fishermen would set 60 nets. This was a maximal number of the nets. There was not possibility to take care of bigger number of the nets. The capture level was much higher. A group of 3 fisherman sets 120 nets now. They increase the amount of work twice. But at the same time the capture level decreased because of the smaller number of fish."

INTERVIEW 2 QUOTE 245-1 A: "We also have the program "Introduction of musk ox." This is a republican program. They brought musk oxen from Canada and released them in the Anabar tundra, Chokurdakh and in Chekanovsky ridge. Near Tchai-Tumus. 2 years ago. In four places in Yakutia. This is in order to preserve biodiversity, on the one hand. On the other hand, even 20

years ago we discussed that one musk ox is almost half a ton of meat. And one reindeer is 50 kilograms of meat. We thought that, if the musk ox acclimatizes, after 10-15 years, their number will become as big, that it will be already possible to hunt them. And this, perhaps, will allow, inter alia, to solve the problem of food products. But we cannot say that they reproduce very successfully. They adapted, they multiply, but not at the pace that we expected."

INTERVIEW 23 QUOTE 18-6 B: "Well, if the coast is about to fall it can destroy the houses. In this case I can say that there is an influence on me. We had some houses fallen this year, Anton, didn't we? Some works should be done to reinforce the constructions. I mean to reinforce the shore. It can be done with aluminum nets, for example. They tried to do something, didn't they?"

INTERVIEW 2 QUOTE 88-1 A: "We are talking about activities, shore protection work. (In a longer term) Resettlement...Partially. Construction of houses which will be not affected by permafrost thaw."

INTERVIEW 27 QUOTE 41-1 Y: "Risks. This is the reduction of land from the cape, that is, the reduction of the village from the cape. And in the future, for example, if we build a village in the direction of the tundra, then we have sanitary facilities there. It turns out that the village needs to be moved beyond the sanitary point deep into the tundra. But, again, it will be more difficult to access for boats. Because the fairway passes for the cape for this.

Therefore, ships coming to us, it is easier for them to stop here. The solutions, I think, the only possibility remains to somehow strengthen the coast. Or pour it off. Or strengthen it with engineering structures. Or install breakwaters. Because a very large volume of the Earth's edge removes ice and strong waves. In order to stop this ice, these waves - you can install breakwaters. But once again, our depth interferes, deep enough on the cape. But if you install them near the coast, then, I think, you can somehow deal with this problem."

INTERVIEW 25 QUOTE 27-2 K: "We have never had a road to Tiksi. We go there by boat in summer, by ice in winter and along the shore in autumn."

INTERVIEW 25 QUOTE 31-2 K: "I have a flat in Tiksi, for instance. I can move there is there is no place to go."

INTERVIEW 25 QUOTE 48-1 K: "Yes, for sure. If people move to Tiksi they will find that working there is different. You have to work by the hour there. Fishermen cannot work like that. They work during fishing season and then they come back. This is their working arrangement. They go to winter fishing, they come back".

INTERVIEW 22 QUOTE 30-2 PE: Well, we're waiting for time when it gets thicker. And you wait, you study the places: where the ice is good, and where is the water, you mark the dangerous places, you drive on snowmobile, and so on.

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