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Ethnobiologie et ethnomédecine des Peuples premiers d'Amérique (Cris d'Eeyou Istchee, Parikwene et Pekuakamilnuatsh) : l'impact de l'alimentation et des médecines locales sur la santé et le bien-être des diabétiques

Michael Rapinski

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Laboratoire Ecologie, Evolution, Interactions
des Systèmes amazoniens | CNRS-UG-IFREMER



Institut de recherche
en biologie végétale

**Université
de Montréal**

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**Ethnobiologie et ethnomédecine des Peuples premiers
d'Amérique (Cris d'Eeyou Istchee, Parikwene et
Pekuakamilnuatsh) :**
**l'impact de l'alimentation et des médecines locales sur la
santé et le bien-être des diabétiques**

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Résumé

Les Peuples autochtones à travers le monde sont disproportionnellement touchés par le diabète. Parmi ces peuples, les Cris d'Eeyou Istchee et les Pekuakamilnuatsh, au Québec (Canada), ainsi que les Parikwene, en Guyane française (France), recourent à leur médecine locale pour soigner cette maladie. En 173 entrevues semi-dirigées, 208 participants venant de ces communautés et/ou travaillant dans leurs services de santé ont décrit ces médecines. Une méthode de recherche mixte, combinant des analyses thématiques à des statistiques multivariées, est développée pour analyser ces descriptions.

Ces analyses ont montré que les participants cris, ilnu et parikwene décrivent leurs médecines en lien avec le diabète tant par les différents éléments du monde naturel, que les pratiques et coutumes locales qui en découlent, que les concepts les liant au territoire. Les pharmacopées à base animales et végétales font parties des thèmes les plus discutés. Plus de 381 espèces (109 animaux, 267 plantes, cinq lichens et champignons) lient les systèmes médicinales et alimentaires ensemble via des notions associées au bien-être ou aux propriétés organoleptiques. Au Québec, là où la population autochtone est plus impliquée dans les services de santé, il existe un rapprochement de la description des médecines locales entre le secteur de la santé et ses usagers.

De façon générale, la place de l'alimentation dans les médecines locales ne peut être négligée dans le contexte du diabète. De plus, ces médecines sont indissociables du territoire qui offre un espace de guérison, de subsistance, et de continuité culturelle. Cela renvoie, *in fine*, à des questions importantes sur la reconnaissance des droits autochtones et des droits fonciers.

Mots-clés : diabète ; ethnobiologie ; ethnomédecine ; méthodes de recherche mixtes ; Peuples autochtones ; Québec ; Guyane française.

Abstract

Indigenous Peoples around the world are disproportionately affected by diabetes. Amongst them, the Cree of Eeyou Istchee and the Pekuakamilnuatsh, from Québec (Canada), and the Parikwene, from French Guiana (France), resort to their local medicines to treat this disease. In 173 semi-structured interviews, 208 participants from these communities and/or working in their healthcare services described these medicines. A mixed-methods research approach, combining thematic analyses with multivariate statistics, was developed to analyse these descriptions.

These analyses showed that Cree, Innu and Parikwene participants described their medicines related to diabetes through different elements of the natural world, the local practices and customs which result from them, as well as concepts linking them to the Land. Animal and plant-based pharmacopoeias are among the most discussed topics. In total, more than 381 species cited, including 109 animals, 267 plants, as well as five lichens and mushrooms, link the local dietary and medicinal systems together via notions associated with well-being or their organoleptic properties. In Québec, where Indigenous Peoples are more involved in their healthcare services, the representation of local medicines is much closer between healthcare workers and users.

In general, the place of food in local medicines cannot be neglected in the context of diabetes. In addition, these medicines are inseparable from the Land which offers a space for healing, subsistence, and cultural continuity. This brings up important questions about the recognition of Indigenous rights and land rights.

Key words: diabetes; ethnobiology; ethnomedecine; mixed-methods research; Indigenous Peoples; Québec; French Guiana.

Table des matières

Résumé.....	i
Abstract.....	iii
Table des matières.....	v
Liste des tableaux.....	ix
Liste des figures.....	xi
Liste des abréviations.....	xiii
Remerciements.....	xvii
Introduction.....	1
Introduction au diabète.....	2
Diabète chez les Peuples Premiers des Amériques.....	5
Approches alternatives ou complémentaires.....	11
Anthropologie médicale et ethnomédecine.....	14
Ethnobiologie.....	16
Quelques précisions sur les définitions de « médecine ».....	19
Le Protocole de Nagoya et « l’affaire couachi ».....	21
Objectifs du projet et hypothèses de travail.....	26
Chapitre 1 - Contexte ethnomédicinale et ethnobiologique concernant les Cris d’Eeyou Istchee, les Pekuakamilnuatsh et les Parikwene.....	31
1.1 Les systèmes de santé.....	32
1.1.1 Le système de santé canadien.....	33
1.1.2 Le système de santé français.....	34
1.1.3 La santé des Peuples autochtones.....	36
1.1.4 La santé communautaire dans les systèmes de santé.....	40
1.1.5 La santé communautaire institutionnalisée.....	42
1.1.6 La santé communautaire « in-formalisée ».....	45
1.2 La santé autochtone : une structure de santé communautaire.....	47
1.2.1 Cris d’Eeyou Istchee (Québec, Canada).....	49
1.2.2 Inlu de Mashteuiatsh (Québec, Canada).....	52
1.2.3 Parikwene (Guyane française, France).....	54
1.3 Les médecines des Peuples des Amériques.....	56
1.3.1 Cris d’Eeyou Istchee et Pekuakamiulnuatsh (Québec, Canada).....	56
1.3.2 Parikwene (Guyane française, France).....	66

1.4	Conclusion	72
Chapitre 2 - Using Unconstrained Ordinations to Analyze Qualitative Information from Interviews in a Mixed Methods Ethnomedicinal Study Relating to Human Health		
2.1	Résumé / Abstract	74
2.2	Introduction.....	76
2.2.1	Broader theoretical context.....	76
2.2.2	Field-specific context.....	78
2.2.3	Methodological and empirical objectives	81
2.3	Materials and Methods.....	82
2.3.1	Methodological Framework.....	82
2.3.2	Community Consultations	93
2.3.3	Data Analyses	94
2.4	Results.....	100
2.5	Discussion.....	111
2.5.1	Advantages and limits.....	111
2.5.2	What doors do these methods open?.....	115
2.6	Conclusion and Final Considerations	118
2.7	Acknowledgments.....	120
Chapitre 3 - Giving a voice to diabetes “the silent killer” in French Guiana’s Parikwene population		
3.1	Résumé / Abstract	122
3.2	Introduction.....	124
3.3	Materials and Methods.....	127
3.3.1	Ethnographic background	127
3.3.2	Biomedical Systems.....	128
3.3.3	Consultations.....	129
3.3.4	Data collection	129
3.3.5	Data Analyses	131
3.4	Results.....	133
3.4.1	Knowledge of the disease	133
3.4.2	Knowledge of treatment.....	147
3.4.3	Attitudes towards the illness	148
3.4.4	Practices	150
3.4.5	Dietary adaptations	162
3.4.6	Animal and plant-based medicines and remedies.....	174

3.4.7	Spiritual interventions.....	182
3.5	Discussion.....	184
3.5.1	Knowledge.....	184
3.5.2	Attitudes.....	187
3.5.3	Practices.....	190
3.6	Conclusion.....	200
3.7	Acknowledgements.....	202
Chapitre 4 - Defining Indigenous medicine in three First Nations (Mashteuiatsh, Mistissini and Chisasibi) in the Canadian province of Québec: recognising the barrier of representation between healthcare staff and healthcare users.....		
4.1	Résumé / Abstract.....	204
4.2	Introduction.....	206
4.3	Materials and Methods.....	208
4.3.1	Study Sites.....	208
4.3.2	Community Consultations.....	212
4.3.3	Data Collection.....	213
4.3.4	Data Analyses.....	214
4.4	Results.....	216
4.4.1	A harmonized and general model of Cree and Innu medicine.....	216
4.4.2	A medical system based on access and connection to the Land.....	223
4.4.3	Land-based healing and diabetes.....	244
4.4.4	Indigenous medicines, unique in their own right.....	250
4.5	Discussion.....	257
4.5.1	Indigenous medicinal systems adapted for lifestyle diseases.....	257
4.5.2	Understanding Local Needs.....	264
4.5.3	What does greater representation of Indigenous medicine look like?.....	271
4.6	Conclusions.....	274
4.7	Acknowledgements.....	276
Chapitre 5 - Treating Diabetes and the representation of the People's Medicine in the healthcare sector: a cross-cultural comparison of Indigenous medicines in the Americas.....		
5.1	Résumé / Abstract.....	280
5.2	Introduction.....	282
5.3	Materials and Methods.....	285
5.3.1	Study Sites.....	285
5.3.2	Community consultations.....	287

5.3.3	Data Collection	288
5.3.4	Data analyses	289
5.4	Results.....	290
5.5	Discussion.....	301
5.5.1	Indigenous medicines in the wake of colonial legacies.....	301
5.5.2	Indigenous medicinal systems: unique in their own right	307
5.6	Conclusions.....	311
5.7	Acknowledgments.....	312
Considérations finales.....		313
	Les limites et les avantages des méthodes mixtes	315
	La médecine et la santé, une question foncière.....	317
	Quelques pistes de réflexion... ..	321
	Perspectives de recherche	325
Bibliographie.....		329
Annexe 1. Certificat d'éthique.....		409
Annexe 2. Exemple de script dans R		411
Annexe 3. Liste complète des espèces citées.....		415

Liste des tableaux

Table 0.1. Date des rencontres avec les Chefs coutumiers parikwene de Saint-Georges et Macouria.	25
Table 1.1. Comparaison entre le système de santé français et canadien en lien avec les populations autochtones.	37
Table 1.2. Comparaison entre médecine classique, santé publique et santé communautaire selon Conill and O’Neill (1984).	43
Table 1.3. Initiatives et actions pouvant être entreprises pour supporter les processus d’autochtonisation selon Viger (2011).	51
Table 2.1. Typical terms employed in quantitative disciplines (<i>i.e.</i> , ecology) and qualitative disciplines (<i>i.e.</i> , sociology) to describe the numerical representation of information.	84
Table 2.2. Participant categories.	94
Table 2.3. Regrouped themes under general themes regarding plants and animals after focused coding during the thematic analysis step of “best-fit” synthesis.	109
Table 2.4. Statistical results for three different models of tb-RDA on themes.	110
Table 3.1. Interview breakdown by communities and description of participant categories.	130
Table 3.2. Types of diabetes based on sex and colour in the local Parikwene classification. ...	134
Table 3.3. Symptoms, complications and problems associated with diabetes listed by Parikwene participants from the communes of Saint-Georges and Macouria.	135
Table 3.4. Relative frequency of citations (%) of the factors responsible with the development of diabetes.	143
Table 3.5. Dietary and medicinal animal and plant species cited by Parikwene participants from Macouria and Saint-Georges.	151

Table 3.6. Food items (animals and plants) cited by Parikwene participants from Macouria and Saint-Georges.....	166
Table 3.7. Animal and plant species cited by Parikwene participants from Macouria and Saint-Georges in the treatment of diabetes and its symptoms.....	175
Table 4.1. Interview breakdown by communities and description of participant categories.....	212
Table 4.2. Overarching themes and concepts, illustrated in Figure 4.3 , in the languages of each community.	219
Table 4.3. Names of plant and animal species mentioned as part of the local medicinal practices and systems of the Pekuakamilnuatsh and the Cree of Eeyou Istchee.	225
Table 4.4. Breakdown of plant and animal species mentioned by participants from Mashteuiatsh, Mistissini and Chisasibi as part of their local medicinal practices and systems.....	234
Table 4.5. Plant and animal types and parts mentioned by participants from Mashteuiatsh, Mistissini and Chisasibi.	240
Table 4.6. List of preparations, ceremonies, rituals and practices, land-use activities as well as arts and crafts cited by participants from Mashteuiatsh, Mistissini and Chisasibi.....	242
Table 5.1. Interview breakdown by communities and description of participant categories.....	287
Table 5.2. Animal and plant types and parts mentioned by all Indigenous participants as part of their local medicinal practices and systems.	291
Table 5.3. List of preparations, land-use activities, ceremonies, rituals, and practices cited by all Indigenous participants.	292

Liste des figures

Figure 2.1. Visual representation of the evolution of a scatterplot to an ordination.....	83
Figure 2.2. Comparison of datasets of numerical and thematic datasets.	86
Figure 2.3. The species abundance paradox illustrated with a numerical example (A), adapted from Orłóci (1978) and Legendre and Gallagher (2001).....	89
Figure 2.4. Thematic accumulation curve illustrating the cumulative total of themes cited by participants with the number of interviews.....	95
Figure 2.5. Methodological steps from “best-fit” framework synthesis to unconstrained and constrained ordinations.	96
Figure 2.6. Hierarchy treemap of the classificatory structure of themes identified by “best-fit” framework synthesis.	101
Figure 2.7. Ordination biplots in type 2 scaling of tb-PCA using Hellinger’s transformation on the frequency count of animal and plant species.....	103
Figure 2.8. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of animal and plant species.	104
Figure 2.9. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of themes.	108
Figure 3.1. Map showing the location of Parikwene villages in French Guiana	125
Figure 3.2. Symptoms, complications and problems associated with diabetes listed by Parikwene participants from the communes of Saint-Georges and Macouria.....	138
Figure 3.3. The operational sequence, or <i>chaîne opératoire</i> , of kwak production.	163
Figure 3.4. Illustrations of the retting process of cassava tubers (<i>Manihot esculenta</i>).....	164
Figure 4.1. Map showing the location of Innu and Cree communities in Québec (Canada).....	209

Figure 4.2. Word clouds and hierarchy tree map illustrating the nesting pattern of themes and concepts.....	217
Figure 4.3. Illustration of the general model for local Indigenous medicine.....	218
Figure 4.4. Illustrations of gathering sites on the land.....	245
Figure 4.5. Illustration of wild game and fowl cooked for a feast during a gathering in Mashteuiatsh to honor Aboriginal Day and the summer solstice.	249
Figure 4.6. Mean total count of themes \pm SE cited by participants when discussing local Indigenous medicine.	252
Figure 4.7. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of animal and plant species.	253
Figure 4.8. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of themes.	256
Figure 4.9. Illustrations of the concepts of well-being and balanced health represented in Mastheuiatsh’s healthcare center (Nituhkulinitshuap).....	262
Figure 4.10. Cross cultural exchanges in action.	270
Figure 5.1. Map showing the location of all Indigenous communities from Québec (Canada) and French Guiana (France)	286
Figure 5.2. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on animal and plant species.	295
Figure 5.3. Ordination triplots in type 2 scaling of db-RDA using Gower’s distance on themes.	296
Figure 5.4. Examples of species perceived as dietary and medicinal at once.....	300
Figure 5.5. Illustrations of camps and <i>carbet</i> providing access to the land.....	303

Liste des abréviations

Abréviation	Définition
ANOVA	<i>Analysis of variance</i> / Analyse de la variance
APA	Accès et Partage des Avantages
CA	<i>Correspondence analysis</i> / Analyse des correspondances
CAP	Connaissances, Attitudes et Pratiques
CBHSSJB	<i>Cree Board of Health and Social Services of James Bay</i> / voir CCSSSBJ
CCA	<i>Canonical correspondence analysis</i> / Analyse canonique des correspondances
CCSSSBJ	Conseil Cri de la Santé et des Services Sociaux de la Baie James
CDPS	Centres Délocalisés de Prévention et de Soins
CHC	Centre Hospitalier de Cayenne Andrée Rosemon
db-RDA	<i>Distance-based redundancy analysis</i> (voir RDA) / RDA basée sur la distance
DT1	Diabète de type 1
DT2	Diabète de type 2
FC	<i>Frequency of citations</i> / Fréquence de citations
FID	Fédération Internationale du Diabète
GI	<i>Glycemic index</i> / Index glycémique
IDF	<i>International Diabetes Federation</i> / voir FID
KAP	<i>Knowledge, Attitudes and Practices</i> / voir CAP
MANOVA	<i>Multivariate analysis of variance</i> / Analyse de la variance multivariée
OMS	Organisation Mondiale de la Santé
PCA	<i>Principal component analysis</i> / Analyse en composantes principales
RDA	<i>Redundancy analysis</i> / Analyse de redondance
T1D	<i>Type 1 diabetes</i> / voir DT1
T2D	<i>Type 2 diabetes</i> / voir DT2
tb-PCA	<i>Transformation-based PCA</i> / PCA basée sur la transformation
tb-RDA	<i>Transformation-based RDA</i> / RDA basée sur la transformation

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Introduction

« Cancer, diabetes, heart diseases are no longer the diseases of the wealthy. Today, they hamper the people and the economies of the poorest populations even more than infectious diseases. This represents a public health emergency in slow motion. »

Ban Ki-moon, Secrétaire général des Nations Unies, Juin 2009

Au moment de déposer cette thèse, une pandémie globale plombe l'humanité. Cela faisait près de 100 ans que la nature n'avait rappelé l'humain à ses vulnérabilités. Mais du jour au lendemain, le mot pandémie est venu dominer notre vie, voire définir une génération. Alors que la COVID-19 nous rappelle les pandémies de maladies infectieuses dignes des événements historiques qui ont décimé des populations, une autre pandémie, insidieuse et sournoise, tient à menacer aussi discrètement que la maladie qui la conduit. Telle une acolyte inconnue, sa présence chez les gens les prédisposent même à la fameuse COVID.

Introduction au diabète

Le diabète atteint des proportions pandémiques. Mondialement, le nombre d'adultes diabétiques a plus que quadruplé depuis 1980 où l'on recensait alors 108 millions d'individus (NCD Risk Factor Collaboration 2016). La Fédération Internationale du Diabète (FID) estimait que la population diabétique entre l'âge de 20-79 ans atteignait 463 millions de personnes en 2019, affectant 9,3 % de la population mondiale de ce groupe d'âge, et que cette prévalence risquerait d'augmenter jusqu'à 700 millions en 2045 (Saeedi et al. 2019). En 2017, il y avait approximativement 5 millions de décès attribués au diabète chez les adultes de 20-99 ans, comptant pour 9,9 % de la cause globale des mortalités mondiales pour les personnes de ce groupe d'âge (Cho et al. 2018). Cela fait de cette maladie l'une des dix causes principales de mortalité attribuée à une mauvaise santé chez les adultes à travers le monde (Bennett et al. 2018; Saeedi et al. 2019), dépassant même le chiffre combiné des décès annuels attribués au virus de l'immunodéficience humaine (VIH), la tuberculose et le paludisme en 2015 (Ogurtsova et al. 2017). Néanmoins, la FID estimait que la moitié (50,1 %) des personnes vivant avec le diabète n'étaient pas diagnostiquées (Saeedi et al. 2019).

Le diabète sucré est une maladie non-transmissible, tels les cancers, ainsi que les maladies cardiovasculaires et respiratoires chroniques (Bennett et al. 2018), qui décrit un groupe de désordres métaboliques associés au sucre (Cho et al. 2018; Punthakee et al. 2018). L'Organisation Mondiale de la Santé (OMS 2016:11) définit le diabète comme « *une maladie chronique grave qui se déclare lorsque le pancréas ne produit pas suffisamment d'insuline (...) ou lorsque l'organisme n'est pas capable d'utiliser efficacement l'insuline qu'il produit* », résultant alors en une concentration accrue de glucose dans le sang : l'hyperglycémie.

Le diabète de type 1 (DT1) et le diabète de type 2 (DT2) comptent globalement pour la majorité des cas de diabète sucré (Punthakee et al. 2018). Alors que le DT1 peut être caractérisé comme maladie auto-immunitaire dont l'apparition est relativement rapide, le DT2, qui affecte plus de 90 % des diabétiques (Saeedi et al. 2019), est caractérisé par une résistance progressive à l'insuline (Punthakee et al. 2018). Les critères diagnostiques du diabète étant fondés sur des seuils de glycémie, soit le taux de glucose dans le sang, le terme « prédiabète » est alors utilisé pour désigner des anomalies glycémiques exposant les personnes à un risque élevé de DT2 (Punthakee et al. 2018). La classification du diabète comprend classiquement un troisième type, soit le diabète gestationnel (Saeedi et al. 2019), mais Diabète Canada cite d'autres types particuliers, surtout d'origine génétique (par exemple, le diabète monogénique et le diabète néonatal, s'ils se manifestent à moins de 6 mois), mais associés aussi à d'autres maladies ou à l'usage de certains médicaments (Punthakee et al. 2018). Malgré ces différents types, leur traitement repose principalement sur le contrôle de la glycémie par les moyens, entre autres, de la pharmacothérapie impliquant des médicaments oraux comme la metformine, les agonistes des récepteurs du glucagon-like peptide-1 (GLP-1), les thiazolidinédiones, les méglitinides, les composés sulfonylurés, les inhibiteurs d'alpha-glucosidases et du sodium/glucose cotransporteur-2 (SGLT-

2), ainsi que des injections d'insuline (Berard et al. 2018; Imran et al. 2018; Lipscombe et al. 2018a). Ces traitements sont aussi accompagnés d'interventions de modifications du style de vie, soit par l'alimentation, l'activité physique et la perte de poids (Sievenpiper et al. 2018a; Sigal et al. 2018a; Wharton et al. 2018).

La pathophysiologie du diabète inclut l'insulinorésistance et la sécrétion altérée de l'insuline (Chao and Hirsch 2000). Les symptômes d'hyperglycémie incontrôlée comprennent la polyurie, la polydipsie, la vision trouble, la déshydratation et la perte de poids, des symptômes qui peuvent mener les diabétiques à se plaindre de soif, d'envies du sucrée, de fatigue, d'inconforts abdominaux et de crampes musculaires (Chao and Hirsch 2000). Cependant, les problèmes liés à l'hyperglycémie chronique comprennent aussi un risque accru de maladies cardiovasculaires ainsi que des complications micro-vasculaires touchant les yeux, soit la rétinopathie, les reins, soit la néphropathie, et les nerfs, soit la neuropathie (da Rocha Fernandes et al. 2016; Cho et al. 2018; Punthakee et al. 2018; Harding et al. 2019). Ces complications peuvent évoluer vers une perte de la vision, de la fonction des reins ainsi qu'à des plaies chroniques du pied, soit le pied diabétique, pouvant mener à des amputations des membres inférieurs (da Rocha Fernandes et al. 2016; Fosse-Edorh et al. 2016; Harding et al. 2019).

Tenant compte de la diversité des complications et des dépenses qui y sont reliées, comme le matériel et les soins hospitaliers, la FID estime que le coût mondial et direct du diabète monte à 760 milliards \$US en 2019 (20-79 ans), et que les projections prévoient une hausse jusqu'à 845 milliards \$US en 2045 (da Rocha Fernandes et al. 2016; Williams et al. 2020). Cependant, Bommer et al. (2017) concèdent que cela représenterait seulement près du tiers du coût réel du diabète. En comprenant les dépenses indirectes associées à la maladie, tels le décrochage de la population active du marché du travail, la mortalité et l'absentéisme, le fardeau économique mondial

monterait à plus de 2.1 trillions \$US d'ici 2030 (Bommer et al. 2018). En bref, le diabète représente un fardeau, sanitaire, économique et social, qui influe grandement sur la qualité de vie des diabétiques et qui ne cesse d'augmenter (Ogurtsova et al. 2017; Cho et al. 2018).

Diabète chez les Peuples Premiers des Amériques

À travers le monde, l'on note des disparités régionales dans la prévalence du diabète. Alors que l'on estime son taux dans les régions de l'Ouest du Pacifique ainsi que de l'Amérique du Nord et des Antilles à plus de 10 % de la population, on l'estime par contre à près de 6% en Europe (Saeedi et al. 2019). Outre ces disparités régionales, l'on observe de surcroît des distinctions marquées chez les Peuples autochtones qui font parties des populations les plus à risque (WHO and IDF 2004; Yu and Zinman 2007; Herman 2017; Crowshoe et al. 2018a; Creatore et al. 2020). Tenant compte de leur diversité à travers le monde, ces peuples sont plus succinctement définis comme étant les populations descendantes de peuples habitant l'ensemble, ou une partie, d'un territoire soumis à la domination par un autre peuple d'origine ethnique différente et venant d'une autre région du monde (Bellier 2008; Filoche 2011).

À titre d'exemple concret, une méta-analyse des études sur le diabète chez les femmes enceintes a trouvé que la prévalence d'un diabète préexistant ainsi que d'un diabète gestationnel était plus élevée chez les femmes autochtones que chez les femme non-autochtones en Australie, en Nouvelle-Zélande, aux États-Unis et au Canada (Voaklander et al. 2020). Par contre, ces disparités n'imputent pas le fait que le Canada et les États-Unis font partis des 10 pays ayant le plus dépensés sur les soins de santé associés au diabète en 2019 (Williams et al. 2020). Cela est d'autant plus vrai pour la France, apparaissant elle-même sur cette liste (Williams et al. 2020), qui rapporte aussi des disparités régionales dans le nombre de personnes diabétiques. Par rapport à ses

départements situés en Europe, le taux de diabète serait plus élevé dans ses départements ultramarins américains (Fosse-Edorh et al. 2016; Mandereau-Bruno and Fosse-Edorh 2017; Fuentes et al. 2020).

Dès le milieu des années 1970, l'on constate déjà un taux de diabète alarmant chez les populations autochtones de l'Amérique et de l'Océanie (West 1974); on estime alors que le diabète était inconnu des Premières Nations avant la deuxième guerre mondiale (West 1974; Waldram et al. 2006; Roy and Michaud 2011; Roy 2013). Le risque plus élevé du diabète chez les populations autochtones de l'Amérique du Nord est mis en évidence au Canada qui rapporte une prévalence de la maladie deux à trois fois plus élevée chez cette population par rapport au taux national (Agence de la santé publique du Canada 2018; Crowshoe et al. 2018a). Sur tout le pays, cela varie de 12,7% à 19 % entre la population autochtone hors-réserve et sur-réserve, respectivement (Agence de la santé publique du Canada 2018). Chez certaines Premières Nations, tel que les Cris d'Eeyou Istchee de la province canadienne de Québec, l'évolution du diabète est bien documentée (Robinson 1988; Ekoe et al. 1990; Brassard et al. 1993a, 1993b; Brassard and Robinson 1995; Dannenbaum et al. 1999, 2008; Kuzmina et al. 2010; Hayward et al. 2012). Depuis 1983, la prévalence du diabète a sauté de 2,4 % à 21,4 % en 2009; à structure d'âge identique, cela correspond à 29 % de la population de ces Premières Nations (Kuzmina et al. 2010). Tout comme les Cris, on estime que le diabète apparaît dans le profil épidémiologiques des Innus durant les années 1970 ; en 1999, l'incidence du diabète chez les Premières Nations de Pessamit, Nutashkuan, Unamen Shipu, Pakuashipi, Ekuanitshit et Matimekush était déjà 1,6 à 5,7 fois celle du Québec (Roy 1999, 2003; Roy and Michaud 2011). Finalement, les populations autochtones du Canada ont tendance à développer le diabète plus tôt, avoir des complications plus tôt, et montrer de moins

bons résultats à l'égard des traitements (Hanley et al. 2005; Dannenbaum et al. 2008; Dyck et al. 2010; Harris et al. 2011; Hayward et al. 2012).

En Amérique du Sud et dans les Caraïbes, les données sont plus rares (Papoz 2002), mais suggèrent de plus hauts taux dans les communautés autochtones urbanisées (Yu and Zinman 2007). Bien qu'elle représente un contexte géopolitique particulier, la Guyane française, le seul département sud-américain français, n'est cependant pas exempte de ces disparités géographiques et populationnelles du diabète (Richard et al. 2015; Fosse-Edorh et al. 2016; Mandereau-Bruno and Fosse-Edorh 2017; Fuentes et al. 2020; Sabbah et al. 2021). En premier lieu, la Guyane possède une population diabétique plus jeune par rapport à la France hexagonale (Ndong et al. 2010). À structure d'âge identique, la prévalence du diabète, estimée à 8,08 % en 2015, était 1,6 fois plus élevée que le taux national (Mandereau-Bruno and Fosse-Edorh 2017). Selon la FID, la Guyane se plaçait parmi les 10 régions de l'Amérique du Sud et de l'Amérique Central possédant les plus hautes prévalences de diabète en 2013, juste au-dessous du Brésil, pays limitrophe de la Guyane (IDF 2013; Aschner et al. 2014).

La composition démographique des habitants de la Guyane française est constituée de divers groupes culturels créoles, businenge, autochtones et migrants (Renault-Lescure and Goury 2009), et les données suggèrent que certaines populations sont plus touchées que d'autres. Le Pôle des Centres Délocalisés de Prévention et de Soins (CDPS) du Centre Hospitalier de Cayenne Andrée Rosemon (CHC) rapporte que le plus grand nombre de patients diabétiques se trouve dans les CDPS de Saint-Georges de l'Oyapock et de Maripasoula (Guarmit et al. 2017), des communes caractérisées par de fortes populations autochtones et businenge, soit les Parikwene, ainsi que les Aluku et les Wayana respectivement (Renault-Lescure and Goury 2009). De surcroît, cette réalité

s'exprime à travers le discours des résidents de Saint-Georges qui identifient le diabète comme l'un des principaux problèmes de santé (Van Gastel et al. 2021).

Cela part de loin pour les Parikwene chez qui l'on rapporte un peuple en bonne santé dans la première moitié du 20^e siècle, malgré les grandes épidémies qui marquent cette époque (Nimuendajú [1926] 2008; Fernandes 1950). Mais à la fin des années 1970, on recense les premiers cas de diabète chez les Parikwene, soit 10 diabétiques vivant au Brésil (Vieira-Filho 1978). En effet, la vitesse des changements de mode de vie, qui incluent l'évangélisation, la monétisation, la sédentarisation, la scolarisation, les changements alimentaires et l'ouverture de la région le long de la frontière brésilienne par l'accès routier en 2003, s'est accélérée depuis le milieu des années 1960 (Grenand 1981; Ouhoud-Renoux 2000a; Capiberibe et al. 2009; Vincent 2013). Malgré tout, un regard global sur la Guyane suffit aux diverses études épidémiologiques du diabète en France pour associer ces taux exceptionnels aux particularités de l'isolement géographique, une faible densité médicale accompagnée d'un faible accès ainsi que des fortes inégalités socio-économiques (Ndong et al. 2010; Bouillot and Czernichow 2013; Richard et al. 2015; Fosse-Edorh et al. 2016; Mandereau-Bruno and Fosse-Edorh 2017; Fuentes et al. 2020; Sabbah et al. 2021; Van Gastel et al. 2021).

Ces facteurs sous-jacents sont caractéristiques des communautés autochtones les plus affectées par les maladies chroniques au Canada (Roy 2003; Roy and Michaud 2011; Harris et al. 2011). Les populations isolées, bien qu'elles peuvent être caractérisées par un éloignement géographique à l'écart des grands flux et regroupements humains, se caractérisent de surcroît par une inaccessibilité aux services publics, dont les services de santé (Peuziat et al. 2012). Combinés à des facteurs culturels et historiques, les conséquences sanitaires vis-à-vis du diabète peuvent être observées sur toute l'Amérique, tant chez les groupes autochtones du Canada que de

la Guyane française (Vincent 2013). Ainsi, plusieurs études estiment que la colonisation, histoire commune des terres américaines comme le Canada et la Guyane (Bellier 2008; Elfort 2010; Chicot 2011; Filoche 2011), fait partie des déterminants sociaux qui contribuent à l'augmentation des maladies chroniques et au fardeau disproportionnellement plus élevé du diabète chez les populations autochtones (Roy 1999; Adelson 2005; King et al. 2009; Jacklin et al. 2017; Voaklander et al. 2020). La Commission de vérité et réconciliation du Canada, quant à elle, expose de manière approfondie l'impact de la colonisation des Peuples autochtones du Canada, détaillant entre autres l'effet des pensionnats sur les déterminant sociaux de la santé et des iniquités sanitaires (Truth and Reconciliation Commission of Canada 2015b).

Globalement, cela résulte en des changements rapides dans le mode de vie, caractérisés par la sédentarisation et une transition alimentaire (Roy 2003; Compher 2006; King et al. 2009; Roy et al. 2013; Voaklander et al. 2020), dont la problématique est exacerbée par le non-respect de l'usage de médicaments et des interventions biomédicales (Roy 1999). En effet, ces changements au mode de vie ont été documenté tant chez les Cris et les Innu du Québec (voir par exemple Conseil des Montagnais du Lac-Saint-Jean 2003; Laberge Gaudin 2012), que chez les Parikwene de la Guyane française (voir par exemple, Ouhoud-Renoux 2000; Capiberibe et al. 2009; Vincent 2013). De surcroît, de nombreux travaux démontrent un lien plus étroit entre le diabète, l'obésité et l'insécurité alimentaire (Clement et al. 2018; Tait et al. 2018), tant chez les populations autochtones (Truth and Reconciliation Commission of Canada 2015b), qui a lieu lorsqu'il n'existe pas un accès physique, social ou économique à de la nourriture saine et consommée en quantité suffisante, le tout pouvant être exacerbé par des services de santé non-adéquats (Council of Canadian Academies 2014). Au Canada, les personnes vivant dans des maisons souffrant d'insécurité alimentaire étaient deux fois plus à risque de DT2 comparées aux maisons

alimentairement saines (Tait et al. 2018). Ainsi, la consommation croissante d'aliments bon marché, pauvres en éléments nutritifs et riches en énergie (Compher 2006; Casey et al. 2006; Downs et al. 2009; Metallinos-Katsaras et al. 2012; Roy et al. 2013), est une problématique qui prend de l'ampleur en santé publique (Council of Canadian Academies 2014). En plus de l'hypertension et des maladies coronariennes, le DT2 est l'une des maladies chroniques risquant le plus de se développer avec l'obésité (Kopelman 2000; Favier et al. 2005).

Des hypothèses d'origine génétique ont déjà été postulées pour expliquer la prévalence du DT2 chez les populations autochtones (Ritenbaugh and Goodby 1989; Neel 1999; Hegele et al. 2003; Chakravarthy and Booth 2004; Yu and Zinman 2007), telle l'hypothèse du génotype vigoureux, ou *thrifty genotype* (Neel 1999). Ces hypothèses impliquent la pathologie de l'obésité, l'un des principaux risques associé au développement du DT2 (Kopelman 2000; Guh et al. 2009), mais l'on admet très tôt l'implication des facteurs environnementaux dans le développement du diabète chez les populations à risque (West 1974). Bien qu'au moins 30 gènes récessifs causant l'obésité ont été identifiés, les cas monogéniques sont plutôt rares (Garver et al. 2013; Hebebrand et al. 2013). Il est davantage évident que les cas polygéniques sont plus communs, impliquant l'interaction de plus de 35 gènes et leurs polymorphismes (Yang et al. 2007; Garver et al. 2013; Hebebrand et al. 2013). De surcroît, l'expression de ces gènes, un facteur biologique bien entendu, se manifeste en réponse à des interactions complexes entre les facteurs environnementaux, soit un environnement obésigénique modulant l'alimentation et l'inactivité (Ravussin and Bouchard 2000; Kilpeläinen et al. 2011), et des facteurs comportementaux (Ludwig and Friedman 2014; Garvey et al. 2014). En d'autres termes, les risques d'obésité et de diabète, par extension, sont considérablement influencés par des facteurs qui sont bons et bien modifiables à travers des choix alimentaires, par exemple, ainsi que d'un soutien mental et émotionnel.

Approches alternatives ou complémentaires

Au Canada, les inquiétudes concernant le fardeau des maladies chroniques auprès de ces communautés occupent déjà une place importante en santé publique. Selon l'Enquête régionale sur la santé des Premières Nations et des Inuits (1999) réalisée au Canada, 80 % des répondants croient qu'un retour à un mode de vie traditionnelle pourraient améliorer le bien-être communautaire et individuel. Le Conseil des académies canadiennes (2014) affirme, tout comme chez les communautés wayãpi et teko de la Guyane (Davy et al. 2012), que le savoir traditionnel touchant les pratiques liées à la cueillette peuvent être comprises dans l'ensemble des pratiques culturelles nécessaires à la souveraineté alimentaire. De plus, la Commission canadienne des affaires polaires souligne l'importance de mieux documenter les conséquences du passage des aliments traditionnels aux aliments importés, plus particulièrement en lien avec les maladies chroniques. En Guyane, on souligne la pression néfaste du mode de vie occidentale, ou français, sur le maintien des activités traditionnelles liées au territoire, telles la chasse, la pêche et l'agriculture sur brûlis (Grenand et al. 2000).

Nombreuses sont les études qui soulignent le besoin urgent de former des équipes pluridisciplinaires quant à la démarche thérapeutique et d'implémenter des stratégies culturellement adaptées pour prévenir les complications du diabète et réduire son incidence chez les populations à risque (Adelson 2005; Hanley et al. 2005; Hayward et al. 2012; Mandereau-Bruno and Fosse-Edorh 2017; Saeedi et al. 2019; Sabbah et al. 2021). Diabète Canada émet, dans ses lignes directrices de pratique clinique (Harris et al. 2013b; Crowshoe et al. 2018a), plusieurs recommandations concernant la prise en charge du DT2 dans les communautés autochtones. Elle recommande, entre autres, qu'avec le soutien des systèmes de santé et d'autres organismes pertinents, les collectivités autochtones mettent sur pied des programmes de prévention primaire

qui s'adressent aux enfants et aux adultes en tenant compte de la dimension culturelle (Crowshoe et al. 2018a). Elle reconnaît et suggère spécifiquement de respecter les particularités langagières, l'histoire culturelle, les croyances et les particularités géographiques (Crowshoe et al. 2018a). Elle propose aussi que les communautés autochtones du Canada bénéficient spécifiquement de partenariats communautaires de prise en charge du diabète comptant une équipe interprofessionnelle, des registres de patients diabétiques ainsi qu'une surveillance et un contrôle de la qualité des soins continus (Harris et al. 2013b; Clement et al. 2018; Crowshoe et al. 2018a). Ces recommandations sont appuyées par les appels à l'action de la Commission de la vérité et réconciliation du Canada qui demande au système de santé canadien de reconnaître et d'intégrer les pratiques de guérison autochtones, voire même créer des centres de santé autochtones, en collaboration avec les Aînés et les Guérisseurs pour les patients autochtones (Truth and Reconciliation Commission of Canada 2015a, 2015b).

Reflétant les recommandations de Diabète Canada dans un langage plus inclusif, les études françaises suggèrent que les actions de prévention primaire visant à réduire les principaux facteurs de risque modifiable (c'est-à-dire, le surpoids et l'obésité, la sédentarisation) soient durables et que des politiques adaptées et des programmes de santé intégrés pour les populations à risque et défavorisées soient mises en place pour stabiliser et ralentir l'incidence du diabète (Ricci et al. 2010; Mandereau-Bruno et al. 2014; Charbonnel et al. 2017, 2018; Fuentes et al. 2020). Plus spécifiquement, un rapport de mission sur la prise en charge médico-chirurgicale de l'obésité en Guyane demandé par l'Agence Régionale de la Santé (ARS) conclut que les partenariats entre les différentes structures du réseau de santé guyanais est nécessaire pour structurer la prise en charge des patients obèses (Bouillot and Czernichow 2013).

De surcroît, il existe une grande disparité en ce qui concerne les notions de médecine et de santé entre la vision des professionnels et des administrateurs de la santé d'une part et celle des membres des communautés d'autre part (Adelson 2005; King et al. 2009). C'est une réalité que partagent plusieurs communautés autochtones où les habitants reconnaissent l'importance des modes de vies traditionnelles pour le bien-être communautaire et individuel. Diabète Canada reconnaît ainsi que les personnes ne trouvant pas les résultats qu'elles attendent de la biomédecine se tournent donc vers des solutions parallèles comprenant, entre autres, les produits de santé naturel à base végétal et les remèdes dits « traditionnels » (Grossman et al. 2018). Sa propre revue de la littérature sur les études cliniques réalisées sur bon nombre de plantes réputées antidiabétiques l'emmène donc à en retenir quelques-unes qui réduisent l'hémoglobine glyquée d'au moins 0,5 % : d'abord, le gingembre (*Zingiber officinale* Roscoe ; Zingiberaceae), l'aloès (*Aloe vera* [L.] Burm. f. ; Asphodelaceae), l'ortie (*Urtica dioica* L. ; Urticaceae) ainsi que le balai doux (*Scoparia dulcis* L. ; Plantaginaceae) (Grossman et al. 2018). Néanmoins, de nombreuses autres plantes, surtout tropicales, ne font pas partie de cette courte liste, tels que le ginseng à cinq foliole (*Panax quinquefolius* L. ; Araliaceae), le sorosi (*Momordica charantia* L. ; Cucurbitaceae) et la liane amère (*Tinospora crispa* [L.] Hook. f. & Thomson ; Menispermaceae), alors que d'autres exercent des effets contradictoires sur la glycémie, comme la cannelle (*Cinnamomum* spp. ; Lauraceae) ou la patate douce (*Ipomoea batatas* [L.] Lam. ; Convolvulaceae) (Grossman et al. 2018). Reconnaisant ainsi la contribution biologique des plantes médicinales aux traitements antidiabétiques, cela souligne d'autant plus le fossé de connaissances pertinentes qui existe concernant l'utilisation des plantes et autres remèdes non-biomédicaux contre le diabète.

Anthropologie médicale et ethnomédecine

L'étude des systèmes de santé relève classiquement de l'anthropologie de la santé, ou l'anthropologie médicale. Cette discipline des sciences humaines et sociales s'intéresse de plus à l'étude de la santé humaine et des maladies, ainsi qu'aux adaptations et aux pratiques bio-culturelles (Singer et al. 2019). Alors que la médecine s'inscrit dans la pratique, l'anthropologie questionne les fondements culturels des comportements des individus considérés, les rapports de pouvoir à l'intérieur des communautés, entre les communautés, et aussi entre les acteurs politiques et les forces de pouvoir, le concept de la santé et son implication, ainsi que les paramètres de la maladie (Roy 2003; Leonti 2011). Le cadre théorique de l'anthropologie médicale critique, tel qu'employé par Roy (2003:15) dans son étude du diabète dans la communauté innue de Pessamit, considère que :

« Si l'être humain appartient au règne de la nature, il relève et vit dans un environnement qui, lui, est façonné par une culture vivante se transformant quotidiennement. Il est impossible de saisir la complexité des réalités humaines en séparant nature et culture. »

Cela étant dit, il faut aussi admettre que si le biologiste s'intéresse aux plantes, ou aux animaux, utilisées par les humains dans ses pratiques de guérison, il s'intéresse intrinsèquement aux fondements des comportements des individus vis-à-vis de la maladie. Les intérêts de l'ethnobiologiste chevauchent donc ceux de l'anthropologie médicale. C'est ainsi que l'anthropologie médicale s'apparente souvent à l'ethnomédecine dont Briggs and Nichter (2018) considèrent une sous-discipline menée par l'intérêt pour l'histoire de la médecine, l'ethnobotanique, les systèmes de médecine comparés et les approches de guérison. Pour Pieroni et al. (2005), l'ethnomédecine serait un champ d'étude multidisciplinaire qui s'apparente à l'ethnobiologie par

l'entremise des pratiques touchant le monde naturel, une thématique plutôt propre à l'ethnobotanique vis-à-vis des plantes et l'ethnozoologie vis-à-vis des animaux ; il se concentre davantage sur l'interprétation culturelle de la santé, des maladies et des pratiques qui y sont associées. Bien entendu, les questionnements sur la perception des maladies chevauchent considérablement ceux de l'anthropologie médicale. Lorsqu'une nouvelle maladie émerge, peut-il y avoir coexistence ou compétition des connaissances et des pratiques ? Quel est le parcours thérapeutique ?

Bien que l'anthropologie se soit historiquement soucié de ces questions (Buchillet 1995; Hausmann Muela et al. 2002; Saethre 2007; Calvet-Mir et al. 2008), les ethnobiologistes s'y sont aussi attardés (Giovannini et al. 2011; Ladio and de Albuquerque 2014). Afin de questionner les déterminants qui influencent l'utilisation d'un système de santé ou d'un autre, ces derniers les regardent plus particulièrement sous l'angle du pôle phytothérapeutique et pharmacothérapeutique (Caniago and Siebert 1998; Vandebroek et al. 2004; Ragupathy et al. 2008). Alors que le regard anthropologique met l'accent sur les fondements culturels des comportements et de la pensée, le regard biologique met l'accent sur la raison d'être des plantes, notamment, dans les pratiques médicales (Leonti 2011).

Plusieurs de ces questions soulevées par l'anthropologie médicale et l'ethnomédecine peuvent être sommairement répondues par des études CAP, soit « connaissance, attitude et pratique » (Raina 2013), qui permettent non-seulement d'évaluer la prestation des soins de santé là où ils existent peu d'informations, mais également d'élucider l'expérience et le vécu d'une population à l'égard d'une maladie. Ces études prennent une importance particulière en France qui n'a pas tendance à tenir des chiffres sur les populations ethniques (Vigneron et al. 2005; Odonne et al. 2011, 2021a; Sridhar et al. 2015; Fritzell et al. 2016; Mosnier 2017; Mosnier et al. 2020).

Provenant tant des milieux médicaux que de la recherche, ces auteurs marient leurs aptitudes et compétences en médecine, anthropologie et biologie pour répondre à des questionnements complexes au sujet de la santé.

Ethnobiologie

La contribution de l'ethnomédecine et de l'ethnobiologie au domaine de la science et de la santé ne pourrait pas être mieux illustrée que par l'exemple de la metformine qui se classe au 4^e rang des médicaments pharmaceutiques les plus prescrits aux États-Unis (Fuentes et al. 2018). Au début du 20^e siècle, la metformine est synthétisée à partir de la guanidine, une molécule hypoglycémisante isolée de la galéga officinal (*Galega officinalis* L. ; Fabaceae), dont les parties aériennes de la plante étaient utilisées en Europe médiévale pour traiter une multitude de maux pouvant être liés au DT2 (Marles and Farnsworth 1995; Bailey and Day 2004).

Bien que le terme « ethnobiologie » apparaisse aux États-Unis en 1935 (Caster 1935), les questions auxquelles elle s'intéresse remontent à l'origine de la botanique et de la médecine (Rousseau 1961; Clément 1998). Les bases de l'ethnobiologie sont posées au 19^e siècle alors que l'on désigne ses différentes sous-disciplines d'un nom (Clément 1998). Bien que Mason (1899) soit le premier à utiliser le terme « ethnozoologie », Harshberger le précède en suggérant le terme « ethnobotanique », dont les propos sont rapportés par un journaliste anonyme (Anonymous 1895), et en formule ses objectifs qui deviendront omniprésents dans l'ethnobiologie et ses sous-disciplines (Harshberger 1896a, 1896b; Clément 1998).

À cette époque, l'ethnologie compte à peine 50 ans d'histoire et les botanistes viennent de s'entendre sur les règles de nomenclature au Congrès International de botanique tenu à Paris en

1867 (de Candolle 1867; Clément 1998). Au début du 20^e siècle, Speck (1917) considère que l'étude des plantes fait partie d'une branche négligée de l'ethnologie. Clément (1995; 1998) l'appuie en inscrivant l'ethnobiologie, et les ethnosciences en général, comme sous-discipline de l'anthropologie, ainsi qu'en la décrivant d'une perspective émiqque comme étant l'étude du savoir biologique que possède les différentes populations humaines des plantes et des animaux, par exemple, présent et passé. Cependant, la discipline prend racine, tant bien que mal, dans les sciences biologiques. Le botaniste suisse de Candolle suggère au début du 19^e siècle que la botanique soit divisée en trois branches : 1) la botanique proprement dite, 2) la botanique organique, ou la physique végétale et 3) la botanique appliquée qu'il définit comme « *l'étude des rapports qui existent entre les végétaux et l'espèce humaine* » (de Candolle 1813:20). Cela reviendrait à inclure la botanique agricole, la botanique médicale, la botanique économique et industrielle, ainsi de suite (de Candolle 1813).

Les travaux en ethnobiologie de Rousseau, ancien directeur du Jardin Botanique de Montréal, soulignent davantage la relation étroite entre cette discipline et les sciences biologiques. L'inscrivant comme sous-discipline de l'ethnobiologie, Rousseau (1961:7) définit l'ethnobotanique comme « *la discipline scientifique qui traite de la place de la plante dans la civilisation* ». Il y prescrit alors trois axes principaux : la première est liée aux conceptions locales des caractéristiques et de la classification des plantes (par exemple, la morphologie, la physiologie, la reproduction, la systématique), la deuxième est liée aux rôles des plantes dans la société (par exemple, l'histoire des noms et de leur place dans l'histoire orale ou écrite comme les mythes et légendes, l'écologie humaine, les plantes utiles, voire alimentaires, fourragères, médicinales, pratiques, rituelles, ornementales), la troisième est auxiliaire aux disciplines anthropologiques, au sens large, en y apportant les techniques botaniques.

Jusqu'à la fin du 20^e siècle, il n'existe pas de définition méthodologique ou théorique à la discipline de l'ethnobiologie (Friedberg 1968; Barrau 1971; Clément 1998). C'est un terme qui est plutôt difficile à définir puisque l'étendue de ses études a considérablement changé à travers son histoire. En effet, Clément (1998) distingue trois époques à la discipline qui reflètent l'attitude et la mentalité des chercheurs. L'époque « préclassique » de l'ethnobiologie commence avec la désignation de ses sous-disciplines (Clément 1998; Hunn 2007). Médecins, archéologues, botanistes, zoologues et ethnologues s'intéressent principalement aux usages à valeur économique que l'on fait de l'environnement (alimentaire, médicinal, alcool, etc.) se tournant ensuite vers la nomenclature, la systématique puis la gestion des ressources (Clément 1998; Hunn 2007). L'époque classique commence autour des années 1950 avec un virage vers une approche éémique de la discipline, c'est-à-dire, comprendre les connaissances dans la perspective des peuples qui les génèrent (Murray 1982; Clément 1998). L'ethnobiologie prend ensuite une saveur politique en mettant l'accent sur les problèmes contemporains et mondiaux (Leonti 2011); l'époque « postclassique » commence autours des années 1980 avec l'émergence des coopérations entre chercheurs et populations (Murray 1982; Clément 1998).

Hunn (2007) reconnaît plus ou moins la caractérisation de Clément (1998), mais il distingue l'époque postclassique de Clément en une période concentrée sur l'ethnoécologie suivi d'un virage sur les droits autochtones et le contrôle du savoir. Plus récemment, plusieurs ethnobiologistes suggèrent la pertinence de l'ethnobiologie pour aborder des problématiques d'envergure globale, dont la perte de la diversité biologique et linguistique, l'effet du changement climatique, ainsi que les iniquités sanitaires (Wyndham et al. 2011; Nabhan et al. 2011). C'est ainsi que Pieroni et al. (2005) considèrent l'ethnobiologie comme un champs d'études multidisciplinaires qui emprunte des approches et des méthodes des sciences sociales et

biologiques. Bref, la définition la plus récente et la plus concise se ramènerait à l'étude réciproque des relations entre les cultures humaines et le monde environnant, ou biologique (Pieroni et al. 2005). Ce champs englobe entre autres l'ethnotaxonomie, soit l'étude de la classification du monde naturel, l'ethnomédecine, soit l'étude des concepts culturels de la santé et des maladies, l'ethnoécologie, soit l'étude des savoirs environnementaux et des effets anthropogéniques, en plus de l'ethnobotanique et l'ethnozoologie (Clément 1995; Pieroni et al. 2005). Enfin, si l'ethnobiologie est l'étude des relations réciproques entre les cultures humaines et leur environnement, nous nous contentons de définir par extrapolation ses sous-disciplines plus spécifiquement, soit l'ethnobotanique et l'ethnozoologie comme étant l'étude des relations réciproques entre les cultures humaines et le monde végétal et animal, respectivement.

Quelques précisions sur les définitions de « médecine »

Il nous semble important ici d'aborder le sujet de la terminologie ayant trait à la médecine afin de mieux caractériser les différents systèmes de santé en présence. La nomenclature adoptée pour les pratiques médicinales locales est souvent dite « médecine traditionnelle ». Tenant compte des caractères uniques attribués aux médecines traditionnelles à travers le monde, l'OMS (2013:15) la traduit dans sa globalité comme étant :

« La somme de toutes les connaissances, compétences et pratiques reposant sur les théories, croyances et expériences propres à différentes cultures, qu'elles soient explicables ou non, et qui sont utilisées dans la préservation de la santé ainsi que dans la prévention, le diagnostic, l'amélioration ou le traitement de maladies physiques ou mentales. »

Cependant, McClatchey (2005) et Leonti (2011) critiquent l'utilisation du terme « traditionnel » en faisant valoir qu'il implique une médecine conservatrice, ancienne et figée dans le temps. À ce titre, l'OMS (2013:15) offre alors une définition de la médecine dite « complémentaire » :

« Les termes "médecine complémentaire" ou "médecine alternative" font référence à un vaste ensemble de pratiques de santé qui ne font pas partie de la tradition ni de la médecine conventionnelle du pays et ne sont pas pleinement intégrées à son système de santé prédominant. Dans certains pays, ils sont utilisés de manière interchangeable avec le terme "médecine traditionnelle". »

Fusionnées ensemble, ces définitions de l'OMS forment la « *médecine traditionnelle et complémentaire* » qui englobe les produits, pratiques et praticiens qui leur sont propre (OMS 2013). Afin de souligner leur caractère unique, et reconnaître les populations auxquelles elles appartiennent, les médecines traditionnelles et complémentaires sont dorénavant nommées ici en fonction de leurs spécificités (par exemple, médecine crie, médecine ilnu et médecine parikwene), ou généralement appelées des médecines « locales ».

Par ailleurs, Giovannini et al. (2011) définissent la biomédecine comme étant un système médical hégémonique mondial basé sur des principes scientifiques occidentaux qui comprend l'utilisation de produits pharmaceutiques, de professionnels de la santé et d'installations biomédicales. Cette définition correspond bien aux systèmes de santé canadien et français qui sont mis à la disposition de leur population. Bien qu'elle sous-entende l'implication de l'État dans sa gestion et mise en œuvre, cette définition implique aussi une mondialité à travers la recherche scientifique. Encore une fois, McClatchey (2005) souligne le sens trompeur du mot « occidental » attribué à la médecine et la recherche. Non seulement le sens géographique du mot est trahi par

des lieux disséminés sur toute la planète pour les sociétés auxquelles elles peuvent faire référence, comme le Canada en Amérique du Nord, la France en Europe et l’Australie en Océanie, mais elle exclut les contributions des sociétés dites « non-occidentales ». Ce terme instaure donc un grand schisme entre l’Occident et le reste du monde. En bref, pour faire référence aux systèmes de santé structurés par une instance gouvernementale, le terme biomédecine est employé ici tel qu’il est défini par Giovannini et al. (2011) avec une démarcation tout de même particulière de l’ambiguïté occidentale.

Le Protocole de Nagoya et « l’affaire couachi »

Dans les trois systèmes de santé présents dans cette thèse (Cri, Ilnu et Parikwene), la volonté d’améliorer la qualité et l’accessibilité des soins retombe sur un processus communautaire et une nécessité de mieux comprendre les populations que desservent ces systèmes de santé. Cette dernière mesure, menée par des études CAP par exemple, relève davantage du domaine ethnomédicinale et ethnobiologique, deux champs d’études qui nous rappellent qu’il existe un cadre juridique particulier : le protocole de Nagoya.

Le Protocole de Nagoya sur l’accès aux ressources génétiques et le partage juste et équitable des avantages découlant de leur utilisation est issu de la Convention sur la Diversité Biologique (CDB) de 1992. Le Protocole de Nagoya sur l’Accès et le Partage des Avantages (APA) a été adopté par les Nations Unies le 29 octobre 2010 à Nagoya, Japon. Il vise l’implémentation de l’un des trois objectifs de la CDB (Secrétariat de la convention sur la diversité biologique 2012) :

« Le partage juste et équitable des avantages découlant de l’utilisation des ressources génétiques, notamment grâce à un accès satisfaisant aux ressources génétiques et à un

transfert approprié des technologies pertinentes, (...) contribuant ainsi à la conservation de la diversité biologique et à l'utilisation durable de ses éléments constitutifs. »

Bien que 92 pays membres aient signé le Protocole de Nagoya, incluant la France qui est aussi l'un des signataires de la CDB en 1992 (Chicot 2011), le Canada où siège le Secrétariat de la CDB, ne l'est pas. Cela est tout à fait particulier en raison du fait que le Canada était l'un des premiers pays à signer et ratifier la CDB, la considérant comme un traité juridiquement contraignant (Environnement et changement climatique Canada 2020). Alors que le Protocole de Nagoya, qui traite plus spécifiquement du partage équitable et juste des avantages découlant des ressources génétiques, rentre parfaitement bien dans les discours revendicatifs reliés à l'autodétermination des Peuples autochtones au Canada, là, c'est la France qui passe à l'action.

La France ratifia le protocole avec la loi du 8 août 2016 (Assemblée nationale 2016) et le décret du 9 mai 2017 (Ministère de l'environnement, de l'énergie et de la mer, en charge des relations internationales sur le climat 2017) afin de légiférer les activités de recherche impliquant des ressources génétiques, incluant les plantes, et les savoirs traditionnels. La nouvelle loi devient effective le 1^{er} juillet 2017 et fixe des règles en matière de procédures déclaratives et d'autorisation (Ministère de l'environnement, de l'énergie et de la mer, en charge des relations internationales sur le climat 2017), bien que la structure n'ait été formalisée qu'en 2019. Cette action de la part de l'État français vient peu de temps après l'« Affaire couachi » où l'Institut de Recherche pour le Développement (IRD) s'est fait accuser de biopiraterie, en octobre 2015, pour le dépôt d'un brevet sur une molécule isolée des feuilles du couachi, *Quassia amara* L. (Simaroubaceae), la simalikalactone E (Bourdy et al. 2017; Thomas 2018; Collomb 2018; Burelli 2019; Odonne et al. 2021b). En effet, c'est une plante populaire utilisée, entre autres, par les différentes populations de

Guyane (autochtones, créoles et businenge) comme traitement curatif et préventif contre le paludisme (Grenand et al. [1987] 2004; Vigneron et al. 2005; Tareau et al. 2017, 2019b, 2020).

Puisque cette loi est fortement associée au concept de communauté où l'on lie les connaissances traditionnelles associées aux ressources génétiques à des communautés d'habitants qui tirent « *traditionnellement ses moyens de subsistance du milieu naturel et dont le mode de vie présente un intérêt pour la conservation et l'utilisation durable de la biodiversité* » (Assemblée nationale 2016:3), il va de soi que cela n'a pas manqué de mettre sous la loupe les revendications quant aux droits autochtones et de leur reconnaissance juridique en France (Collomb 2018; Burelli 2019). De plus, cela a mis à la lumière du jour des débats importants sur l'origine et la possession des connaissances (Thomas 2018; Collomb 2018; Burelli 2019; Odonne et al. 2021b). Les conséquences sur la recherche en Guyane française furent immédiates : aucun prélèvement de ressources génétiques reliées aux savoirs locaux, notamment des plantes, n'est dorénavant possible sans une autorisation sur l'APA.

Il est important de souligner qu'au moment de commencer cette thèse en septembre 2015, la France n'avait pas encore appliqué le Protocole de Nagoya par une loi nationale. Le contact avec les communautés impliquées avait été initié à travers des collaborations précédentes, d'une part entre le Dr. Alain Cuerrier et moi-même avec les Cris d'Eeyou Istchee et les Pekuakamiulnuatsh (Cuerrier et al. 2012; Forêt modèle du Lac-Saint-Jean 2015), et d'autre part entre le Dr. Damien Davy et les Parikwene (Davy 2007; Ogeron et al. 2018). Les activités de recherche pour la composante québécoise de cette thèse s'inscrivaient alors dans le contexte d'un accord de recherche signé avec les Premières Nations d'Eeyou Istchee et de Mashteuiatsh. Cet accord est basé sur le modèle d'un précédent accord construit avec les Cris d'Eeyou Istchee concernant l'étude des propriétés antidiabétiques des plantes de leur pharmacopée dont découle

notre relation initiale (Cuerrier et al. 2012). Ces accords délimitent, entre autres, le cadre dans lequel la recherche se poursuit, l'implication des communautés, la responsabilité des chercheurs, l'engagement au retour de l'information, des données et des résultats et encore plus important, le partage des propriétés intellectuels découlant de la recherche.

Dans la mesure où aucun cadre juridique approprié n'existait en Guyane française pour ce genre d'accord au commencement de cette thèse, des rencontres furent entamées par les Drs. Davy et Cuerrier avec les Chefs coutumiers parikwene de Macouria et de Saint-Georges pour discuter du projet alors que je commençais mes entretiens au Québec. Ces discussions portaient entre autres sur l'accès et le partage des avantages issus de la recherche à l'image des engagements établis avec les Premières Nations du Québec. À la suite de la finalisation de la convention de cotutelle entre l'Université de Montréal et l'Université de Guyane, mes rencontres avec les Chefs coutumiers parikwene commencèrent dès mon arrivée en Guyane en février 2017, alors que la France n'avait pas encore mis en place la loi qu'elle venait d'élaborer. Les dates de ces rencontres sont présentées dans la **Table 0.1**. Durant ces rencontres, les formulaires de consentement et les questionnaires, révisés et approuvés par les Premières Nations Cris et Ilnu tel qu'indiqué dans l'accord de recherche, et conforme au comité d'éthique de l'Université de Montréal (CERAS-2016-17-081-P ; **Annexe 1**), furent présentés aux Chefs coutumiers parikwene qui les révisèrent, les commentèrent et les approuvèrent.

Étant donné l'ambiguïté de la loi au moment du décret, car à ce moment-là, aucune consignes précises n'étaient disponible, ni de formulaire d'autorisation établi, les activités de recherche se sont poursuivies selon nos engagements envers les Parikwene. Afin d'être conforme à la loi, aucun prélèvement n'a été réalisé pour valider les taxons nommés par les participants. Seuls les taxons bien connus sont présentés, c'est-à-dire, ceux pouvant être associés à des espèces

Table 0.1. Date des rencontres avec les Chefs coutumiers parikwene de Saint-Georges et Macouria.

Date	Village (Commune)	Personnes présentes
1^{ère} rencontre : Discussion du projet, présentation des formulaires de consentement et des questionnaires		
18 mars 2017	Espérance 1 (Saint-Georges)	Chef coutumier R. Labonté, D. Davy, A. Cuerrier, M. Rapinski
19 mars 2017	Espérance 2 (Saint-Georges)	Chef coutumier E. Guiome, D. Davy, A. Cuerrier, M. Rapinski
15 mars 2017	Norino (Macouria)	Chef coutumier J. Narcis, D. Davy, A. Cuerrier, M. Rapinski
15 mars 2017	Kamuyene (Macouria)	Chef coutumier A. Felicio, D. Davy, A. Cuerrier, M. Rapinski
2^{ème} rencontre : Discussion du projet, logistique, interprétation		
1 novembre 2017	Espérance 1 (Saint-Georges)	Chef coutumier R. Labonté, M. Rapinski
16 novembre 2017	Espérance 2 (Saint-Georges)	Chef coutumier E. Guiome, M. Rapinski
10 janvier 2018	Norino (Macouria)	Chef coutumier J. Narcis, D. Davy, M. Rapinski
12 janvier 2018	Kamuyene (Macouria)	Chef coutumier F. Labonté*, D. Davy, M. Rapinski
12 février 2018	Kamuyene (Macouria)	Chef coutumier F. Labonté, M. Rapinski
3^{ème} rencontre : Discussion du projet, suivi des résultats et de l'avancement de l'étude		
16 janvier 2019	Norino (Macouria)	Chef coutumier J. Narcis, D. Davy, M. Rapinski
23 janvier 2019	Kamuyene (Macouria)	Chef coutumier F. Labonté, D. Davy M. Rapinski ; présentation au village
1 mars 2019	Espérance 1 (Saint-Georges)	Chef coutumier R. Labonté, M. Rapinski
2 mars 2019	Espérance 2 (Saint-Georges)	Chef coutumier E. Guiome, M. Rapinski

* À la suite du remplacement du Chef coutumier de Kamuyene en 2017, ce fut réellement la première rencontre avec le Chef coutumier F. Labonté.

dont les savoirs sont communs et répandus (par exemple, le manguier [*Mangifera indica* L. ; Anacardiaceae] et l'anacardier [*Anacardium occidentale* L. ; Anacardiaceae], connus par la communauté scientifique (par exemple, le sorosi [*Momordica charantia*], le roucou [*Bixa orellana* L. ; Bixaceae] et le carapa [*Carapa* spp. ; Meliaceae]) ou disponible dans des listings déjà publiés (Fernandes 1950; Grenand and Grenand 1991; Berton 1997), comme la pharmacopée de Guyane (Grenand et al. [1987] 2004). Les nouvelles espèces ne sont pas révélées et devront conséquemment être validées une fois que le Laboratoire Écologie, Évolution, Interactions des Systèmes Amazoniens (LEEISA) aura obtenu l'autorisation de ses demandes d'APA. Bien que ces formulaires soient maintenant disponibles depuis peu, son processus de révision a bien entendu été perturbé par la crise sanitaire mondiale de la COVID-19 qui a présentement lieu.

Objectifs du projet et hypothèses de travail

Ce projet de doctorat s'inscrit, en premier lieu, dans le cadre des activités de l'Équipe de Recherche sur les Médecines Autochtones Antidiabétiques des Instituts de Recherche en Santé du Canada (EMAA-IRSC), dont les objectifs principaux sont d'augmenter l'accessibilité aux médecines locales et de développer des approches culturellement adaptées pour traiter le diabète dans les communautés canadiennes. Depuis l'élaboration de diverses ententes de recherche, l'EMAA-IRSC travaillent avec le Conseil Cri de la Santé et des Services Sociaux de la Baie James (CCSSSBJ) depuis 2003. En un deuxième temps, il s'inscrit aussi dans le cadre des activités de recherche de l'Observatoire Hommes-Milieus (OHM) de l'Oyapock (financé par le labex DRIIHM), dont l'objectif principal est d'étudier les impacts de la construction du pont fluviale au-dessus du fleuve de l'Oyapock sur les communautés qui l'entourent. Étant donné que ce pont et les routes y menant modifient considérablement l'accessibilité à la zone et les rapports que les

populations locales entretiennent avec leur environnement. Ainsi, depuis 2008, l'OHM Oyapock accompagne ou initie de nombreuses études interdisciplinaires permettant de mieux comprendre les enjeux sociaux, économiques, environnementaux et de santé que connaît la région transfrontalière de l'Oyapock.

Les Peuples autochtones impliqués dans cette étude incluent plus spécifiquement les Premières Nations Cris d'Eeyou Istchee de Mistissini et Chisasibi (Québec), la Première Nation des Pekuakamiulnuatsh de Mashteuiatsh (Québec), ainsi que les Parikwene des villages de Kamuyene et Norino dans la commune de Macouria (Guyane française), et des villages d'Espérance 1 et Espérance 2 dans la commune de Saint-Georges de l'Oyapock (Guyane française). Étant donnée la proximité des villages, leurs résidents sont renvoyés à leur commune d'attache, c'est-à-dire, les Parikwene de Macouria et les Parikwene de Saint-Georges.

Tenant compte des activités de recherche de l'EMAA-IRSC et de ses ententes avec les Cris d'Eeyou Istchee et les Pekuakamiulnuatsh, le contexte de cette étude s'inscrit aussi dans les démarches d'autochtonisation des systèmes de santé disponible aux populations autochtones (Viger 2011). Tenant compte des différences fondamentales entre les systèmes de santé canadien et français, l'ampleur de ce processus ne peut vraisemblablement pas être identique. Cependant, à travers les principes de la santé communautaire dont les bases existent dans ces deux systèmes, diverses initiatives et actions sont entreprises pour arriver à leurs buts. Cela implique la mobilisation des Anciens, mais aussi le travail en interdisciplinarité et à l'intersectorialité¹, ainsi que l'éducation de la population, d'où la justification d'interviewer des personnes parties prenantes des réseaux de santé (Autochtones et non-Autochtones) et des personnes qui ne sont pas forcément

¹ « Actions entreprises par d'autres secteurs que celui de la santé, en collaboration avec le secteur de la santé, qui visent des résultats de santé ou d'équité en santé ou ciblent des déterminants de la santé ou de l'équité en santé » (Ministère de la Santé et des Services Sociaux 2017:4).

considérées comme des « porteurs de savoirs ». Alors que la majorité des stratégies présentées par Viger (2011), soit l'autogouvernance, l'autochtonisation des professions, l'engagement à la décolonisation et l'utilisation de la langue locale, reviennent en grande partie aux populations concernées et aux structures organisationnelles et politiques déjà en place, le partage et la restitution des résultats aux parties prenantes engagent la protection des savoirs locaux et la compétence culturelle de la main-d'œuvre en promouvant la sécurité culturelle dans les services de santé.

Enfin, bien qu'elle n'exclût pas les notions associées à la santé, cette thèse s'intéresse davantage aux paramètres de la maladie du diabète, soit les connaissances et les pratiques.

Les objectifs principaux de cette thèse sont :

- i)* développer des méthodes statistiques employées en écologie pour analyser de larges bases de données issus d'entrevues ;
- ii)* définir les systèmes médicaux cris, ilnu et parikwene afin d'élucider plus particulièrement la relation entre la médecine et l'alimentation ;
- iii)* identifier les plantes et les animaux faisant parties de ces systèmes médicaux et alimentaires qui sont perçus pour leurs propriétés bénéfiques sur les maladies chroniques, plus spécifiquement le diabète ;
- iv)* comparer les systèmes de médecine cris, ilnu et parikwene.

Tenant compte des dimensions sociales et historiques du diabète qui découlent directement de la colonisation des Amériques, la comparaison des systèmes de médecine cherche à vérifier l'hypothèse que :

- 1) l'accès au territoire et à la nature est un principe central des médecines décrites dans cette thèse et que la santé des diabétiques en dépend ;
- 2) le schisme entre territoire et nature dans les systèmes biomédicaux disponibles à la population crie, ilnu et parikwene varie en importance fonction de l'implication de la population locale dans ces systèmes de santé, c'est-à-dire, plus le système biomédicinal est représenté par une population non-autochtone, plus le territoire est ignoré comme composante essentielle de la santé des populations locales.

Afin de répondre à ces objectifs, une approche pluridisciplinaire, qui emprunte des méthodes de recherche aux sciences biologiques et aux sciences sociales, est employée. L'avantage des méthodes de recherche mixtes permet d'engager les parties prenantes et de les impliquer dans la recherche et la co-crédation du savoir (Viger 2011; Molina-Azorin and Fetters 2019). De plus, les parties prenantes ne valorisent pas tous l'information de la mme maniere, certaines peuvent être interpellées par des résultats statistiques alors que d'autres peuvent être interpellées par des histoires, des observations et autres résultats qualitatifs (Molina-Azorin and Fetters 2019).

Cette thèse est présentée sous format d'articles qui n'ont pas encore été publiés, étant sous embargo à l'heure actuelle. Alors que les articles concernant les Cris d'Eeyou Istchee et les Pekuakamilnuatsh font présentement l'objet d'une révision de la part de ces Premières Nations, tel que stipulé par l'accord de recherche, ceux concernant les Parikwene attendent toujours les autorisations APA pour valider les taxons avec des spécimens d'herbier. Le contexte ethnomédicinal et ethnobiologique des Peuples impliqués dans cette thèse est détaillé au **Chapitre 1** et correspond au seul chapitre qui n'est pas destiné à un journal scientifique. Le **Chapitre 2** répond au premier objectif de cette thèse ; il présente les méthodes mixtes employées pour faire la

collecte de données et l'analyse comparative des systèmes de médecine autochtones à l'aide de statistiques. Afin de combler un fossé important de connaissance ethnomédicinale quant au du diabète chez les Parikwene, le **Chapitre 3** présente une étude classique CAP réalisée auprès des villages Parikwene pour répondre au deuxième et au troisième objectif de cette thèse. Pour ce qui a trait aux Cris et aux Innu, le troisième objectif est abordé au **Chapitre 4** en considérant que les animaux et les plantes ne peuvent pas être étudiés isolément (Parlee et al. 2005). Cela s'apparente à la pharmacothérapie qui ne peut pas non plus être prise de manière isolée dans la gestion du diabète. L'on peut donc faire appel à l'approche « *2-eyed seing* » (Bartlett et al. 2012; Peltier 2018), où l'image de chaque objectif est consolidée ici à l'aide d'outils développés en écologie et adoptés en ethnobotanique quantitative (Höft et al. 1999; Legendre and Legendre 2012). Finalement, l'analyse comparative des médecines cries, ilnu et parikwene, soit le dernier objectif de cette thèse, et non le moindre, est abordée au **Chapitre 5**. Bien que la première hypothèse soit évaluée principalement de manière qualitative, ce sont les outils développés dans le **Chapitre 2** qui seront utilisés pour tester la deuxième hypothèse en réalisant le dernier objectif de cette thèse.

**Chapitre 1 - Contexte ethnomédicinale et ethnobiologique
concernant les Cris d'Eeyou Istchee, les Pekuakamilnuatsh et les
Parikwene**

1.1 Les systèmes de santé

L'alarme que sonnent la multitude d'études et de rapports sur le diabète, ainsi que l'urgence de développer des stratégies adaptées aux populations soulignent la pression opérée par cette maladie sur les systèmes de santé à travers le monde, et cela est d'autant plus vrai au Canada et en France. Le diabète de type 2 (DT2) est l'une des conditions chroniques les plus fréquentes au Canada (Rosella et al. 2015). En 2019, il y avait 2,5 millions de diabétiques, représentant 7,8% de la population (Statistique Canada 2020), alors qu'en France, le nombre de personnes traitées pharmacologiquement pour le diabète était estimé à 3,3 millions d'individus en 2015, soit 5% de la population (Mandereau-Bruno and Fosse-Edorh 2017). De plus, Bilandzic and Rosella (2017) estiment que les nouveaux cas de diabète prévus entre 2011-2022 coûteront 15,36 milliards \$CAN au système de santé canadien et la France estime que le coût direct des dépenses médicales associées au DT2 aurait monté à 8,5 milliards € en 2013, soit 5 % des dépenses totales du système de santé français (Charbonnel et al. 2017, 2018). Pour ces deux systèmes de santé, financés par des fonds publics afin d'offrir des services gratuits à la population (Grignon 2010; Morgan et al. 2017; Naylor et al. 2020), cela représente un fardeau important à la société les supportant (Bilandzic and Rosella 2017; Charbonnel et al. 2017, 2018).

Malgré tout, plusieurs des recommandations proposées pour les populations à risque, comme les Peuples autochtones, proviennent d'une littérature principalement canadienne (Adelson 2005; Hanley et al. 2005; Yu and Zinman 2007; Dannenbaum et al. 2008; Dyck et al. 2010; Harris et al. 2011; Hayward et al. 2012; Jacklin et al. 2017; Crowshoe et al. 2018a; Voaklander et al. 2020). Préconisant une sensibilité culturelle envers les pratiques thérapeutiques locales, comme les plantes médicinales, ces recommandations tournent beaucoup autour du concept de la « communauté ». On a pu ainsi voir se créer des initiatives communautaires à travers des

programmes ou des partenariats issues localement (Yu and Zinman 2007; Dyck et al. 2010; Harris et al. 2011; Hayward et al. 2012; Jacklin et al. 2017; Clement et al. 2018; Crowshoe et al. 2018a; Voaklander et al. 2020). Émanant du mouvement de la santé communautaire provenant du Royaume-Uni, du Canada et des États-Unis, le développement de ce domaine de la santé est ancré dans des valeurs constitutionnelles caractérisant des systèmes de politiques et de gouvernances bien différentes de la France. Tenant compte du contexte international de cette thèse, soit un projet en lien avec les Premières Nations vivant tant au Québec (Canada), qu'en Guyane française (France), il est donc important de contextualiser les systèmes de santé qui leur sont disponibles dans ces deux milieux afin de comprendre la place que peuvent prendre les médecines locales et l'impact des soins sur la santé autochtone.

1.1.1 Le système de santé canadien

Le système de santé canadien se contextualise dans une gouvernance fédéraliste qui implique le partage du pouvoir entre différents niveaux de gouvernement (Jordan 2008; Dubois and Saunders 2013). De son héritage politique britannique, le fédéralisme canadien est caractérisé par deux principales entités juridiques et politiques, le national et le provincial, qui peuvent agir indépendamment, interagir ou faire compétition (Palley 1987; Jordan 2008). Ainsi, le partage des pouvoirs a été initialement formulé dans la Loi constitutionnelle de 1867, inspirée du style de Westminster des institutions politiques du Royaume-Uni (Jordan 2008), et l'un des premiers et principaux textes adoptés dans la Constitution du Canada (Ministère de la justice Canada 2012). Promulguée par le Parlement du Royaume-Uni, elle formalise non-seulement la création du Dominion du Canada, mais aussi la distribution des pouvoirs aux provinces fondatrices comme le

Québec, dont la responsabilité des soins de santé (Tiedemann 2008; Ministère de la justice Canada 2012).

Les provinces sont donc responsables, entre autres, des hôpitaux, de la prestation directe de la plupart des services médicaux et de la formation des médecins (Tiedemann 2008). Le gouvernement fédéral, quant à lui, exerce ses rôles dans la structure du système de santé à partir de trois pouvoirs constitutionnels, dont l'un étant sa compétence en matière de droit criminel (par exemple, les substances réglementées, les médicaments et les aliments), et un deuxième étant son pouvoir de dépenser (Tiedemann 2008). C'est en exerçant son pouvoir de dépenser que le gouvernement fédéral développe et établit les normes nationales du système de santé canadien, soit par le moyen de contributions financières attribuées aux provinces en fonction des normes auxquelles elles répondent (Palley 1987; Tiedemann 2008). En bref, c'est l'interaction des entités provinciales et fédérale qui est à l'origine du système de santé canadien. Les idéaux du fédéralisme, fondés sur le principe de l'unité dans la diversité à travers la promotion, la conciliation et la protection des identités distinctes au sein d'un État (Ronald 2008), prévoient donc une place prépondérante pour la reconnaissance des communautés, comme les Premières Nations (Chicot 2011).

1.1.2 Le système de santé français

Le système de santé français s'inscrit dans une gouvernance républicaine qui implique l'unité du peuple. Les concepts d'une France unie et indivisible proviennent de l'héritage jacobin qui défend la souveraineté populaire et l'indivisibilité de la France, et qui s'oppose au fédéralisme (Gauchet 2001; Bouquet and Dubasque 2011; Chicot 2011; Tulard 2014). Prenant son nom du Club des Jacobins qui, s'identifiant au peuple, exerça une influence sociale et politique au sein de

la Révolution française de 1789, cette doctrine politique est née d'un mouvement populaire qui précipita la transition de la monarchie absolue en France à une république (Gauchet 2001; Tulard 2014; Renard 2015). La fin du Club en 1794 n'empêche cependant pas à l'idéologie jacobiniste de se perpétuer dans une doctrine qui tend à organiser le pouvoir de façon centralisée et à l'exercer de manière uniforme à tous les échelons géographiques et sociaux (Duran and Thoenig 1996; Gauchet 2001; Tulard 2014; Dumont 2018). Ces valeurs idéologiques sont reflétées dans la constitution française qui stipule dans l'article premier (Gouvernement de la République 2018:1) :

« La France est une république indivisible, laïque, démocratique et sociale. Elle assure l'égalité devant la loi de tous les citoyens sans distinction d'origine, de race ou de religion. Elle respecte toutes les croyances. Son organisation est décentralisée. »

Malgré ce dernier énoncé de l'article premier, ratifié depuis la rédaction initiale de la Constitution de 1958 suite à l'adoption de lois de décentralisation en 1982-1983 et de la réforme constitutionnelle de 2003 (Elfort 2010; Chicot 2011; Filoche 2011; Dumont 2018), la politique de santé en France est historiquement considérée *« comme un domaine régalien, c'est-à-dire, relevant de la compétence de l'État central »* (Jourdan et al. 2012:173), évoquant plus particulièrement son indivisibilité. Ainsi, les idéaux de la République, supposant un peuple uni (Renard 2015), ne préconise pas la reconnaissance des communautés. La décentralisation des systèmes de santé est tout de même apparente dans les mandats des Agences Régionales de la Santé (ARS), des établissements publics administratifs de l'État chargés des politiques de santé dans leur région en fonction des besoins de la population (Mosnier 2017). Quant à la Guyane française, c'est le Conseil général de la Guyane qui prend en charge les *« Centres de médecine collective des départements d'outre-mer »* en 1983 (Mosnier 2017). En raison du cout, ces centres sont délégués au Centre Hospitalier de Cayenne Andrée Rosemon (CHC) qui les dénomme

désormais des Centres Délocalisés de Prévention et de Soins (CDPS) en 2000 (Mosnier 2017; Van Gastel et al. 2021). Seuls les centres de Protection Maternelle et Infantile (PMI), qui assurent les suivis de grossesse, demeurent sous la gestion de la Collectivité Territoriale de Guyane (Mosnier 2017).

1.1.3 La santé des Peuples autochtones

En ce qui concerne les populations autochtones, les caractéristiques des systèmes de santé français et canadien sont résumées dans la **Table 1.1**. L'interprétation de l'article premier de la constitution française est importante pour comprendre les différences fondamentales dans la gestion des soins entre la France et le Canada, particulièrement en lien avec les populations autochtones. Ne distinguant donc pas les origines, la race ou la religion, les populations autochtones sur le territoire français sont avant tout : Français. Or, depuis la départementalisation de l'ancienne colonie de la Guyane française en 1946, il n'y a pas de place dans l'ordre juridique français pour l'individu, ni les collectivités autochtones (Elfort 2010; Chicot 2011; Filoche 2011; Collomb 2011; Guyon and Trépied 2013), tels les Parikwene qui se sont faits plus tard octroyer la citoyenneté française en 1967 (Grenand and Grenand 1990; Guyon and Trépied 2013). Les départements à l'ultra-périphérie du centre géographique de la France étant donc soumis au principe de l'assimilation législative (Bellier 2008; Elfort 2010; Chicot 2011; Filoche 2011), les Peuples autochtones dans ce département sud-américain accèdent donc aux services de santé de la même manière que tous les citoyens français.

Au Canada, cependant, les Peuples autochtones, officiellement dénommés Premières Nations, Métis et Inuit (Chicot 2011), sont dotés d'une reconnaissance juridique particulière de leur statut (Caron et al. 2006; Chicot 2011). Pré-datant la Confédération canadienne de 1867, la

Proclamation royale de 1763 reconnaît les titres ancestraux, soit le droit inhérent des Peuples autochtones aux terres et à leur utilisation, par exemple, chasser et piéger (O'Reilly 1984; Chicot 2011; Saganash 2011; Dubois and Saunders 2013; Leclair and Morin 2017). En spécifiant que seule la Couronne, britannique à l'époque, est en mesure d'acheter des terres autochtones et de les acquérir par des traités avec ces peuples (Leclair and Morin 2017), certaines interprétations supposent que ces peuples sont reconnus comme étant des entités politiques distinctes et autonomes capable d'entrer en négociations avec la Couronne (Saganash 2011; Dubois and Saunders 2013).

Table 1.1. Comparaison entre le système de santé français et canadien en lien avec les populations autochtones.

Description du système de santé	France	Canada
• Système politique	République	Fédération
• Financement	Publique	Publique
• Accès	Gratuit	Gratuit
• Gestion	Régalien	Régionalisé
• Contrôle	L'État	La Première Nation (selon les traités)
• Statut juridique autochtone	Non	Oui
• Reconnaisances des communautés	Non	Oui

Indifférente, la Confédération canadienne adopta la Loi constitutionnelle de 1867 sans l'implication des Peuples autochtones (Dubois and Saunders 2013). Au lieu de maintenir la souveraineté au sein des divers peuples, la Loi constitutionnelle de 1867 divise les pouvoirs entre les provinces, définies territorialement, et transforme les Peuples autochtones en des sujets

britanniques sans autorité juridique ou gouvernementale propre à eux (Dubois and Saunders 2013). Malgré tout, la Loi constitutionnelle de 1982, marquant le rapatriement de la constitution au Canada, réaffirme tout de même la validité de la Proclamation royale de 1763 et autres traités signés avec la couronne britannique, reconnaissant ainsi les droits et libertés des Peuples autochtones du Canada (O'Reilly 1984; Ministère de la justice Canada 2012). Face à un déficit fédératif important à l'égard des Peuples autochtones (Caron et al. 2006), les gouvernements provinciaux et fédéral n'ont toujours pas clairement spécifié ce que sont ces droits et libertés (Chicot 2011; Dubois and Saunders 2013).

Bien que ce soit aux provinces de fournir les soins de santé à la population canadienne, la Constitution du Canada confère au gouvernement fédéral l'autorité sur les Peuples autochtones du Canada (Chenier 2004; Ministère de la justice Canada 2012). C'est donc à lui de fournir de multiples services de santé à ces populations qui font juridiquement exception à la population canadienne générale. Mais en vérité, la responsabilité des prestations des services de santé envers ces peuples est réellement partagée avec les gouvernement provinciaux qui participent principalement dans la prestation des services médicaux et hospitaliers (Chenier 2004; Lemchuk-Favel and Jock 2004; Tiedemann 2008). Le gouvernement fédéral, quant à lui, détient la responsabilité de fournir et de financer divers programmes, tel le *Aboriginal Diabetes Strategy* (Lemchuk-Favel and Jock 2004), axés sur la promotion de la santé, la prévention ainsi que la santé communautaire (Chenier 2004). L'approche à la santé des populations autochtones du Canada semblerait contredire le statut particulier que possède ces peuples au sein de l'État (Dubois and Saunders 2013). Mais c'est à travers cette structure politique complexe que les idéaux fédéralistes sont souvent devancés pour répondre aux demandes à l'autodétermination des Peuples autochtones

du Canada, telle qu'en matière de la gestion des soins (Dubois and Saunders 2013; Leclair and Morin 2017).

Il va de soi que l'accès aux soins et sa structure d'offre et de délivrance chez les différents Peuples autochtones du Canada dépend largement de leurs relations entre les gouvernements provinciaux et fédéral. Mais il dépend plus de l'histoire unique de chacun de ces peuples avec l'État à travers les traités et les ententes, que des interprétations concernant les titres ancestraux et des droits, qui ne sont pas égaux d'une Nation à l'autre (Chicot 2011), et demeurent au centre des revendications autochtones (Lemchuk-Favel and Jock 2004; Commission de vérité et réconciliation du Canada 2012). Tenant compte de ces contraintes, ainsi que de celles attribuées à l'éloignement géographique et la taille des communautés, Roy (1999) estime que les services de santé chez les Premières Nations au Québec sont néanmoins comparables dans l'ensemble du Canada.

De nos jours, les Peuples autochtones réaffirment leur place dans le fédéralisme canadien. Collaborant avec les différents paliers du gouvernement, plusieurs développent leurs structures d'autogouvernance et reprennent davantage le contrôle des services et des programmes offerts auprès de leur population, incluant les services de santé (Lemchuk-Favel and Jock 2004; Walker et al. 2010; Saganash 2011; Dubois and Saunders 2013). C'est en phase avec les recommandations de la Commission de vérité et réconciliation du Canada (2012) qui revendique les droits autochtones en matière de santé, entre autres, tels qu'identifiés dans la constitution, les traités et le droit international (Truth and Reconciliation Commission of Canada 2015b). Il est alors surprenant que le Canada signe tardivement, en 2010, la Déclaration des Nations Unies sur les Droits des Peuples Autochtones, adopté en 2007 (Saganash 2011; Leclair and Morin 2017), reconnaissant le droit de ces peuples à l'autodétermination, l'autogestion et la santé, dont l'accès à leur

pharmacopée (Hermitte 2007; Nations Unies 2008; Gentelet et al. 2010). Tandis que la France soutient officiellement la Déclaration des Nations Unies sur les droits des Peuples autochtones (Nations Unies 2008), étant l'un des signataires au moment de son adoption (Hermitte 2007; Elfort 2010; Filoche 2011; Guyon and Trépied 2013), bien qu'aucun statut juridique particulier n'existe pour ces peuples.

1.1.4 La santé communautaire dans les systèmes de santé

Malgré le positionnement contentieux du Canada et de la France à l'égard des droits des Peuples autochtones, c'est à travers leurs revendications que l'on peut voir apparaître les notions de santé communautaire. En fait, les notions associées à la santé communautaire apparaissent dans la première moitié des années 1960, émergeant principalement des États-Unis « *comme un mode alternatif de dispensation des soins* » (Conill and O'Neill 1984:172). Durant les années 1970, ces notions apparaissent mondialement, soit par exportation du concept à partir des États-Unis ou en trouvant un terreau fertile dans les endroits où les conditions socio-économiques sont propices à susciter des réactions du type santé communautaire (Lathem 1976; Conill and O'Neill 1984; Jourdan et al. 2012). Mais la terminologie n'étant pas consolidée, on parle alors indistinctement de « *médecine communautaire* » ou de « *santé communautaire* » (Conill and O'Neill 1984). De même, entre 1965-1971, l'Organisation Mondiale de la Santé (OMS) finance des projets pour développer des programmes de santé publique impliquant la participation de la population ; il les dénomment variablement : « *services de santé communautaire* », « *services sanitaires de base* », « *soins de santé de base* » ou « *services communautaires de santé* » (Djukanovic and Mach 1975; Conill and O'Neill 1984).

Quoique les notions associées à la santé communautaire soient très employées durant cette période, elle ne possède toujours pas de définition simple et univoque (Jourdan et al. 2012).

L'OMS décrit la santé communautaire comme un :

« Processus par lequel les membres d'une collectivité, géographique ou sociale, conscients de leur appartenance à un même groupe, réfléchissent en commun sur les problèmes de leur santé, expriment leurs besoins prioritaires et participent activement à la mise en place, au déroulement et à l'évaluation des activités les plus aptes à répondre à ces priorités » (Motamed 2015:564).

Jourdan et al. (2012) précisent que la santé communautaire se rapporte à la définition classique de la santé publique de Winslow, soit *« l'art et la science d'améliorer l'état de santé de la population, de prévenir la maladie, et de promouvoir l'efficacité des services de santé par la coordination des efforts communautaires »* (Winslow 1920; traduit de l'anglais par Conill and O'Neill 1984:169), avec l'ajout des dimensions de la participation communautaire ou d'une organisation intégrée des services curatifs et préventifs de santé. Jourdan et al. (2012:172) produisent, à leur tour, une définition contemporaine de la santé communautaire comme étant :

« Une pratique multidisciplinaire et multisectorielle d'intervention et de recherche située à la frontière du sanitaire et du social, imprégnée de valeurs phares précises portées par des acteurs provenant de divers milieux qui mettent l'accent sur des théories, approches et méthodes particulières appliquées à certains espaces privilégiés pour l'action. »

Valorisant la promotion de la santé ainsi que la participation et le développement social, le domaine de la santé communautaire s'inscrirait donc dans le champ du socio-sanitaire chevauchant en partie le domaine de la santé publique (Conill and O'Neill 1984; Jourdan et al. 2012). Pour la

distinguer des notions de santé publique et de médecine classique, Conill and O'Neill (1984) détaillent leurs éléments caractéristiques (**Table 1.2**). Tout de même, Jourdan et al. (2012) soulignent que la santé communautaire serait plutôt un carrefour disciplinaire qu'une discipline en soi. De plus, la participation communautaire, voire des parties prenantes, peut compter jusqu'à sept niveaux, commençant à partir de séances d'informations ou de consultations publiques dans les niveaux inférieurs jusqu'au contrôle citoyen dans les niveaux supérieurs (Motamed 2015). Il n'est donc pas surprenant que la santé communautaire prenne une place et un parcours différent dans les systèmes de santé québécois et français.

1.1.5 La santé communautaire institutionnalisée

En raison du partage des pouvoirs et des responsabilités politiques et juridiques concernant la gestion du système de santé canadien, la santé communautaire, qui est caractérisée par un système décentralisé et qui vise les groupes de populations comme usagers (**Table 1.2** ; Conill and O'Neill 1984), a vite su faire sa place. Il serait difficile de généraliser le développement de la santé communautaire dans ce pays sans distinguer les différences entre les provinces et les territoires. Quoique le gouvernement fédéral ait fortement encouragé le virage vers la santé communautaire dans les provinces canadiennes, le Québec ne faisant pas exception (Conill and O'Neill 1984), c'est de la santé communautaire chez cette dernière que nous traiterons ici.

Dès le début des années 1970, la santé communautaire s'institutionnalise au Québec en devenant la philosophie à partir de laquelle le Québec tente de réorganiser ses services de santé publique (Bergeron and Gagnon 2005; Jourdan et al. 2012). À partir des idéaux de participation, de multidisciplinarité et de médecine globale (Conill and O'Neill 1984), le Québec crée alors les Centres Locaux de Services Communautaires (CLSC) joignant ensemble les services

Table 1.2. Comparaison entre médecine classique, santé publique et santé communautaire selon Conill and O'Neill (1984).

Éléments de comparaison	Médecine classique	Santé publique	Santé communautaire
1) Usagers	Individus	Population	Groupes de population
2) Initiatives	Malade	Service	Patient et service
3) Choix	Large	Restreint	Restreint
4) Accès	Difficile	Difficile	Facile
5) Soins	Épisodiques	Périodiques	Continus
6) Continuité	Minime	Minime	Grande
7) Attitude des usagers	Obéissance et soumission	Soumission	Participation
8) Attitude des professionnels	Aristocratique et technocratique	Technocratique	Démocratique
9) Techniques	Diagnostique et traitement de la maladie, conseil	Investigation et contrôle des maladies de masse, persuasion	Identification et solution des problèmes ressentis, orientation et aide
10) Approche	Individu, système et organes, hypothèse unicausale, recherche de la certitude	Société, groupes sociaux, hypothèse multicausale, recherche de la certitude	Familles et groupes, individus et communauté, hypothèse multicausale, tolérance à l'incertitude
11) Modalités de service	Un pour un, plusieurs pour un	Un pour plusieurs, plusieurs pour plusieurs	Un pour un, un pour plusieurs, plusieurs pour un, plusieurs pour plusieurs
12) Caractéristique	Médecine libérale	Système centralisé	Système décentralisé

Éléments de comparaison	Médecine classique	Santé publique	Santé communautaire
13) Rémunération	Directe, paiement à l'acte	Indirecte, salariale	Indirecte avec ou sans complément, salaire per capita
14) Évaluation	Maladies soignées	Maladies évitées	Problèmes résolus
15) Jugement de valeur	Qualité	Coût-efficacité	Satisfaction de l'utilisateur, couverture de la population

de santé primaire, les services sociaux et les projets communautaires (Palley 1987; Turgeon et al. 2005). Mais l'on constate depuis les années 1990 qu'ils n'ont pas su efficacement orienter l'ensemble de ces services du fait de la force et de l'emprise des acteurs du secteur curatif, tels les médecins et les hôpitaux (Jourdan et al. 2012). Bien que les CLSC perdurent aujourd'hui, formant un réseau de 147 centres dans toute la province, sans relâche de cette emprise, la santé communautaire en soi est maintenant réduite à un sous-ensemble d'interventions portées à l'intérieur des institutions de santé publique et par des organismes communautaires de la mouvance associative (Jourdan et al. 2012).

1.1.6 La santé communautaire « in-formalisée »

Si le Québec et le Canada se lancent très tôt dans le mouvement de la santé communautaire, ce n'est qu'à partir de 2009, avec la loi du 21 juillet 2009 portant sur la réforme de l'hôpital et relative aux patients, à la santé et aux territoires, que l'on voit réellement émerger les caractéristiques de la santé communautaire dans la politique de santé française (Jourdan et al. 2012). Il n'est donc pas surprenant qu'à cette période l'on retrouve des arguments pour une approche communautaire dans la santé, appuyés sur l'exemple des États-Unis et du Québec (Shankand et al. 2009). Mais une pratique similaire existe tout de même depuis plus de 40 ans par l'entremise d'initiatives locales, particulièrement dans les régions rurales isolées et en milieu défavorisé (Bouquet and Dubasque 2011; Jourdan et al. 2012).

Ce n'est qu'à partir de 1983, avec les lois de décentralisation, que la France délègue l'action sociale aux collectivités territoriales (Jourdan et al. 2012). Les initiatives locales émergeant dans le cadre de contrats de ville voient peu à peu s'intégrer les problématiques de santé, particulièrement vers la fin des années 1990 (Jourdan et al. 2012). Malgré le développement à

petits pas d'une approche communautaire de la santé en France, ces notions ne sont pas sans apporter un certain malaise :

« Il n'est pas anodin de constater que le terme "santé communautaire" ne fait toujours pas partie du vocabulaire utilisé par la santé publique française [...] largement disqualifiée par les acteurs politiques qui n'ont pas hésité à l'assimiler à une éphémère mode "post-1968" ou bien à l'expression d'un communautarisme potentiellement dangereux » (Jourdan et al. 2012:174).

Effectivement, il existe des difficultés fondamentales à employer les termes « communauté » et « communautaire » qui renvoient à une interprétation de l'article premier de la constitution française les opposant aux concepts d'indivisibilité et d'égalité (Broussouloux and Houzelle-Marchal 2006; Shankand et al. 2009). Alors que d'autre part ces termes désignent des groupes d'individus engagés dans des actions communes et qui sont rattachés les uns aux autres par des intérêts, des aspirations ou des valeurs communes (MacQueen et al. 2001; Shankand et al. 2009), voire même différents groupes ethniques situés localement (Bouquet and Dubasque 2011), la parcellisation de la société sous forme de groupements unis est davantage associée en France à un communautarisme connoté négativement (Shankand et al. 2009). Tenant compte de la tradition politique française qui ne préconise pas la communauté, les notions associées à la santé communautaire sont plutôt remplacées par les concepts de localité et de collectivité qui paraissent mieux adaptés au contexte politique (Bouquet and Dubasque 2011).

La Guyane fait tout de même exception à la France. Car bien qu'elle s'abstient juridiquement de reconnaître les populations autochtones de ce département comme « Peuples », elle tend à les décrire comme des « *communautés d'habitants qui tirent traditionnellement leurs moyens de substance de la forêt* », dont les droits d'usage collectif sont reconnus pour « *toute*

activité nécessaire à la subsistance de ces communautés », telles la chasse et la pêche (Chicot 2011; Guyon and Trépied 2013; Davy et al. 2016). En lien avec sa posture à l'internationale à l'égard des droits autochtones, concordant de plus en plus avec le discours international, la France reconnaît davantage, quoiqu'implicitement, leurs particularismes et leurs droits coutumiers (Elfort 2010; Filoche 2011). Sous les prétextes additionnels des particularités géographiques du département, caractérisées entre autres par un fort mouvement de populations entre le Suriname et le Brésil, ainsi que de l'isolement géographique des communes et des populations, la santé communautaire y trouve sa raison et sa place, notamment dans les initiatives des CDPS et du CHC (Brousse et al. 2015; Mosnier 2017).

1.2 La santé autochtone : une structure de santé communautaire

Malgré l'historique du Canada avec la santé communautaire, certains projets d'intervention, qui naviguent dans ce champ disciplinaire, ont manqué le coup au niveau de la participation communautaire. Le *Nova-Scotia Prediabetes Project* s'est démarqué dans sa démarche du dépistage et de l'intervention du prédiabète et du diabète en impliquant l'Agence de la Santé Publique du Canada (ASPC) et deux autorités sanitaires locales (Talbot and Dunbar 2011). Bien que le projet visait le développement d'un programme de modification des habitudes de vie au stade du prédiabète ancré dans la réalité et le vécu des partenaires de la communauté, par faute de financement, elle se limita au dépistage et à la communication d'information (Talbot and Dunbar 2011).

Tout de même, le carrefour de la santé communautaire semble trouver un terreau fertile dans le milieu autochtone grâce à leur statut particulier dans la juridiction canadienne. Là, ces

notions se marient avec le concept de sécurité culturelle, formalisé en Nouvelle-Zélande par des infirmières maories, où « *la pratique auprès d'une personne ou d'une famille d'une autre culture, est déterminée par cette personne ou cette famille* » (Blanchet Garneau and Pepin 2012:25). Bien qu'initialement, le gouvernement fédéral soit impliqué directement dans la prestation des services de santé dans les communautés autochtones, le transfert du contrôle et de l'administration s'est fait et continue de se faire à petits pas (Lemchuk-Favel and Jock 2004; Bellier 2008). Il s'ensuit, dans plusieurs cas, des changements fondamentaux au sein du système de départ, tout comme les politiques de réformes observées dans les systèmes de santé provinciaux (Lemchuk-Favel and Jock 2004). L'appropriation des systèmes de santé par les Peuples autochtones contribue au climat de réaffirmation, d'autodétermination et d'autogouvernance que revendiquent ces populations et peut conséquemment améliorer l'accès aux services à l'aide d'un environnement culturellement approprié (Lemchuk-Favel and Jock 2004).

De multiples systèmes de santé autochtones ont vu le jour à travers le Canada intégrant les pratiques de guérisons locales, ainsi que les notions holistiques de bien-être (Lemchuk-Favel and Jock 2004). Certains modèles impliquent des guérisseurs traditionnels, des médecines autochtones et des Aînés des communautés (Lemchuk-Favel and Jock 2004; Dooley et al. 2009; Walker et al. 2010), parfois même s'alliant avec la recherche en milieu académique (Paradis et al. 2005; Cuerrier et al. 2012; Haddad et al. 2012; Tremblay et al. 2018). De surcroît, plusieurs programmes de santé, unique à chaque système, ont été développés en réponse aux problématiques de santé propres aux populations autochtones, comme le diabète et l'obésité. La Première Nation Mohawk de Kahnawake (Québec), notamment, s'est dotée d'un programme efficace d'éducation au diabète : le *Kahnawake Schools Diabetes Prevention Project*, KSDPP (Potvin et al. 2003; Bisset et al. 2004; Paradis et al. 2005; Tremblay et al. 2018). En plus de développer des programmes ciblés au

traitement et à la gestion du diabète, d'autres Premières Nations vont aussi loin que de se doter de centres de santé offrant un espace pour la biomédecine et les médecines locales, comme le *All Nations' Healing Hospital* au Saskatchewan (Sanzone et al. 2019; Drost 2019), ainsi que le *Noojmowin Teg Health Centre* sur l'Île Manitoulin (Maar 2004) et le *Meno Ya Win Health Centre* à Sioux Lookout (Sanderson 2016), deux des dix centres de santé appartenant au réseau des *Aboriginal Health Access Centres* en Ontario. Ainsi, ces types d'actions communautaires correspondent au niveau le plus poussé, soit le contrôle citoyen (Motamed 2015).

1.2.1 Cris d'Eeyou Istchee (Québec, Canada)

Suite à l'opposition des Cris d'Eeyou Istchee et des Inuit du Nunavik à l'égard des projets hydroélectriques menés par Hydro-Québec, les revendications territoriales ont été résolues par la signature de la Convention de la Baie-James et du Nord québécois avec le Gouvernement du Canada et du Québec en 1975 (Lemchuk-Favel and Jock 2004; Saganash 2011; Affaires Autochtones et Développement du Nord Canada 2014). Le système de santé cri est ainsi ancré dans la convention. Cette entente contient des lignes directrices pour l'établissement de conseils régionaux de santé contrôlés localement et opérant avec le support du Ministère de la Santé et des Services Sociaux du Québec (MSSSQ) et le gouvernement fédéral qui finance plusieurs programmes et initiatives (Lemchuk-Favel and Jock 2004; Affaires Autochtones et Développement du Nord Canada 2014). Depuis, les Cris d'Eeyou Istchee ont réaffirmé leur droit à l'autogestion et l'autogouvernance à multiple reprise. En 2002, leur relation avec le Gouvernement du Québec est révisée avec une entente de 50 ans de « nation à nation » appelée « La Paix des Braves » ; en 2007, ils font de même avec le Gouvernement du Canada pour une durée de 20 ans (Saganash 2011).

Aujourd'hui, le Conseil Cri de la Santé et des Services Sociaux de la Baie James (CCSSSBJ) est responsable de la prestation des services de santé et sociaux dans les neuf communautés cries situées dans la région administrative 18 du MSSSQ (Viger 2011; Morrow 2019). Le CCSSSBJ opère le Centre hospitalier régional de Chisasibi ainsi que les Centres Miyupimaatissiiun Communautaire (CMC) dans chaque communauté (Viger 2011; Morrow 2019). Les CMC se rapprochent des Centres Intégrés de Santé et de Services Sociaux (CISSS) existant ailleurs au Québec ; ils offrent des services de médecine générale, des soins à domicile, des soins dentaires, des services paramédicaux et des services sociaux (Morrow 2019). Plus précisément, les CMC sont organisés autour de quatre services principaux : 1) les services courants, 2) les services aux enfants et jeunes familles, aussi nommé Awash, 3) les services aux jeunes, aussi nommé Uschiniichu, et 4) les services aux adultes et aux aînés, aussi nommé Chishaayiyiu (Viger 2011). C'est ce dernier service qui s'occupe principalement de la prévention, la prise en charge et le suivi des patients diabétiques ; il forme des intervenants spécialisés, met en œuvre les activités de sensibilisation et de promotion des saines habitudes de vie autour de l'alimentation et de l'exercice physique (Viger 2011).

La vocation communautaire du CCSSSBJ se manifeste dans la mission que se donne l'organisation et qui s'inscrit dans une démarche d'autochtonisation passant par l'implication de la communauté et du contrôle de leurs services (Viger 2011). Cette démarche, dont les stratégies sont énumérés dans la **Table 1.3**, peut être définie comme « *le processus de construction d'organisations culturellement compétente au sein de populations culturellement "déterminées"* » (Viger 2011:224). Certaines communautés d'Eeyou Istchee ont donc un comité communautaire actif de Miyupimaatissiiun représentant divers secteurs de la communauté pour soutenir leurs priorités locales (Viger 2011; Morrow 2019). De plus, le service Nishiiyuu, créé en 2011 au sein

Table 1.3. Initiatives et actions pouvant être entreprises pour supporter les processus d’autochtonisation selon Viger (2011).

Stratégie
<ul style="list-style-type: none">• Utiliser la langue locale• Engager la main-d’œuvre locale• Former la main-d’œuvre locale• Implanter des programmes de prévention de la fuite des cerveaux• Fournir une formation culturellement adaptée• S’engager dans l’autochtonisation des professions• Augmenter la compétence culturelle de la main-d’œuvre non-autochtone• Assurer la sécurité culturelle dans les services• Reconnaître l’approche holistique de la santé et du bien-être• Assurer la participation et le contrôle communautaire• Éduquer la population• S’engager dans un processus de décolonisation• Mobiliser les anciens• S’engager à la protection des savoirs traditionnels• Utiliser les synergies entre les approches classiques et traditionnelles• Promouvoir une approche holistique de la justice• Assurer des services locaux intégrés• Travailler en interdisciplinarité• Travailler à l’intersectorialité• S’autogouverner• Disposer du territoire• Disposer de ressources financières réalistes

de la structure organisationnelle, fait le lien avec le Conseil de Nishiiyuu, constitué d’un groupe d’Aînés issus des communautés, afin de répondre au développement communautaire, ainsi qu’au développement des services et programmes complémentaires (Morrow 2019). Plus précisément,

son mandat est de veiller à l'intégration des connaissances et des valeurs criées dans les services du CCSSSBJ, telle la guérison axée sur le territoire et les médecines locales (Morrow 2019).

Face aux problématiques croissantes liées au diabète, le Système d'Information du Diabète Cri (SIDC) a été mis sur pied en 1996 comme registre et système de surveillance des cas de la maladie (Dannenbaum et al. 1999; Légaré 2004). En raison des complications liées à la maladie, les patients diabétiques doivent souvent se déplacer, parfois sur de longues distances, afin d'accéder à des spécialistes ou des services spécialisés dans les centres urbains plus au sud (Montréal, Chibougamau, Val-d'Or). Dans l'optique d'adopter des stratégies culturellement adaptées pour s'attaquer au diabète, le CCSSSBJ a depuis mandaté une étude sur le vécu du diabète chez les Cris (DyckFehderau 2017), et il est entré en partenariat avec des chercheurs académiques pour évaluer l'activité antidiabétique de leurs médecines (Cuerrier et al. 2012; Haddad et al. 2012).

1.2.2 Innu de Mashteuiatsh (Québec, Canada)

À ce jour, la Première Nation de Mashteuiatsh n'a toujours pas signé une entente via un traité avec le gouvernement canadien ; depuis 40 ans, les Pekuakamiulnuatsh, ou les Innu du Pekuakami (lac Saint-Jean), sont engagés dans un processus de négociation territoriale (Tipi and Boivin 2020). Le respect de leur droit à l'autodétermination est assuré par une entente de principe entre le Gouvernement du Canada, le Gouvernement du Québec ainsi que les Premières Nations de Mashteuiatsh, Essipit et Nutashkuan, en attendant la résolution des négociations d'un traité (Premières Nations de Mamuitun et de Nutashkuan et al. 2004; Tipi and Boivin 2020). Cette entente stipule que le Canada et le Québec conservent leurs responsabilités à la préservation de la santé publique (Premières Nations de Mamuitun et de Nutashkuan et al. 2004). Cependant, elle prévoit que les lois innu auront prépondérance dans les organismes de santé et des services sociaux,

en plus que d'accorder une place aux médecines traditionnelles, sous réserve des lois concernant la santé publique (Premières Nations de Mamuitun et de Nutashkuan et al. 2004).

Le Centre de santé et mieux-être collectif de Mashteuiatsh, *Milueliniun mahk mamu miluelimun*, est géré par le Pekuakamiulnuatsh Takuhikan, l'organisation politique et administrative de la Première Nation (Pekuakamiulnuatsh Takuhikan 2015a). Ainsi, la gestion du centre de santé constitue une unité administrative du Conseil de Bande et il dessert uniquement les membres de la Première Nation. Outre les services de santé généraux, soit la biomédecine, le centre de santé comporte un volet de santé publique offrant plusieurs services dont un programme axé sur les maladies chroniques, comme le diabète, un volet de santé des jeunes et des familles, offrant notamment des suivis prénataux et postnataux, ainsi qu'un volet de santé des Aînés qui gère le Centre Tshishemishk, un centre d'hébergement pour Aînés avec un service d'infirmierie (Pekuakamiulnuatsh Takuhikan 2015a). Tout comme les Cris, les patients diabétiques doivent souvent se déplacer, parfois sur de longues distances, pour accéder à des spécialistes ou des services spécialisés dans les centres urbains non-autochtones (Montréal, Québec, Roberval, Alma).

L'expression de la santé communautaire est apparente par la multitude d'organismes à vocation communautaire qui sont rattachées à la direction de la santé des jeunes et des familles, dont le Carrefour social Ushkui, lieu de création de réseaux sociaux pour favoriser les saines habitudes de vie, et la Maison de la famille, qui vise l'amélioration des conditions de vie des familles (Pekuakamiulnuatsh Takuhikan 2015b). Mis à part le dépistage du diabète, l'équipe pluridisciplinaire du centre de santé de Mashteuiatsh organise aussi des événements communautaires qui s'inscrivent dans une stratégie misant sur la prévention de la maladie et la promotion des saines habitudes de vie.

1.2.3 Parikwene (Guyane française, France)

Puisque les Parikwene accèdent au système de santé de la même manière que tout français, il n'existe aucune structure concrète permettant aux populations autochtones de la Guyane française de participer activement aux décisions concernant les questions de santé. L'action communautaire correspond plutôt aux premiers paliers de l'intervention communautaire : soit des actions menées par des professionnels de la santé prenant place dans les populations ciblées ou à la marge des systèmes sanitaires, soit des interventions menés par des organismes locaux touchant l'éducation thérapeutique, l'aide à l'accès aux droits et à l'acquisition d'habiletés psychosociales (Shankand et al. 2009). En Guyane française, ces organismes locaux comptent des associations de promotion de la santé comme Guyane Promo Santé (GPS), ainsi que des associations de médiations locales, comme le Développement Accompagnement Animation Coopération (DAAC) et l'Actions pour le Développement, l'Éducation et la Recherche (ADER).

C'est à travers l'implication des associations, comme le DAAC et l'ADER que les populations locales peuvent trouver leur place dans les activités du CHC et plus spécifiquement dans les CDPS en régions isolées, comme c'est le cas de Saint-Georges (Mosnier 2017; Moriceau et al. 2018). Mais jusqu'à présent, les intérêts demeurent concentrés davantage sur les maladies infectieuses comme le paludisme, voir par exemple le programme PALUSTOP (Moriceau et al. 2018; Mosnier et al. 2020), et celui sur le virus de l'immunodéficience humaine (VIH) (Mosnier 2017). Pour le diabète, il existe seulement la mise en place d'un registre de diabétiques en Guyane, DIABSAT, pouvant éventuellement servir à mieux cerner l'ampleur du diabète comme problème de santé publique (Sabbah et al. 2021). Bien que durant le cours de cette thèse, un programme d'éducation thérapeutique du patient ait été établi dans le CDPS de Saint-Georges pour les patients

atteints du VIH (Mosnier 2017), ce programme a aussi été offert aux diabétiques afin d'atténuer la stigmatisation que pouvait subir la patientèle visée.

Alors que les Parikwene de Saint-Georges accèdent aux soins de la santé dans le bourg de la commune, un relais existe entre le CDPS et le CHC de Cayenne pour des urgences ou services spécialisés, comme l'hémodialyse. Les services de santé à Saint-Georges sont assurés par des médecins généralistes en pratique publique (CHC) et privée (un cabinet), alors que les diabétiques doivent se déplacer sur une longue distance jusqu'à Cayenne pour voir des spécialistes (par exemple, diabétologue et podologue). Seule une pratique infirmière privée existe spécifiquement pour les soins à domicile des personnes diabétiques. À Macouria, les services sont à une courte distance en voiture des villages parikwene. Le CHC est le centre de santé public le plus proche alors que des médecins généralistes libéraux opèrent des cabinets privés dans les villes et villages avoisinantes, à savoir deux à Macouria et un autre à Cayenne. Comme à Saint-Georges, il existe un service privé de soins infirmiers à domicile pour les diabétiques.

Malgré la reconnaissance d'un problème de santé publique émergeant à l'égard du diabète en Guyane française (Ndong et al. 2010; Richard et al. 2015; Fosse-Edorh et al. 2016; Guarmit et al. 2017; Mandereau-Bruno and Fosse-Edorh 2017; Sabbah et al. 2021), l'intérêt épidémiologique de ce département d'Outre-mer s'inscrit plutôt dans l'épidémiologie amazonienne qui s'intéresse davantage aux maladies vectorielles (Boudehri 2002; Vitor-Silva et al. 2016; Folegatti et al. 2017; Corder et al. 2020; Van Gastel et al. 2021). Ces études, en Guyane française du moins, soulignent la place de l'automédication du paludisme à l'aide de pratiques médicinales locales (Douine et al. 2017; Mosnier et al. 2020; Odonne et al. 2021a). En tenant compte de données épidémiologiques, des études sur les connaissances, attitudes et pratiques (CAP) associées au paludisme ont démontré que les pratiques comme la chasse, la pêche, l'agriculture et l'utilisation des plantes médicinales

étaient associées à une pathologie asymptomatique (Mosnier et al. 2020; Odonne et al. 2021a), suggérant alors comment elles peuvent contribuer à la qualité de vie des personnes atteintes du paludisme. Certes, il existe néanmoins un fossé de connaissances important vis-à-vis des conséquences, de la perception et du vécu du diabète qui pourrait avoir un impact local sur la finalité des mesures de traitement et de gestion.

1.3 Les médecines des Peuples des Amériques

1.3.1 Cris d'Eeyou Istchee et Pekuakamiulnuatsh (Québec, Canada)

Les langues et dialectes parlés par les Cris d'Eeyou Istchee et les Pekuakamiulnuatsh font partie du continuum linguistique de la famille des langues algonquiennes (Rousseau 1957a; Junker and Stewart 2008), l'une des principales familles linguistiques autochtones au Canada (Hultkrantz 1992). Appelé Innu, Algonquin, Montagnais, Naskapi, Montagnais-Naskapi et Cri, ces Premières Nations ont fréquemment été confondues. Cependant, l'organisation politique et distincte de chacune de ces Nations nous invite à donner quelques précisions.

Les Cris d'Eeyou Istchee regroupent neuf Premières Nations, soit quatre dans les terres et cinq sur la côte. Il existe au moins deux dialectes de la langue chez les Cris d'Eeyou Istchee; Mistissini est la plus grande Première Nation dans les terres qui parlent *Inuu Ayimuun*, soit le « dialecte du sud » et Chisasibi est la plus grande Première Nation sur la côte qui parle *Iiyiyuu Ayimuun*, soit le « dialecte du nord » (CBHSSJB 2012a; Junker et al. 2018). Bien qu'*Inuu* et *Iiyiyuu* soient les désignations appropriées pour « Cri » dans leurs langues respectives, cet exonyme, dérivé du terme « Kristineaux » donné par les Français depuis 1640 (Hunter 1875; Smith 1929; Leechman 1945; Dickason 1996), est d'usage dans la désignation du Grand Conseil des

Cris, l'instance politique qui unit les neuf Premières Nations sur le territoire d'Eeyou Istchee, soit les Cris d'Eeyou Istchee. Ainsi, la « Terre du Peuple », ou Eeyou Istchee, se dit *Iiyiyiu Aschii* et *Inuu Aschii* dans les dialectes du nord et du sud, respectivement (Desbiens 2007; Grand Council of the Crees (Eeyou Istchee) 2020).

La Première Nation de Mashteuiatsh, quant à elle, est l'une de cinq membres du Conseil tribal de Mamuitun (Premières Nations de Mamuitun et de Nutashkuan et al. 2004; Conseil tribal Mamuitun 2018). Cette structure unit Mashteuiatsh aux Premières Nations Innus dans leurs négociations d'un traité. Cependant, le dialecte local de Mashteuiatsh, qui s'appelle *Nehlueun*, « Notre langue », précise que « Innu » se dit « Ilnu » et que la langue *Innu-Aimun* se dit *Ilnu-Aimun* (Drapeau and Moar 1996; Laurendeau 2011; Roy 2015). En *Nehlueun*, les résidents de Mashteuiatsh s'appellent plus précisément « Pekuakamiulnuatsh », soit « Le Peuple du lac plat » (*pekuakami* « lac plat » - le nom donné au lac Saint-Jean ; *ilnu* « personne » ; *-atsh* « pluriel ») (Kurtness 2014). Le territoire ancestral des Pekuakamiulnuatsh s'appelle le *Nitassinan* (Conseil des Montagnais du Lac-Saint-Jean 2003).

La prédominance de l'anglais et du français chez ces Premières Nations est associée aux relations historiques avec les premiers colons, les gouvernements fédéral et provincial et jusqu'à plus récemment, leur placement dans les écoles résidentielles. Ainsi, les Cris d'Eeyou Istchee et les Pekuakamiulnuatsh, occupant de larges espaces géographiques servant à la chasse, la pêche et la cueillette, principalement en forêt boréale, continuent de se côtoyer là où les territoires se rejoignent. Les us et coutumes étant similaire, le mode de vie est historiquement caractérisé par un semi-nomadisme (Rousseau 1949, 1957a; Conseil des Montagnais du Lac-Saint-Jean 2003; Roy 2015). L'occupation du territoire se dessinait autour d'un retour cyclique sur des secteurs connus : des territoires de chasse familiaux, en petit groupe familiaux, et des regroupements dans des sites

de rassemblement estival (Rousseau 1949, 1957a; Anderson 1956; Hultkrantz 1992; Conseil des Montagnais du Lac-Saint-Jean 2003).

À partir des journaux des premiers explorateurs et missionnaires de la Nouvelle-France jusqu'aux publications académiques, la littérature abonde sur la description des systèmes de guérison crie et ilnu. Puisque le champ de vision sur le sujet a considérablement évolué avec les intérêts des rapporteurs, il nécessite un exposé historique des descriptions du système médicinal algonquien avant d'en faire le portrait actuel.

Avant le 20^e siècle

L'intérêt pour les médecines algonquiennes est évident dès les premiers voyages réalisés par les explorateurs français. La fameuse histoire de *l'annedda* qui a sauvé l'équipage de Jacques Cartier du scorbut lors de son deuxième voyage en Nouvelle-France en 1535-1536 paraît pour la première fois en 1545 (Rousseau 1954). L'histoire est reprise par Samuel de Champlain à de multiples reprises (Rousseau 1954), et Sagard (1632) l'attribue aux Peuples innus alors qu'il s'agirait plutôt des peuples iroquois (Rousseau 1945a, 1954). La flore du Québec, entre autres, est décrite au 17^e et 18^e siècle par les médecins du roi, Michel Sarrazin et Jean-François Gauthier (Rousseau 1954). Cependant, les premiers écrits s'intéressent aussi au caractère spirituel du système de croyances des peuples algonquiens, le comparant ainsi au christianisme. Bien que ce soit Samuel de Champlain (1613) qui semble être le premier à décrire la tente tremblante, le Père Paul Le Jeune la décrit chez les Innus en 1634 dans son rapport sur les Relations des Jésuites de la Nouvelle-France (Le Jeune 1858). Lescarbot (1617) décrit la tente de sudation chez les Mi'kmaq, alors nommés Souriquois, et Champlain et Sagard la décrivent plus tard jusque dans la région des Grands Lacs (de Champlain 1619; Sagard 1632).

Première moitié du 20^e siècle

Selon Anderson (1956), la première guerre mondiale marque des changements majeurs dans le mode de vie des Premières Nations rivalisant avec la période de l'arrivée des colons français et anglais au XVII^e siècle. Après la guerre, les gouvernements canadiens ouvrent les territoires au nord des chemins de fer transcontinentaux à l'exploitation (minière et forestière, pêche commerciale, développement hydroélectrique [Anderson 1956]). Alors que les Cris et les Innu sont déjà en pleine transformation religieuse, le catholicisme s'intégrant aux Innu et l'Anglicanisme chez les Cris (Rousseau 1945b, 1953; Kurtness and Girard 1997), nombre d'auteurs observent néanmoins chez eux des cérémonies de la tente tremblante et de la tente de sudation.

Dans l'Eeyou Istchee, on signale alors la tente tremblante autour de Mistissini (Chambers 1896; Cooper 1944; Rousseau 1953), la rivière Eastmain (Skinner 1911), Waskaganish (Rupert's House à l'époque; Flannery 1939), Chisasibi (Fort George à l'époque; Cooper 1944), et Whapmagoostui (Whale River à l'époque; Cooper 1944), ainsi que dans la région du Pekuakami, donc Mashteuiatsh (Pointe-Bleue à l'époque; Burgesse 1944). On signale aussi la tente de sudation dans tout le territoire boréal et subarctique du nord-est de l'Amérique, partant de la baie James à l'ouest jusqu'à la péninsule du Labrador à l'est (Skinner 1911; Speck 1935), et de l'Ungava au nord jusqu'à la côte nord du fleuve Saint-Laurent au sud (Turner 1894; Rousseau 1953). Bien que certains auteurs notent l'abandon progressif de ces pratiques (Burgesse 1944; Rousseau 1953), elles perdurent toujours à cette époque chez les Peuples algonquiens des régions subarctiques et boréales du nord-est de l'Amérique, soit du Québec et du Labrador, jusqu'aux Grandes Plaines du centre canadien et états-unien (Skinner 1911; Speck 1935; Flannery 1939, 1944; Beardsley 1941;

Hallowell 1942; Burgesse 1944; Collier 1944; Cooper 1944; Martin 1951; Rousseau 1953; Ray 1983).

Au cœur de l'intérêt particulier apporté à ces pratiques, Strath (1903) et Speck (1917), documentant respectivement la pharmacopée végétale des Cris du Manitoba et des Innus de Tadoussac, des Escoumains et de Terre-Neuve, notent que le traitement des maladies est indépendant des pratiques chamaniques ou, du moins, que les pratiques sont spécialisées. À cette époque, les études ethnobiologiques se font plus abondantes. Suite au don d'un nombre de plantes médicinales à la *Pharmaceutical Society* par le chirurgien Walton Haydon, alors posté à Moose Factory en Ontario, Holmes (1884) est le premier à décrire l'utilisation des plantes par les Cris de la baie James. Beardsley (1941) publie les notes de terrain de I. Cowie réalisées en 1892 sur les plantes médicinales des Cris vivant dans les Territoires du Nord-Ouest et Strath (1903) documente la pharmacopée végétale des Cris de Norway House du côté manitobain de la baie d'Hudson.

Dans l'Eeyou Istchee, Rousseau réalise des inventaires ethnobotaniques et ethnozoologiques à Mistissini, décrivant l'usage alimentaire, médicinale et spirituel des plantes et des animaux (Rousseau 1945b, 1946; Cosset and Mansion 2009). Par ailleurs, il documente la gastronomie animale et végétale chez les Peuples du nord-est de l'Amérique, incluant aussi les Innus, témoignant de plus des changements alimentaires (Rousseau 1945b, 1946, 1948, 1955, 1957a, 1957b). Bien que le mode de vie des Cris de Mistissini est toujours décrit comme semi-nomade en 1945, des routes forestières existent déjà jusqu'à Roberval et Mashteuiatsh (Rousseau 1945b).

En plus d'une « *médication de l'âme et un moyen d'influencer l'esprit des animaux* », Rousseau (1953:152) décrit, tout comme (Speck 1935), que la tente de sudation est aussi un remède physique, comme les remèdes à base végétale et animale. Martin (1951) rajoute qu'il existe

plusieurs motivations pour sa pratique mais qu'il y a toujours une signification spirituelle. Ayant la nature pour temple (Conseil des Montagnais du Lac-Saint-Jean 2003), elle créait une atmosphère spirituelle où les conducteurs des cérémonies trouvaient leur inspiration dans les révélations oniriques ou spirituelles (Speck 1935; Rousseau 1953). Les invocations, tels les prières et les chants, évoquaient les esprits des animaux, des plantes, des roches, du vent, de l'eau et des étoiles (Conseil des Montagnais du Lac-Saint-Jean 2003). Ce système de croyance cadre alors pleinement avec ce que l'on appelle une pensée animiste (Rousseau 1953).

Seconde moitié du 20^e siècle

Les projets hydroélectriques initiés par Hydro-Québec dans l'Eeyou Istchee marquent un tournant important dans l'histoire contemporaine des Premières Nations au Québec. Le processus de revendication de bon nombre de communautés Cris et Inuit de la baie James et de la baie d'Hudson mène à la signature de la Convention de la Baie-James et du Nord québécois (Saganash 2011). Inspirées par cette convention, des Premières Nations Atikamekw et Innues, situées ailleurs au Québec, forment le Conseil des Atikamekw et des Montagnais (CAM) en 1975 afin de revendiquer l'accès au territoire (Tipi and Boivin 2020). En 1994, le Conseil Tribal Mamuitun, regroupant à l'époque les Premières Nations de Mashteuiatsh, d'Essipit, de Pessamit et de Uashatmak-Mani Utenam, prend la relève du CAM et s'entend avec les gouvernements du Canada et du Québec sur une *Entente de principe d'ordre général* jusqu'à ce qu'un traité soit conclu (Premières Nations de Mamuitun et de Nutashkuan et al. 2004; Tipi and Boivin 2020). Le processus de revendication cible non-seulement l'accès au territoire, mais souligne aussi sa pertinence pour les pratiques et le mode de vie qui continuent de changer.

À Chisasibi, la tente de sudation est toujours pratiquée, bien qu'elle soit plutôt prescrite pour une personne très malade et construite pour accommoder une personne allongée (Anonymous

1971). Quant à la tente tremblante, les dernières manifestations sont décrites par les chercheurs au tournant des années 1970s : Waskaganish en 1965 (Preston 2002) et Mistissini en 1972 (Tanner 1979). Ainsi, sa pratique est considérée comme disparue dans le nord-est de l'Amérique du Nord depuis les années 80 suite à l'influence du christianisme et de la sédentarisation (Proulx 1988; Tanner 2007). Cependant, cela n'empêche pas une certaine continuité surtout en ce qui a trait aux relations privilégiées avec les animaux de perdurer (Proulx 1988).

En effet, les recherches anthropologiques conduites durant cette période soulignent toujours le lien entre la guérison et la spiritualité chez les Peuples algonquiens. Le système de croyance des Cris, entre autres, est toujours inscrit dans une pensée animiste (Descola 2005a, 2007; Tanner 2007), justifiant ainsi certains rituels sacrés autour de la nourriture animale (Hultkrantz 1992). La santé est interprétée comme la condition naturelle de l'humain et renvoie à une harmonie et un équilibre avec le monde environnant (Hultkrantz 1992). Les maladies, quant à elle, sont attribuées à un comportement condamnable. Différent d'un recours à une pharmacopée végétale ou animale issue d'un savoir commun ou expert pour les douleurs, les blessures et les problèmes aux os (Hultkrantz 1992), l'ordre spirituel était rétabli par l'intervention d'acteurs communiquant avec les forces habitant leur environnement afin d'être informés des causes et de la solution, comme avec la cérémonie de la tente tremblante (Hultkrantz 1992; Tanner 2007).

En ce qui concerne le diabète, les études en anthropologie médicale de Roy (1996, 1999) auprès des Innus de Pessamit, Nutashkuan et de Unamen Shipu, ainsi que des Atikamekw d'Opitciwan démontrent un rapprochement avec les notions biomédicales. Malgré l'incidence élevée du diabète, la population enquêtée possédait un haut niveau de connaissance des symptômes à l'égard de la maladie (Roy 1996, 1999). Et le nom donné au diabète à Pessamit, soit *kashiuashiu*,

littéralement « une personne sucrée », souligne le lien fait entre cette maladie et le sucre (Roy 1999).

L'occupation du territoire, au centre des revendications, est toujours importante et ses ressources sont toujours pertinentes, comme cela est illustré dans un livre de recette alimentaire de Chisasibi qui met en vedette le gibier, les petits fruits et les lichens, ainsi que certaines descriptions de la pharmacopée animale et végétale (Anonymous 1971). L'Association des Métis et Indiens hors réserves (1982), quant à elle, publie un recueil de pharmacopées animales et végétales en collaboration avec les Pekuakamiulnuatsh de Mashteuiatsh. En effet, Roy et al. (2013) signale un changement important dans le système alimentaire innu de Pessamit depuis le milieu du 20^e siècle. L'attitude envers les aliments introduits change avec l'accroissement des revendications et l'acte alimentaire se cristallise davantage sur des codes identitaires (Roy et al. 2013).

Finalement, Jauvin (1993) décrit l'utilisation des médecines animales et végétales à partir d'entretiens avec des aînés Innus de Unamen Shipu en 1982. Il souligne le chevauchement de l'acte alimentaire et l'acte thérapeutique à travers la consommation de l'ours noir (*Ursus americanus* Pallas, 1780 ; Ursidae) (Jauvin 1993). Clément (1990; 2014) décrit l'utilisation alimentaire et médicinale dans l'ethnobotanique des Innus d'Ekuanitshit. Chez les peuples algonquiens de l'Amérique du Nord, bon nombre d'études ethnobotaniques, en particulier, mettent en lumière l'usage médicinal et alimentaire des plantes (Rousseau et Raymond 1945; Rousseau 1947, 1957b; Black 1980; Leighton 1982, 1985; Zieba 1990; Siegfried 1994; Clavelle 1997).

Le constat actuel

Au tournant du millénaire, la part des Premières Nations dans la recherche, ainsi que dans la documentation de leur savoir et leur mode de vie devient considérablement plus importante (voir par exemple Conseil des Montagnais du Lac-Saint-Jean 2003; Fireman 2011; Young et al. 2015).

Les Cris d'Eeyou Istchee, notamment, publient eux-mêmes des pharmacopées issues de Waskaganish (Marshall et al. 2003) et Chisasibi (Marshall 2006; Fireman 2011) et forment une entente avec l'Équipe de Recherche sur les Médecines Autochtones Antidiabétiques des Instituts de Recherche en Santé du Canada (EMAA-IRSC) pour étudier le potentiel antidiabétique de leurs plantes médicinales. Afin de sélectionner les plantes les plus pertinentes aux études pharmacologiques, l'usage des plantes médicinales est documenté à Mistissini (Leduc et al. 2006), Whapmagoostui (Fraser 2006), Nemaska et Waskaganish (Downing 2010), ainsi qu'à Wemindji et Oujé-Bougoumou (Rapinski 2012). Tandis qu'à Mashteuiatsh, la pharmacopée végétale des Pekuakamiulnuatsh est documentée dans le cadre des objectifs de gestion du territoire et de la préservation du patrimoine (Conseil des Montagnais du Lac-Saint-Jean 2003; Laurendeau 2011; Forêt modèle du Lac-Saint-Jean 2015). Plusieurs des plantes utilisées par les Cris d'Eeyou Istchee, communes à la pharmacopée des Pekuakamiulnuatsh, pour traiter des symptômes pouvant être associés au diabète ont fait l'objet de multiples bioessais et ont démontré un potentiel antidiabétique (Cuerrier et al. 2012; Haddad et al. 2012).

Quant aux notions associées à la santé, elles sont davantage en lien avec le bien-être et l'accès au territoire. Chez les Innus de Pessamit, le concept de la santé, qui se traduit « *être bien dans sa famille* », « *être bien dans sa peau* » ou « *être capable de prendre soin de soi-même* », évoque le concept holistique du bien-être (Roy 2003). Pour les Cris d'Eeyou Istchee, *miyupimaatisiun* se traduit « *être vivant et bien* » ; elle se rapporte à la capacité de vivre de la Terre ainsi qu'à la nature des relations sociales et l'identité culturel (Adelson 2000). Le territoire et la culture sont aussi des référents identitaire chez les Innus et les Pekuakamiulnuatsh qui les résumant dans le concept d'*ilnu-aitun*, soit les connaissances relatives à la vie en forêt et tout ce qui concerne ce mode de vie (Roy 2015). Selon Parlee et al. (2005), les termes se rapprochant de

terre et du territoire découlent de concepts écosystémiques. La « Terre » serait donc une métaphore pour la santé socio-écologique impliquant le concept des humains dans la nature (Parlee et al. 2005), tel que présumé dans l'anthropologie médicale critique de Roy (2003).

De surcroît, ces notions ethnomédicinales reliées à la Terre et au bien-être équilibré, c'est-à-dire, mentalement, physiquement, émotionnellement et spirituellement, ont percé le milieu politique. Elles sont reprises dans les appels à l'action de la Commission de vérité et réconciliation du Canada qui demande au gouvernement fédéral du Canada de continuer à financer les programmes existant qui intègrent les pratiques et concepts autochtones et d'en créer des nouveaux (Truth and Reconciliation Commission of Canada 2015a). Cela est d'autant plus vrai pour les Cris d'Eeyou Istchee qui s'impliquent et financent même la recherche.

À titre d'exemple, le CCSSSBJ commissionna la collecte des témoignages de diabétiques de l'Eeyou Istchee qui racontent l'expérience crie du diabète (DyckFehderau 2017). Éluclidant particulièrement les connaissances associées au diabète et l'attitude qu'on y apporte, l'ouvrage offre un témoignage important sur l'ethnomédecine crie. En racontant l'impact de la colonisation sur les individus, leurs familles et leurs communautés à travers l'incidence croissante du diabète, elle révèle les conséquences vécues, les symptômes, les complications et les causes perçues à l'origine de la maladie, soit les changements du mode de vie et l'introduction du sucre et des produits sucrés dans un système alimentaire en transition rapide (DyckFehderau 2017). Ces connaissances façonnent ce que représente cette maladie chez les diabétiques ; la gravité du DT2 demande le support biomédicale mais révèle de part et d'autre une histoire turbulente avec un système médical étranger à l'origine (DyckFehderau 2017). À défaut de développer sur l'impact de ces changements et du développement du diabète sur les pratiques médicales locales à l'égard de cette maladie, l'ouvrage révèle un système de santé en plein processus de transformation.

1.3.2 Parikwene (Guyane française, France)

Considéré comme étant la plus vieille référence aux groupes autochtones sur le territoire brésilien, les Palikur sont initialement mentionnés en 1513 par Vincent Yanez Pinzon qui déclare avoir découvert « La mer douce » et la province qu’il appelle « Paricuria » en remontant l’Oyapock au nord de l’Amazone (Nimuendajú [1926] 2008; Arnaud 1984; Berton 1997; DeFillips et al. 2004; Davy 2007). Malgré cela, ce n’est vraiment qu’à partir du 20^e siècle, commençant avec le travail ethnographique de Nimuendajú (1926), que l’on trouve des récits plus exhaustifs sur le Peuple Arukwayene, soit le « Peuple de la rivière d’Urucacua » (Silva et al. 2018; Martins et al. 2020). Plus communément connus sous le nom de Palikur en français, le terme « parikwene », en langue parikwaki, serait né du contact avec les Européens pour distinguer plus spécifiquement toutes personnes appartenant aux Peuples autochtones (Martins et al. 2020). Bien qu’il exista jusqu’à 29 clans apparentés aux Arukwayene avec leurs particularités culturelles et linguistiques, il ne reste plus que six clans unis dans la langue (Grenand and Grenand 1987; Batista 2018). Appartenant à la sous-famille Maipuran de la famille des langues arawak, le parikwaki serait plus proche des langues arawak du haut Xingu dans le Brésil central que de celles parlées sur le plateau des Guyanes, dont les Arawak-Lokono (Arnaud 1970, 1984; Dreyfus 1981; Davy 2007; Capiberibe et al. 2009).

Le peu d’information qui existe au sujet des Parikwene avant le 20^e siècle pourrait être attribué à des déplacements constant sur le territoire depuis le 16^e siècle sous l’influence des puissances coloniales, dont la France, la Hollande, l’Angleterre, l’Espagne, le Portugal et plus tard le Brésil, qui se disputent le plateau des Guyanes et mettent en place des plantations esclavagistes (Grenand et al. [1987] 2004; Berton 1997; Green and Green 2009). Au 19^e siècle, les Arukwayene

se regroupent et se recentrent définitivement sur les rives du Rio Urucauá, maintenant situé dans l'état de l'Amapá au Brésil, où ils se sentiraient bien centré sur le territoire et côtoient de façon régulière les populations créoles (Dreyfus 1981; Grenand and Grenand 1987, 1990; Berton 1997; Green and Green 2009). Cependant, l'histoire orale indique une présence des deux côtés de la rivière Oyapock qui délimite maintenant la frontière entre la France et le Brésil (Dreyfus 1981). Mais la migration vers l'emplacement actuel de leurs villages en Guyane française aurait commencé après le Contesté franco-brésilien de 1900, qui cède officiellement l'état de l'Amapá au Brésil, où un certain nombre de Parikwene s'installent d'abord sur la crique Marouane (Fernandes 1950; Dreyfus 1981; Arnaud 1984; Berton 1997).

Des vagues de migrations importantes remontent ensuite aux années 1960 avec la création du village d'Espérance I, à Saint-Georges de l'Oyapock (Dreyfus 1981; Ouhoud-Renoux 2000a), puis ensuite le village de Kamuyene à Macouria (Berton 1997). En raison de la législation française interdisant l'enregistrement des données de recensement distinguant l'origine ethnique, il n'y a pas de chiffres précis sur la population de Parikwene en Guyane française. Les chiffres auto-déclarés des dirigeants parikwene de Saint-Georges de l'Oyapock et de Macouria donnent une estimation dans ces communes à près de 1 800 Parikwene en Guyane française en 2018, doublant leur nombre estimé de 850 personnes en 2001 (Capiberibe et al. 2009) ; ils seraient environs 1400 au Brésil (Silva et al. 2018). Malgré les nationalités françaises et brésiliennes accordées aux Parikwene, ils sont réellement un peuple transfrontalier pour qui la frontière est un artéfact colonial qui n'empêche pas les déplacements (Pereira and Martins 2019; Van Gastel et al. 2021).

Le mode de vie des Parikwene, tel qu'il a été historiquement décrit, est caractéristique des peuples d'agriculteur qui ajoutent la pêche, la chasse et la cueillette de subsistance aux activités d'agriculture itinérante sur brûlis, appelé localement "abattis" (Arnaud 1984). Le manioc amer

(*Manihot esculenta* Crantz ; Euphorbiaceae), cultivé en abattis selon des méthodes d'agriculture sur brûlis, demeure la base de l'alimentation jusqu'à ce jour et les activités de subsistances sont toujours d'actualités (Grenand 1981; Arnaud 1984; Boutefeu et al. 2002; Grenand and Grenand 2004; Capiberibe et al. 2009; Davy et al. 2011; Monteiro 2018; Ogeron et al. 2018; Alves and Monteiro 2019; Richard-Hansen et al. 2019). Malgré tout, plusieurs auteurs signalent des changements importants dans le système alimentaire qui se résument par les constats suivants.

Dans un premier temps, on voit apparaître de nouveaux aliments dans les pratiques agricoles, dont la canne à sucre (Vieira-Filho 1978; Arnaud 1984), ainsi que de nouveaux outils et processus de transformation du manioc amer. C'est ainsi que l'introduction de la platine en métal dédiée à la torréfaction, ainsi que la presse à manioc en bois brésilienne introduite dans les années 1980, facilitent la transition du mode de préparation préféré pour le manioc, passant de la galette de cassave à la farine de manioc torréfié, le **kwak** (Arnaud 1984; Davy 2007). Deuxièmement, la diversité des espèces végétales et des variétés de manioc cultivées dans les abattis tend malgré tout à diminuer (Arnaud 1984; Boutefeu et al. 2002). Troisièmement, il y aurait une diminution de la superficie des abattis cultivée et de la quantité de **kwak** produite (Boutefeu et al. 2002). Quatrièmement, les Parikwene sont davantage intégrés au marché économique (Ouhoud-Renoux 2000a, 2000b; Boutefeu et al. 2002; Monteiro 2018; Alves and Monteiro 2019), ce qui conduit à une dépendance croissante à l'égard des aliments manufacturés et achetés en magasin, par exemple, le lait en poudre, le café, les condiments, l'huile, les biscuits, le riz, le beurre, le pain et les boissons gazeuses (Capiberibe et al. 2009; Davy et al. 2011; Vincent 2013; Ogeron et al. 2018; Richard-Hansen et al. 2019). Dès les premiers cas de diabète recensés chez les Parikwene (Vieira-Filho 1978), l'acculturation alimentaire est pointé du doigt comme coupable, de même que certains

auteurs suggèrent aussi la consommation élevée de manioc pour son contenu en carbohydrates (Vieira-Filho 1978; Arnaud 1984).

Les premières descriptions du système médicinal parikwene, qui a évolué tout comme le système alimentaire, le relie à la cosmologie et leur système de croyance. Les maladies « envoyées » sont attribuées aux forces surnaturelles que seules les personnes dotées du pouvoir, transmis dans la famille et à travers les révélations oniriques (Berton 1997), d'invoquer et de travailler avec les esprits peuvent résoudre (Fernandes 1950). Les chants, les incantations, les prières et les danses, entre autres, appellent et manipulent les esprits qui résident tant chez les êtres animés et que chez les êtres inanimés (par exemple, les rivières et les formations terrestres) dans une cosmologie cadrant avec une ontologie perspectiviste (Fernandes 1950; Arnaud 1970, 1984; Dreyfus 1981; Capiberibe 2009; Green and Green 2009).

Malgré l'influence des églises chrétiennes, les notions animistes reliées à la présence des esprits dans les plantes et les animaux persistent dans l'histoire orale et dans la pratique, telle que la distinction des maladies dites « envoyées » et des chants qui leurs sont propres, jusqu'à la fin du 20^e siècle au moins (Grenand et al. [1987] 2004; Berton 1997; Davy 2007). En effet, plusieurs dénominations chrétiennes, soit catholique, pentecôtiste, adventiste et évangélique, ont réalisé des missions d'évangélisation auprès des Parikwene (Dreyfus 1981; Grenand et al. [1987] 2004; Berton 1997; Cantuário et al. 2021). Le Pentecôtisme est introduit en 1967 (Arnaud 1984), et peu après, Arnaud (1970) estime qu'un tiers des Parikwene y adhèrent. Les églises pentecôtistes et adventistes sont toujours fortes dans les villages parikwene et on y attribue la cause de beaucoup de changements liés au mode de vie, dont la transformation des rites funéraires et des pratiques de guérison ainsi que l'abandon du cachiri (bière de manioc) et autres pratiques culturelles (Arnaud 1970; Boutefeu et al. 2002; Capiberibe 2009; Silva et al. 2018; Martins et al. 2020; Cantuário et

al. 2021). Néanmoins, il existe toujours des porte-paroles parikwene qui soutiennent leurs coutumes et savoirs (Silva et al. 2018), et certains aspects de la cosmologie perdurent sous forme d'hybridation ou syncrétisme avec le christianisme (Capiberibe 2009; Cantuário et al. 2021).

Le système médicinal des Parikwene a vraisemblablement beaucoup changé depuis l'arrivée des Européens. De nouvelles conceptions médicales ainsi que des nouvelles plantes sont introduites par les diverses puissances coloniales lors de leurs escales d'une colonie à l'autre (Berton 1997; DeFillips et al. 2004). Certes, l'intérêt européen à l'égard des plantes sud-américaines ne peut-être nié. Aublet (1775), apothicaire-botaniste du roi, publie l'*Histoire des plantes de la Guiane françoise* en quatre tomes alors que les plantes voyagent de l'Amérique du Sud et de l'Amérique Centrale vers l'Europe depuis le 16^e siècle (DeFillips et al. 2004), notons notamment : le tabac (*Nicotiana tabacum* L. ; Solanaceae), le maïs (*Zea mays* L. ; Poaceae), la patate douce (*Ipomoea batatas* [L.] Lam. ; Convolvulaceae), le cacao (*Theobroma cacao* L. ; Malvaceae), le piment (*Capsicum annuum* L. ; Solanaceae) ou l'ananas (*Ananas comosus* [L.] Merr. ; Bromeliaceae). Le médecin-botaniste du roi, Pierre Barrère, fut le premier à collectionner les plantes de la Guyane française et le médecin-botaniste Jean-Baptiste Patris envoya des spécimens en France pour la collection botanique de l'Impératrice Joséphine (DeFillips et al. 2004). Bien que la contribution intellectuelle des peuples autochtones aux pharmacopées européennes soit indéniable, l'histoire écrite nous prive d'identifier les parties prenantes en les éclipant.

Des observations détaillées de la pharmacopée parikwene commencent à partir du milieu du 20^e siècle. Déjà, le métissage entre les savoirs et les pharmacopées créoles est observé (Grenand et al. [1987] 2004; Berton 1997). Au moment de documenter la pharmacopée végétale des Parikwene, Grenand et al. ([1987] 2004) et Berton (1997) signalent que les Parikwene distinguent

les maladies « envoyées » des maladies « importées », c'est-à-dire, associées à l'arrivée des Européens. Cela inclurait le diabète, alors nommé « *kadahan sukgu* » ou « présence de sucre » (Grenand et al. [1987] 2004). Ainsi, les connaissances reliées à la guérison relèvent donc d'une spécialisation des savoirs et des pratiques (Grenand et al. [1987] 2004). De surcroît, les Parikwene distinguent les maladies dites « normales » dont il n'existe aucune origine magico-spirituelle, et dont les pratiques de guérison, les Parikwene pratiquant souvent l'automédication, sont plus communes et accessibles (Grenand et al. [1987] 2004; Boudehri 2002). Malgré ce constat à l'égard de l'automédication, il n'existe que quelques recueils qui documentent la pharmacopée, principalement végétale d'ailleurs, des Parikwene (Fernandes 1950; Grenand et al. [1987] 2004; Grenand and Grenand 1991; Berton 1997). Seule Fernandes (1950) note, sans toutefois les détailler, l'utilisation de remèdes à base animale et minérale, dont la consommation d'un type d'argile appelé « *paraukama* ».

De nos jours, les Parikwene sont maintenant plus impliqués dans la recherche et publient leurs propres récits et histoire, valorisant et mettant en vedette les éléments, entre autres, qui traitent de la culture et de l'identité (Batista 2018; Iaparrá and Ramos 2018; Monteiro 2018; Silva et al. 2018; Alves and Monteiro 2019; Guiome Ioiô 2019; Martins et al. 2020). En effet, la transmission orale de l'histoire est toujours vivante (Santos Almeida and Barros da Silva 2018). De plus, leurs travaux nous donnent un aperçu de l'actualité quant au mode de vie et du système alimentaire parikwene, tel le calendrier agro-écologique des activités agricoles et de subsistance qui est construit autour du cycle des saisons et des cycles de vie des plantes et des animaux (Iaparrá and Ramos 2018; Guiome Ioiô 2019).

1.4 Conclusion

En conclusion, la description des médecines cries, ilnu et parikwene repose sur une littérature plutôt vaste dont les intérêts ont changé avec le temps et le courant de multiples disciplines. Certes, ces médecines sont marquées par des pharmacopées importantes à base végétale et animale, mais leurs descriptions soulignent des peuples dont les savoirs et les pratiques médicinaux ont évolué depuis l'arrivée des Européens. De plus, le développement des systèmes biomédicaux contemporains joue un rôle important dans cette évolution en confrontant les concepts et les pratiques locaux à ceux d'un système hégémonique. Bien entendu, la structure des systèmes biomédicaux du Canada et de la France dépend en grande partie des politiques qui leurs sont propres et des idéaux constitutionnels qui décrivent la place de l'individu dans sa nation, ou l'État. Dans le cas des Peuples autochtones, la reconnaissance du titre autochtone est un facteur important. C'est grâce à cela que la santé communautaire s'assimile facilement aux services de santé à la portée des communautés autochtones du Québec. Pourtant, cela ne l'empêche pas de s'intégrer au système de santé français, car le constat est clair : sur le vaste territoire français, le peuple français fait face à des réalités et des contraintes sanitaires différentes. Nul autre que le diabète suffit pour souligner ces différences tant en France qu'au Canada. Si la santé communautaire cherche à mobiliser la communauté, et donc l'environnement de la personne dans ses soins, elle s'intéresse alors autres options qui se présentent dans son parcours des soins. C'est ainsi que dans le contexte du diabète touchant les Peuples autochtones, la comparaison des descriptions de leurs médecines par les personnes travaillant dans les secteurs québécois et français de la santé et leurs usagers pourraient aider à élucider les facteurs qui influencent l'accès aux pratiques médicinales locales.

Chapitre 2 - Using Unconstrained Ordinations to Analyze Qualitative Information from Interviews in a Mixed Methods Ethnomedicinal Study Relating to Human Health

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2.1 Résumé / Abstract

Les procédures statistiques issues de la recherche quantitative sont souvent critiquées pour leur limitation à saisir les relations complexes qui existent dans les données générées qualitativement. Nous suggérons l'utilisation des ordinations, fréquemment utilisées en écologie pour étudier les relations multidimensionnelles entre les espèces, ainsi que des indices de diversité pour minimiser la perte d'informations et produire des résultats statistiques parlants. Nous utilisons une conception séquentielle exploratoire qui commence par la synthèse du cadre « le mieux adapté » des transcriptions d'entretiens dans une approche intégrée consistant à informer et à produire des données adaptées aux statistiques multivariées. Les ordinations ont produit des résultats hautement descriptifs qui ont aidé à détecter des patrons de réponse et à formuler des hypothèses vérifiables. La synthèse du cadre « le mieux adapté » éclaire en outre l'utilisation des indices de diversité afin de produire des résultats plus révélateurs. Enfin, les méthodes statistiques et quantitatives développées pour tester les théories écologiques sont bien adaptées pour analyser les relations complexes issues des réponses des participants aux entretiens.

Mots-clés : méthodes mixtes ; synthèse du cadre « le mieux adapté » ; ordination ; indices de diversité ; science de la santé.

Statistical procedures from quantitative research are often criticized for their limitation in capturing complex relationships in qualitatively generated data. We suggest using ordinations, frequently used in ecology to study multi-dimensional relationships between species, and diversity indices to minimize information loss and produce meaningful statistical results. We use an exploratory sequential design that begins with the “best-fit” framework synthesis of interview transcripts in an integration approach of informing and producing data suitable for multivariate statistics. Ordinations produced highly descriptive results that helped detect response patterns and formulate testable hypotheses. “Best-fit” framework synthesis further informs the use of diversity indices to produce more meaningful results. Finally, statistical and quantitative methods developed to test ecological theories are well-adapted to analyze complex relationships in participant’s interview responses.

Key words: mixed methods; “best-fit” framework synthesis; ordination; diversity indices; health science.

2.2 Introduction

The main purpose of this paper is to demonstrate how multivariate statistical methods frequently used in ecology, including the use of diversity indices, can be applied to analyze complex topics from interview transcripts. The data used to demonstrate the method herein is generated from ethnomedicinal research and interviews carried out in collaboration with three First Nation communities in Québec, Canada, on the definition and representation of local Indigenous medicines amongst participants working in the healthcare network (*e.g.*, healthcare professionals and administrators) and using healthcare services (*e.g.*, residents of First Nation communities, including Elders).

2.2.1 Broader theoretical context

Amidst the paradigm wars concerning the use of qualitative and quantitative research methods² in academic disciplines (Johnson and Onwuegbuzie 2004; Ochieng 2009; Hammarberg et al. 2016), a number of researchers from various fields of social and behavioral sciences have advocated for the use of mixed methods since the late 1950s (Johnson et al. 2007; Collins et al. 2007). More precisely, mixed method research is defined as a type of research that combines in one study elements of both qualitative and quantitative approaches relating, for example, to data collection and analysis (Johnson et al. 2007). Nonetheless, limitations to using quantitative methods on qualitative data like interview responses are arguably far and wide; it has long been highlighted that the conversion of qualitative information into frequency counts leads to the

² Allwood (2012) warns of the difficulty in truly distinguishing and defining the difference between qualitative and quantitative research. For the sake of this study, however, we distinguish quantitative research and methods from qualitative ones in that they deal with data expressed numerically.

reduction and oversimplification of information expressed by participants in interviews (Ochieng 2009; Yilmaz 2013; Fakis et al. 2014; Hammarberg et al. 2016). Despite epistemological differences between qualitative and quantitative research paradigms regarding the quantitative transformation of qualitative information (Yilmaz 2013), some research questions require the contribution of a greater number of participants. This inadvertently adds a dimension of quantity, which can naturally lead to further questions of a quantitative nature.

Indeed, multiple studies born of qualitative research have resorted to using such transformation strategies as reducing the data to numerical indices like frequency counts, total counts of themes, categorizing into subthemes, providing weights and representing these numerically in a tabular format (Ochieng 2009; Yilmaz 2013; Fakis et al. 2014; Fetters and Freshwater 2015). These methods for quantifying qualitative information from interviews have been used for multiple purposes including triangulation, or corroboration, of data to consider robustness of research results and complementarity of each other, namely for determining prevalent themes in interviews, recognizing patterns and deviations, as well as testing and generating new hypotheses (Greene et al. 1989; Malterud 2001; Fakis et al. 2014; Hammarberg et al. 2016). This ultimately brings up an important question that aims directly at the credibility of mixed-method approaches: “When resorting to quantitative methods and attempting to obtain meaningful results, how do we capture the richness of qualitative information?”

In a literature review of qualitative or mixed methods studies employing numerical transformations on qualitative data, Fakis et al. (2014) found that most used classic univariate statistics for hypothesis testing, interpreting correlations and determining if themes or subthemes were associated with various participant characteristics (*e.g.*, gender, age). In keeping with criticism attributed to the oversimplification of quantitatively transforming qualitative

information, the most commonly used univariate statistical analyses (*i.e.*, chi-square, *t*-test, Mann-Whitney *U*, analysis of variance) were not found to be properly fitted to analyze and interpret the complexity of the relationships within qualitative data (Fakis et al. 2014). In order to fully benefit from the use of quantitative methods, Fakis et al. (2014) suggests that there is room for growth in mixed-methods research by exploring and developing more advanced methods of statistical analysis and modelling. Namely, exploring multidimensional relationships using clustering and multivariate regression, for example.

In fact, Mohler and Zuell (2001), describe how to transform thematic datasets made from content analysis to use in multivariate analysis and there have since been several studies resorting to such methods (Spiller et al. 2009; Ponnam and Dawra 2013; Ayiesah et al. 2014; Sbalchiero and Tuzzi 2016). Although the methods employed in these studies are useful tools for detecting and analyzing patterns between participants and their responses, such as principal component analysis (PCA), correspondence analysis (CA), multiple correspondence analysis (MCA) and multidimensional scaling (MDS), these techniques for analyzing multidimensional relationships are further limited by their inability to provide tests of significance on the patterns detected. Furthermore, thematic datasets may contain many holes which are the results of questions not answered by participants or themes not mentioned while free listing. To the best of our knowledge, the numerical interpretation of these “absence of information” and their implications has yet to be discussed.

2.2.2 Field-specific context

Thematic analysis is a common method of qualitative data analysis used for identifying and analyzing themes that arise from interview transcripts (Braun and Clarke 2006). The process

of transforming such themes to numeric indicators like frequency counts for statistical analyses is akin to such processes as counting the number of species known and used by people, a common practice in ethnobiological interviews (Höft et al. 1999). Although anthropology has played a central role in the development of such interdisciplinary fields (Peroni et al. 2014), quantitative techniques to transforming ethnobiological knowledge and qualitative information from participant interviews have been developed since the early-1970s (Prance et al. 1987; Turner 1988; Phillips and Gentry 1993a, 1993b; Phillips 1996). In this field, this type of data has already been paralleled to that gathered through ecological sampling when analyzing species community structures (Höft et al. 1999; Peroni et al. 2014). Hence, ecological methods have since been frequently used to analyze such data with the use of diversity indices (Begossi and Richerson 1993; Begossi 1996; Hanazaki and Begossi 2000), or multivariate analyses (Höft et al. 1999; Leduc et al. 2006; Rapinski et al. 2018a).

In keeping with the practice of interpreting the count of cited species by individuals with indicators of diversity (Begossi 1996; Peroni et al. 2014), we broaden that to themes expressed by interviewed participants to describe complex ideas and phenomena. Just as they were devised in the field of ecology to compare different environments based on species composition, namely richness and evenness, they can help to compare the importance of specific themes between groups of participants based on the composition of secondary themes that characterize them. This has the added benefit of bridging the comparison between groups of participants, or communities, from distinctively different geographical, historical and cultural backgrounds whereby the interpretation of primary data may not be as informative to the research question as the aggregated data (*e.g.* comparing the use of specific means, such as local practices for treating specific health problems, between participants who do not have access to the same resources vs. the number of useful means

derived from available resources). We argue that multivariate statistical analyses, aided by the use of diversity indices, become interesting tools to interpret and analyze large thematic datasets constructed from interview responses to semi-structured and open-ended questions. To solve issues highlighted by Fakis et al. (2014), we suggest using multivariate analyses such as constrained ordination techniques to visualize, evaluate and interpret multidimensional relationships between themes and subthemes. Constrained ordinations allow for hypothesis testing through non-parametric tests of significance by permutation (Legendre and Anderson 1999; Legendre et al. 2011), thus reducing limitations associated with verifying underlying assumptions that typically apply to parametric testing in univariate analyses (*i.e.*, normal distribution). Furthermore, diversity measurements from ecology can consider the number of themes, or subsets of themes, that were cited into meaningful numbers. Though they are reductionist by nature, their strategic use can help navigate the fine balance between the reduction and conservation of information and ultimately reduce the inherent loss that results from converting qualitative data into a numerical format.

Complex ideas and phenomena undoubtedly require extensive and in-depth qualitative research approaches to properly characterize and understand (Malterud 2001; Tong et al. 2007). This can require the involvement of more participants to properly capture all associated themes. As the number of participants and themes increase, the numeric datasets obtained when transforming themes into frequency counts increasingly resemble those obtained from species counts in ecological surveys. Exploring the analytical techniques of such fields like ecology that have a long history of examining associations in large datasets may thus provide further insight in developing appropriate approaches to quantitatively analyze large thematic datasets (*i.e.*, the

implication of datasets containing large amounts of zero or null citations, the use and interpretation of visual diagrams).

2.2.3 Methodological and empirical objectives

In agreement with Greene et al. (1989), the method developed for applying these quantitative procedures on qualitative data is based on a mixed method research approach using qualitative and quantitative research methods as complementary tools of one another in an exploratory sequential design (Fakis et al. 2014; Fetters and Freshwater 2015; Hammarberg et al. 2016). Beginning with a qualitative phase, we used “best-fit” framework synthesis to determine themes and categories in an integration approach aimed at informing the use of diversity indices and producing quantitative data meant for analysis in multivariate procedures (*i.e.*, ordinations). Hence, the method developed addresses methodological issues associated with information loss by employing methods designed for analyzing, visualizing and interpreting complex relationships between elements of a large dataset.

The data used to demonstrate the method herein is generated from interviews carried out with three First Nation communities in Québec, Canada, on the definition and representation of local Indigenous medicines amongst participants working in the healthcare network (*e.g.*, healthcare professionals and administrators) and using healthcare services (*e.g.*, residents of the First Nations, including Elders). Using a subset of this data, we also demonstrate how our method addresses content specific objectives based on qualitative and quantitative questions. Namely, on the interpretation of ideas and concepts in terms of the meanings people bring to them (*e.g.*, what is Indigenous medicine?), as well as determining patterns, comparing groups and testing hypotheses regarding the perception of said ideas and concepts (*e.g.*, participants that work in the

healthcare sector describe local Indigenous medicine differently from healthcare users), whereby the notions and concepts underlined by participants help to further understand what is observed (e.g., how and why are these descriptions different or alike?).

2.3 Materials and Methods

2.3.1 Methodological Framework

Unconstrained and constrained ordinations

Ordinations consists of operations aimed at representing and arranging in some order multidimensional relationships using the rows and columns of a table in a reduced space that contains fewer dimensions (*i.e.*, generally two or three; **Figure 2.1**) than what describes the original dataset (Gower 1987; Höft et al. 1999; Legendre and Legendre 2012). They are well known to ecologists who have used them for the interpretation of community structures based on species presence-absence or species abundance, optionally including various environmental and ecological variables (Gower 1987; Höft et al. 1999; Legendre and Gallagher 2001; Legendre and Legendre 2012). Although a number of methods exist that allow for quantitative (*i.e.*, abundance, frequency counts), semiquantitative (*i.e.*, ordered relationships, scaled categories) and binary (*i.e.*, presence-absence) descriptors in meaningful ordinations (Legendre and Legendre 2012), we focus our method on the use of PCA and redundancy analysis (RDA).

Ordinations like PCA are largely descriptive in nature, allowing one to derive information based on the visual projection and study of the relationships between rows (elements) and columns (descriptors) of a data table (**Figure 2.1c, Table 2.1**). They are unconstrained and thus, do not permit testing of underlying hypotheses. In canonical analysis, however, ordinations are

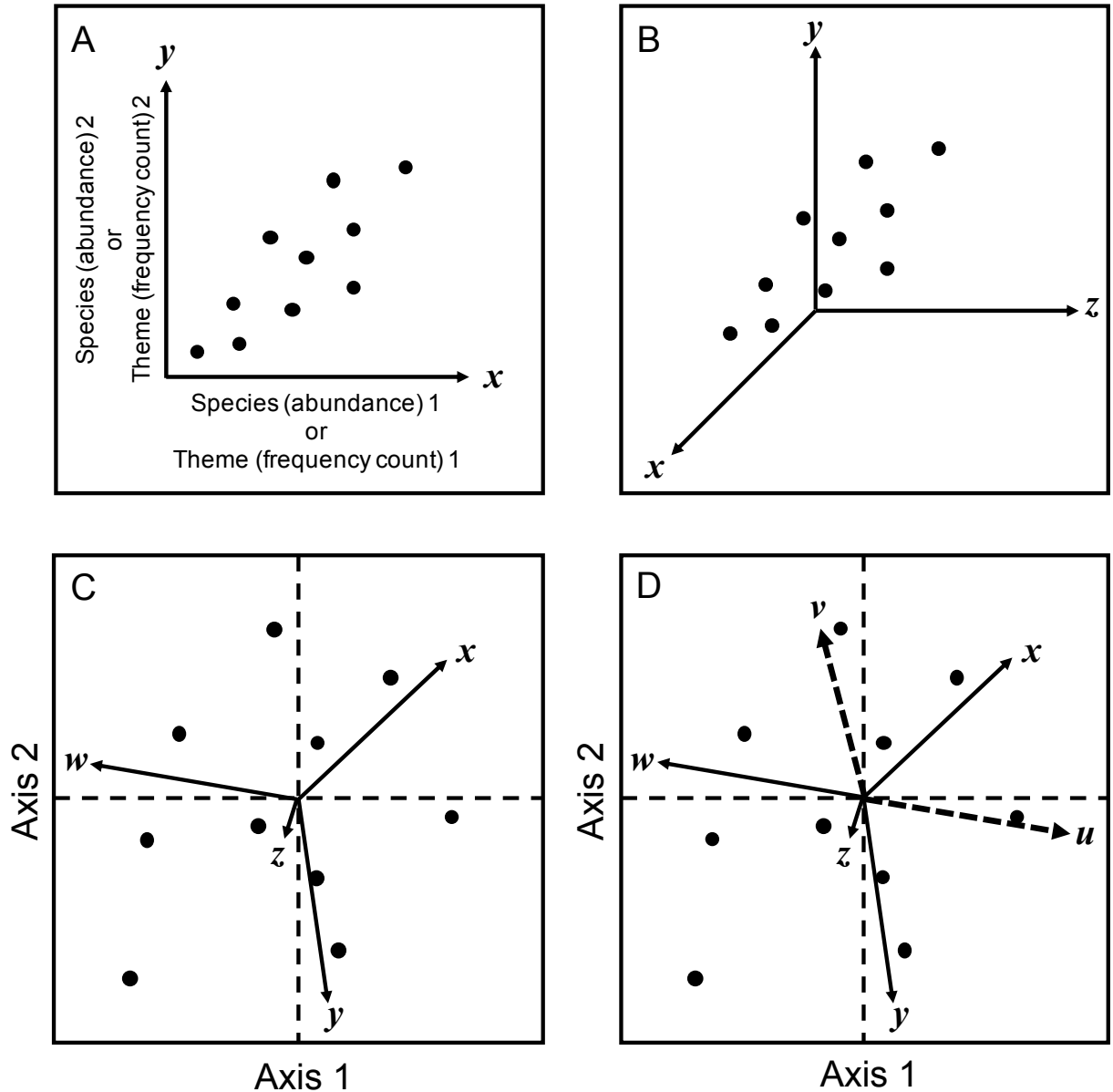


Figure 2.1. Visual representation of the evolution of a scatterplot to an ordination. The fictional dataset contains either the abundance of species observed at 10 different sampling sites, or the frequency count of themes discussed by 10 interviewed participants (points; $n=10$). A) The relationship between two of these descriptors (x and y), can be projected on a scatterplot represented by 2 axes (solid arrows). B) A third descriptor (z) is represented by adding a third axis to the scatterplot. C) In order to include a fourth descriptor (w) or more, unconstrained ordinations like PCA center, or rotate, their axes around two reference axes (dotted lines) that can explain, in a reduced two-dimensional space, as much of the variation from the multidimensional space. D) Constrained ordinations like RDA enable the inclusion of explanatory descriptors (u and v ; dashed arrows) whose relationship with response descriptors (x , y , z and w) may be tested. See chapter 9 and 11 in Legendre & Legendre (1998) for an in-depth visual demonstration and description of unconstrained and constrained ordination methods, respectively.

Table 2.1. Typical terms employed in quantitative disciplines (*i.e.*, ecology) and qualitative disciplines (*i.e.*, sociology) to describe the numerical representation of information. The provided definitions are neutral in their description so that analogous terms may be understood on similar grounds.

Ecological structures	Thematic analysis	Definition
	Matrix, table	Dataset expressed in a tabular format.
Community	Discourse	An assemblage of descriptors that form a cohesive unit based on commonalities.
Species	Themes	<i>Descriptors</i> : assigned to the columns of a dataset, whose numerical value describes an element. Frequently called variables.
Sites	Participants	<i>Elements</i> : assigned to the rows of a dataset, whose numerical value is described by a descriptor.
Species abundance	Theme frequency count	Total count of a given descriptor characterizing a specific element.
Species richness	Counts of themes	Total count of all descriptors characterizing a specific element.
Species presence-absence (1/0)	Presence of theme (yes/no)	Binary measurement indicating the presence (1) or absence (0) of a given descriptor in characterizing a specific element.

constrained by a set of explanatory descriptors that intervene in the underlying calculations, thus allowing for tests of significance for the purposes of hypothesis testing on multivariate data (**Figure 2.1d**). The constrained extension of PCA is RDA, which combines the concepts of:

- i) univariate multiple regression, allowing for the testing of the null hypothesis (H_0) that the strength of the linear relationship between a set of response variables and a set of explanatory variables is not larger than that the strength obtained for unrelated datasets of the same sizes;
- ii) ordination, allowing for the visualization of relationships between a set of response variable and a set of explanatory variables in a reduced space.

For an in-depth description of unconstrained and constrained ordinations and their algebraic formulation, see chapter 9 and 11, respectively, of Legendre & Legendre (2012).

Applying ordinations to qualitative information from interviews

Specific words and terminology are used by ecologists when describing these methods as they have contributed a lot to the development of these methods. If these methods are stripped of this jargon, reverting to the language of matrix algebra and statistics that explain these methods, we can reinterpret them in different disciplines. **Table 2.1** elucidates some of the core terms employed by numerical ecologists and how they are analogous to terms used when quantifying qualitative information based on themes.

Ordinations employed by ecologists in the context of interpreting community structures will reveal patterns that characterize sampling sites, or groups of sites, based on the associations and relationships between species at these locations. These may alternatively be used in the context of revealing patterns amongst participants, or groups of participants, based on the associations and relationships between the themes used by people to describe a phenomenon or an idea mentioned in interviews. Mathematically, datasets describing sites based on the species that they contain are structurally no different than datasets describing participants based on the themes that they cite (**Figure 2.2**).

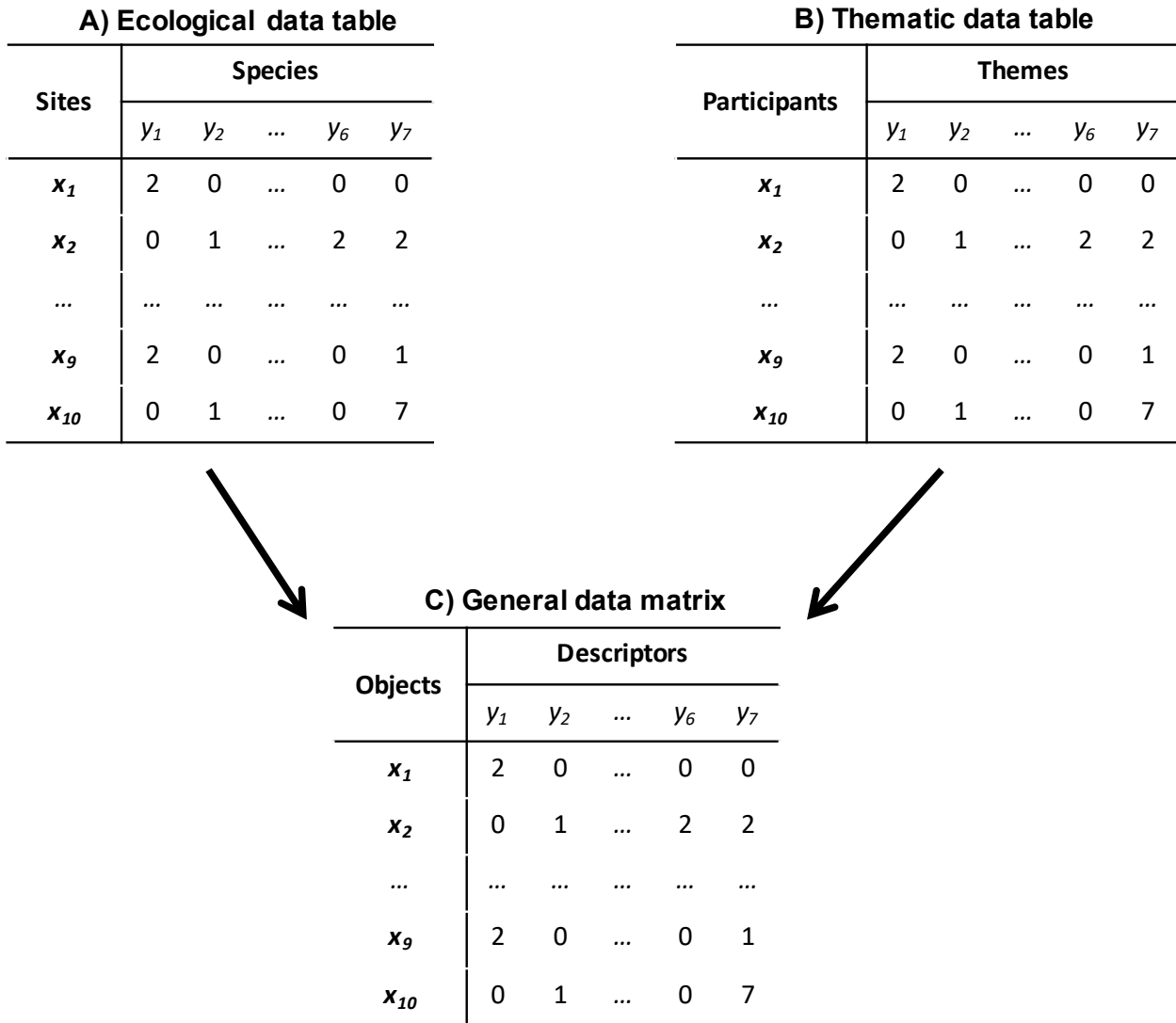


Figure 2.2. Comparison of datasets of numerical and thematic datasets. Both fictional datasets used in ecology, to study species occurring at sites in community structures (A), and thematic analysis, to study themes discussed by participants (B), are expressed in their algebraic form using matrix language (C).

Zeros or nulls: real values, or missing data, and the “species abundance paradox”

When considering geographical and environmental factors, ecological studies frequently sample along long gradients leading to many species being replaced by others, therefore introducing many zeros into data tables (Legendre and Gallagher 2001). The significance and implication given to these values have been elucidated as early as the mid-20th century (Goodall

1954), and discussed ever since in the ecological literature (Gower and Legendre 1986). Briefly, if one species is present at two sampling sites, this can be interpreted as an indication of their similarity. If that species is absent from two sites (double-zero), one does not know if these share the same characteristics that are unfavorable to the species in question, suggesting an indication of similarity, or if this may be caused by different unfavorable characteristics that ultimately indicate dissimilarity (Legendre and Legendre 2012).

Along this line of thought, the same can be said regarding themes discussed around a phenomenon or idea whose description increases in complexity, especially when considering various cultural, political, even environmental and geographical gradients. This is arguably truer for thematic analysis than classical ecological studies. While it is conceivable to develop ecological sampling methods by which one reasonably attempts to count every individual in a given area, it is not reasonable to expect interview responses to provide as much of an exhaustive sampling, or representation, of participants' actual knowledge of a specific subject. Hence, if one theme is not mentioned by two participants (double-zero), it is harder to conclude whether or not this is an indication of similarity as there may be many reasons why these were not discussed (*e.g.*, taboos, subjective elements like trust level between interviewer and interviewee, or the participant simply forgot to mention it), especially concerning delicate or controversial topics like death and healthcare experiences (Foley and Timonen 2015).

The predominant presence of zeros, that inherently occur in ecological and thematic datasets, may also lead to what is known as the species abundance paradox in ecological circles. Orłóci (1978:46) first describes the paradox, illustrated by a numerical example (**Figure 2.3**), explaining that “*an anomalous situation can arise: two quadrats which have no species in common may appear more similar than two other quadrats whose species lists are identical.*” Broadly

speaking, ordinations, like PCA and RDA, that measure distances between points in a geometric space (*i.e.*, the Euclidean distance) are not appropriate for raw datasets that contain many zeros (Legendre & Gallagher, 2001).

When projected onto a PCA ordination (**Figure 2.3b**), the proximity of two objects, 1 and 2, that share no common descriptors is observed along the first principal component axis (PC1). Along this axis, object 3 is placed in opposition to objects 1 and 2, the latter two to be separated along a second (PC2), less important axis in explaining the variation in the dataset. The species abundance paradox is remediated by transforming the dataset using one of multiple equations that handle the presence of zeros differently (Legendre and Gallagher 2001). When employing Hellinger's transformation (**Figure 2.3c**), frequently used in analyzing ecological structures, transformation-based PCA (tb-PCA) ordinations more accurately projects object 1 in opposition to object 2 and 3, along with the appropriate descriptors that characterize each object.

Projecting ordinations

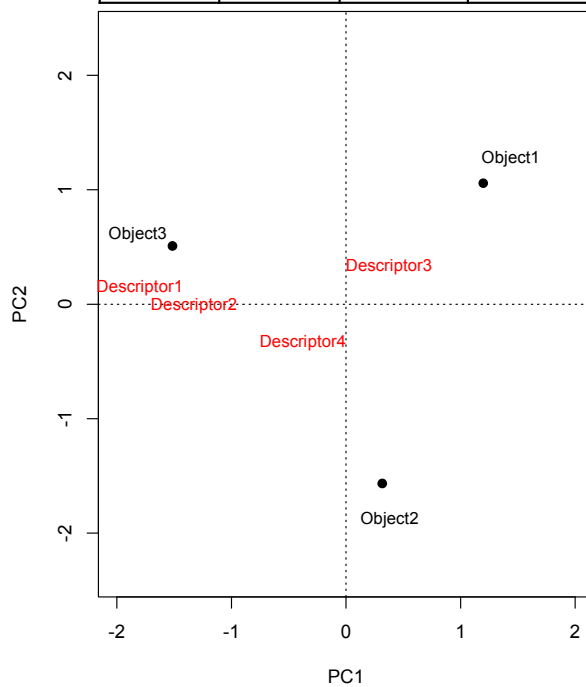
For an in-depth description on the visualization of ordination results in biplots and triplots diagrams, as well as scaling, see ter Braak (1994) and Legendre & Legendre (2012). Results from unconstrained and constrained ordinations are drawn onto diagrams that contain either two or three sets of points (biplots, **Figure 2.1c**; triplots, **Figure 2.1d**). Whereas objects from a dataset are presented as points on a PCA biplot, those from descriptors are typically linked to the center of the diagram by an arrow (**Figure 2.1c**). Constraining, or explanatory, descriptors added to an RDA are included in triplots using arrows if they are continuous (*e.g.*, age, temperature) or points if they are grouping (*e.g.*, gender, community, profession). The contribution of descriptors to the variation in the dataset are evaluated by the length of their arrow, whereas the association between descriptors and axes are evaluated by the angle between them (Legendre and Legendre 2012).

A) Species abundance paradox table

Objects (Sites or participants)	Descriptors (Species or themes)			
	Descriptor 1	Descriptor 2	Descriptor 3	Descriptor 4
Object 1	0	0	1	0
Object 2	1	1	0	1
Object 3	4	3	0	1

B) PCA (Euclidean distance)

Objects	Object 1	Object 2	Object 3
Object 1	0	-	-
Object 2	2.00	0	-
Object 3	5.20	3.61	0



C) tb-PCA (Hellinger)

Objects	Object 1	Object 2	Object 3
Object 1	0	-	-
Object 2	1.41	0	-
Object 3	1.41	0.261	0

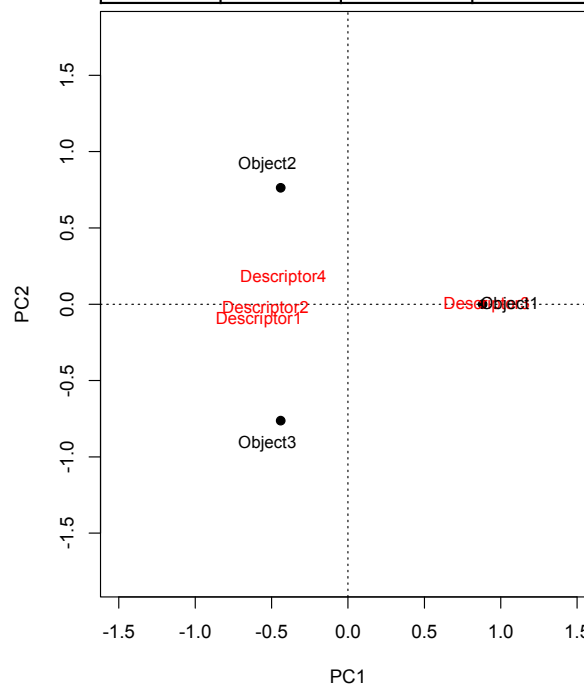


Figure 2.3. The species abundance paradox illustrated with a numerical example (A), adapted from Orlóci (1978) and Legendre and Gallagher (2001). Objects 1 and 2 have no common descriptors, but their Euclidean distance is smaller (2.00) than the distance between objects 2 and 3 (3.61). The proximity of these two objects is displayed along the main principal component axis (PC1) drawn to reflect the maximum amount of variation possible in the dataset using PCA (B). When applying Hellinger’s transformation in tb-PCA, objects are realigned along PC1 to reflect the relationships between objects that one would expect through qualitative interpretation of the dataset (C).

Furthermore, due to the amount of information generated by ordination techniques, not all are optimally displayed in biplot and triplot diagrams. Choosing the scale to visualize and interpret data depends on fundamental questions of interest, more precisely, whether it is the relationship between objects (*i.e.*, sites or participants) or descriptors (*i.e.*, species or themes) that are most important. Scaling 1 preserves the distance between objects, whereas scaling 2 preserves the distance between descriptors.

Reporting the R^2

We use the canonical coefficient of determination (R^2), or bimultivariate redundancy index, as a statistic to represent the proportion of variation in a set of response variables explained by a set of explanatory variables in canonical analysis (Miller and Farr 1971). Though it is used as a measure of the strength of the linear relationship between these sets of variables (Legendre et al. 2011), the estimator has been reported to be biased (Peres-Neto et al. 2006). As suggested by Peres-Neto et al. (2006) and Legendre et al. (2011), we report the adjusted R^2 (R^2_{adj}), applying Ezekiel's adjustment to the coefficient of multiple determination used in multiple regression (Ezekiel 1930). This corrected statistic provides a more accurate estimation and valid comparison of factors explaining multivariate datasets containing continuous or Hellinger-transformed data in RDA (Peres-Neto et al. 2006).

Measures of diversity

Because ecological and thematic data tables reflect changes that occur over long and implicit gradients, these types of datasets not only contain many zeros, but also many rare or uncommon descriptors, characterized by low occurrences and frequency counts, along with a few common descriptors (Legendre and Gallagher 2001; Blanchet et al. 2014). How rare descriptors are treated remains at the center of much debate (Poos and Jackson 2012). Although choices may

lay on the level of attention brought to determining rare descriptors, if these were not systematically and rigorously sought out, many papers suggest removing rare descriptors as they add noise to multivariate analyses all the while providing little additional information and meaningful results (Legendre and Legendre 2012; Blanchet et al. 2014).

Due to the complex nature of knowledge systems, involving different dimensions (theoretical and practical) and elements (plants, animals, soil, etc.), describing and measuring these systems are no easy task (da Silva et al. 2014). Proper qualitative analysis may elucidate phenomena and ideas that are best described through multilevel structures that are not well represented in datasets used for multivariate analysis. Forcing these into datasets designed for ordinations may not only poorly capture the structure of these knowledge systems, but also overload the analysis in an effort to preserve as much of the themes identified through thematic analysis. To solve this problem, we suggest using indices of diversity to summarize subsets of data, suggested by qualitative analysis, into overarching congruent themes that are placed into datasets meant for ordinations.

Such measurements like those based on the aggregation of uses, or sum of uses, were developed in ethnobiology to summarize the multiple uses of plant or animal resources into overarching categories, like grouping all medicinal or dietary uses into one measurement (Turner 1988; Phillips and Gentry 1993a, 1993b; Phillips 1996). Grouping is performed based on use categories but may also be based on taxon (*i.e.*, species, family) or another classificatory scheme. These measurements are very similar to calculating species richness or the count of themes as they require counting the number of descriptors to include in a group (**Table 2.1**). Although these indices provide fast and straightforward ways of quantifying the information of multiple columns of a row in a table into one measurement (Phillips 1996), they have limitations. These techniques

do not differentiate the relative importance of infrequently appearing descriptors; rare species or themes are therefore treated as equivalent to even the most abundant descriptors (Phillips 1996). The use of diversity measurements resolves this problematic by considering abundance, or frequency.

Peroni et al. (2014:398) describe diversity as a reflection of “*the variety that exists in a certain place and refers to the number of categories that can be differentiated, and the proportions (or relative abundance) of the objects in each category.*” One of the fundamental measurements of diversity is species richness, which is the count of the number of species present in a sampling unit (Gotelli and Colwell 2001, 2011; Peroni et al. 2014), which we also define as the count of descriptors for a given object (**Table 2.1**). Others, such as the Simpson diversity index ($1/D$) and the Shannon-Wiener index (H), consider this count along with abundance, or frequency count (**Table 2.1**), in order to capture evenness amongst abundant and rare species, or descriptors (Hill 1973; Peroni et al. 2014).

Summary of points to consider when choosing an ordination

- The purpose and questions to answer (*i.e.*, descriptive analysis or hypothesis testing);
- The length of implicit and underlying gradients (*e.g.*, short or long);
- What information to include in the dataset (*e.g.*, raw or transformed, all or specific descriptors);
- The type of transformation, if necessary, to apply to the raw data;
 - The presence and significance of zero values (0);
 - The weight, or importance, given to rare objects in the dataset;
- The visual representation of results in diagrams (*e.g.*, biplots or triplots) in accordance with the relationships of interest (*i.e.*, between objects or descriptors; scaling).

2.3.2 Community Consultations

Field work took place from fall 2015 to winter 2016. Data were collected through semi-structured interviews and participant observation (*i.e.*, observation and participation in community activities) in three First Nation communities, Mashteuiatsh, Mistissini and Chisasibi (Québec, Canada). Participants were selected primarily through nonprobability and nonrandomized approaches, researchers resorting to convenience sampling at times. More specifically, potential participants were selected based on their association to one of four sub-groups that place them as either working members of the healthcare network or non-working member, namely service users (**Table 2.2**), and were primarily identified by snowball sampling, whereby participants are identified by community members. Names were initially provided through existing relationships between community members and many of the authors (Leduc et al. 2006; Forêt modèle du Lac-Saint-Jean 2015), and by consulting with supporting organizations (*i.e.*, Band Offices, Cree Board of Health and Social Services of James Bay (CBHSSJB), Centre de santé et mieux-être collectif de Mashteuiatsh, Musée amérindien de Mashteuiatsh). Search for more participants ceased when researchers judged that saturation had been reached, as evidenced by a sharp decline in the accumulation of new themes when approaching 100 interviews (**Figure 2.4**).

Informed consent was obtained in written from participants prior to each interview. Consent forms and questionnaires were approved by each community's Ethics Committee along with the Ethics Committee of the Université of Montréal (Certificate #: CERAS-2016-17-081-P; **Annex 1**). Overall, the approach behind this project was conducted with respect to the International Society of Ethnobiology's Code of Ethics (International Society of Ethnobiology 2006).

Open-ended interview questions related to people's knowledge and definition of medicine, namely differentiating between local practices and the biomedical system, as well as attitudes and

Table 2.2. Participant categories.

Category	Example
<i>Community members and healthcare users</i>	
Knowledge holders (KH)	Elders, healers, etc.
Healthcare users (HU)	All other community members.
<i>Healthcare network staff</i>	
Healthcare administrators (HA)	Directors, administrators.
Healthcare professionals (HP)	Doctors, nurses, nutritionists, etc.

practices related to the use of these medical systems. Interviews were held in the language of choice of the participant, primarily English and French. With the help of an interpreter, some were also held in *Nehlueun* and both dialects of *Iiyiyuu Ayimuun*. We recorded relevant words, terms and affiliated concepts in all three of the Algonquian languages spoken in each First Nation communities. We returned to the communities to validate and confirm terminology, nomenclature as well as validate the accuracy of codes, categories and developing theory with as many participants who had originally participated.

2.3.3 Data Analyses

We used a mixed-method approach to analyzing data (**Figure 2.5**). Briefly, a “best-fit” framework synthesis approach was used to qualitatively analyze interview transcripts. Quantitative datasets were generated from these analyses to examine the relationships between themes and participants using multivariate statistics. All authors have worked with Indigenous communities on local knowledge (Davy et al. 2012; Haddad et al. 2012; Cuerrier et al. 2014; Rapinski et al.

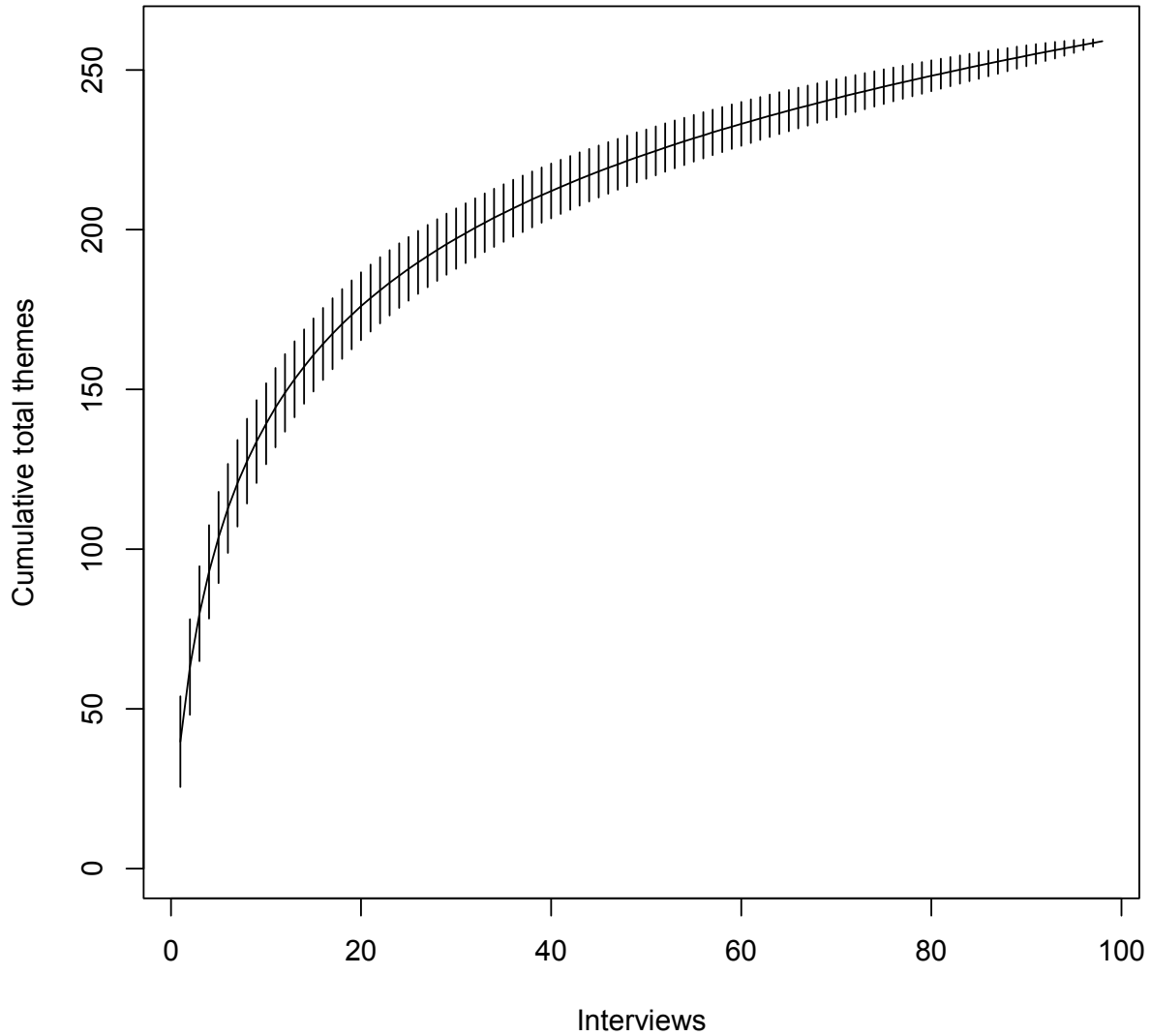
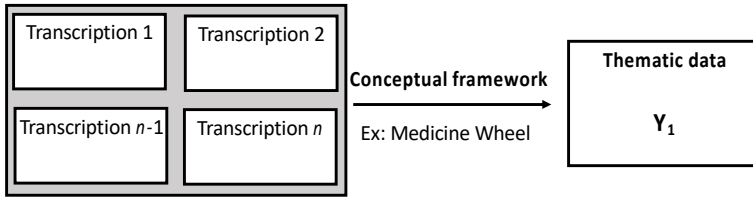


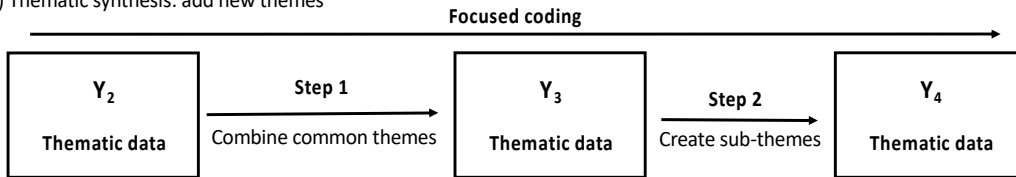
Figure 2.4. Thematic accumulation curve illustrating the cumulative total of themes cited by participants with the number of interviews. The mean accumulation curve (solid line) and each point's standard deviation (bars) are calculated from 100,000 random permutations in the order by which each interview is added to the count (Gotelli and Colwell 2001, 2011). Calculations are performed using the function `specaccum{vegan}` developed for finding species accumulation curves.

“Best-fit” framework synthesis

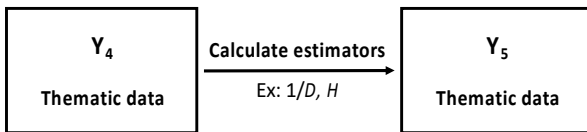
(a) Define *a priori* themes



(b) Thematic synthesis: add new themes

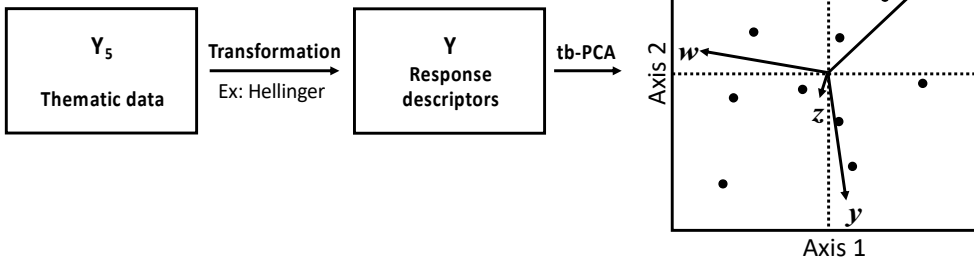


Biodiversity measurements



Multivariate analysis

(a) Unconstrained ordination of descriptors



(b) Constrained ordination of descriptors

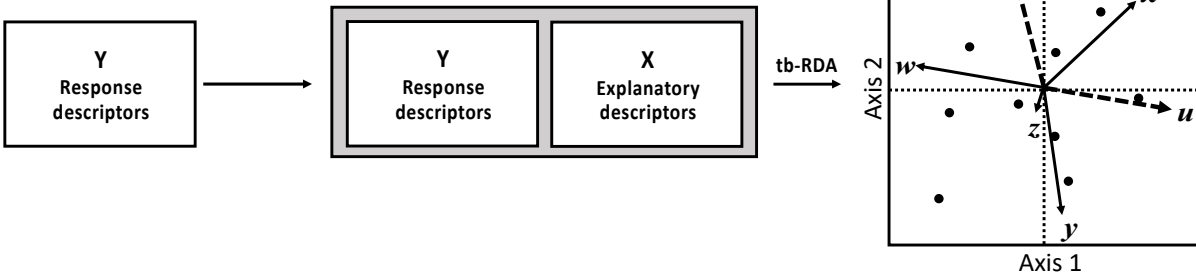


Figure 2.5. Methodological steps from “best-fit” framework synthesis to unconstrained and constrained ordinations.

2018a; Ogeron et al. 2018; Richard-Hansen et al. 2019). The first and last authors are trained biologist, namely in botany and ecology, that have experience using mixed-method approaches (Cuerrier et al. 2015a; Rapinski et al. 2018b). The second and third authors are trained pharmacologist and anthropologist, respectively.

Qualitative Analyses

Audio files of interviews were transcribed verbatim. For interviews performed with an interpreter, only the English and French dialogue was transcribed. The researchers, namely the first author, first listened to each recording while reading the completed transcripts to familiarize themselves with the data (*i.e.*, note taking: annotations and memos for reflections and analytic questions that arise) and establish a preliminary list of recurring themes (*e.g.*, concepts, notions, terms and keywords used to describe local medicines).

Originating from framework analysis (Ritchie and Spencer 1994), a “best-fit” framework synthesis approach, previously described (Carroll et al. 2011, 2013; Houghton et al. 2016), was used to analyze interview transcripts. Briefly, a conceptual framework, built from existing knowledge of indigenous medicine, is used to identify *a priori* themes. Thematic synthesis is employed for new themes to build onto the existing framework and allow a new model to emerge. Because the Medicine Wheel had been mentioned by multiple participants from all three communities, we used its four major dimensions of the human being as the conceptual framework to structure our analysis: physical, intellectual (or mental), emotional and spiritual (Reney 2001; Bergeron-Martel 2011; Robertson 2011; King-Paquette 2012; Laberge Gaudin 2012).

We used NVivo qualitative data analysis software (QSR International 2015), a computer-assisted qualitative data analysis software (CAQDAS), to handle, store, manage, retrieve and link data to data from interview transcripts. More precisely, each transcript was imported as a case

linked to a set of classificatory attributes regarding participants (*e.g.*, community, demographic group; **Table 2.2**). Themes were coded using broad-brush coding, whereby specific words are located and stored as nodes using text queries. These are then tracked, reorganized and checked to ensure that they are grounded in the data (Bassett 2010; Leech and Onwuegbuzie 2011; Bergin 2011; Houghton et al. 2013). The purpose and application of the NVivo functions used here (Cases, Attributes/Classification, Nodes, Queries and Matrices) are described in depth in (Houghton et al. 2016).

Initial coding was first performed in the language used to communicate during the interview, *i.e.*, French or English. For each node, individual entries are reviewed in order to establish if the coded terms are employed by participants to define, explain or represent indigenous medicine; entries employed out of context were removed from the dataset. English terms were then grouped with their French equivalent.

Themes were classified and those which point to narrowly defined concepts were grouped into categories (Mohler and Zuell 2001; Ponnam and Dawra 2013). During the first step of focused coding, synonymous terms were grouped together into a representative theme or concept (*i.e.*, “flora”, “vegetation” and “plants” become “plants”; “Labrador tea” and “Labrador bush” are grouped under their Latin name “*Rhododendron groenlandicum*”). During the second step of focused coding, themes were grouped furthermore into a more general overarching theme (*e.g.*, “*Abies balsamea*”, “*Larix laricina*” and “*Rhododendron groenlandicum*” become “plant species”; “bark”, “fruit” and “leaf” become “plant parts”). This process is repeated sequentially to refine each category formed until a general conceptual model of local medicine becomes apparent (*e.g.*, “plant species”, “plant part” and “plant type” are grouped in with “plants”, “animal species”, “animal part” and “animal type” are grouped in with “animals”).

Using matrix coding to cross-tabulate information from the NVivo database (Bassett 2010; Bergin 2011; Sinkovics and Alfoldi 2012; Casey et al. 2016), a table of the coded text was generated with a row for each participant and columns representing key themes around local medicine (*i.e.*, response descriptors) and specific demographic attributes (*i.e.*, explanatory descriptors), namely community and group demographic. It expresses, in a numerical fashion, the frequency count of specific themes evoked by participants to describe local medicine. This table of themes frequency count was exported for use in multivariate analyses, as described by Mohler and Zuell (2001). Participants who preferred to be interviewed together were considered as n=1, reducing the effective participant sample size.

Quantitative Analysis

All quantitative transformations and multivariate statistical analyses were performed with R statistical language (R Core Team 2019) using the built-in ‘stats’ package, as well as the ‘vegan’ package (Oksanen et al. 2019). Specific functions are presented in sample scripts as a supplementary document (**Annex 2**).

Because our datasets show a considerable amount of zero values (0) and double-zeros, Hellinger’s transformation was applied to the response matrix of cited themes to allow for ordinations in Euclidean space. Both tb-PCA and transformation-based RDA (tb-RDA) were performed on matrices as described by (Legendre and Gallagher 2001). We use tb-RDA to test the relationship between themes mentioned by participants with the community and group demographic they have been assigned to as factors in a nonparametric multivariate analysis of variance (MANOVA) model described by Legendre and Anderson (1999) for distance-based RDA (db-RDA).

We use the R^2_{adj} statistic to assess the strength of the relationship between themes and the constraining factors (Peres-Neto et al. 2006; Legendre et al. 2011). Testing the significance of these relationships were performed using 100,000 permutations of residuals under a reduced model, as described by (Legendre et al. 2011). These operations compute the significance of the general model, the factors included and the constrained axis upon which the ordinations are projected. Significance was established at $\alpha = 0.05$. Post-hoc pairwise comparisons were realized by performing an tb-RDA for each pair of factors (*i.e.*, community and group demographics) and adjusting the α value using Holm's correction (Holm 1979; Legendre and Legendre 2012).

To assess the impact of various diversity measurements on our ordination methods, we worked with different datasets containing overarching themes and categories resumed by a total count of themes (*i.e.*, species richness, count of themes; **Table 2.1**), Shannon-Weiner index and raw data.

2.4 Results

Altogether, over 259 terms used to describe local Indigenous medicines were coded during the first stage of analysis. Focused coding revealed a complex structure to how people perceive, describe and define these medicines (**Figure 2.6**). Some of the major themes discussed by participants were related to knowledge and use associated with plants and animals, as is evidenced by the large numbers of species spontaneously cited by participants. Other major themes touched on traditional, cultural and customary practices and various aspects of health. The tree map of themes cited by participants provides a transparent work board for tracking the grouping of themes into categories and their classification (**Figure 2.6**), as well as finding and discussing associations

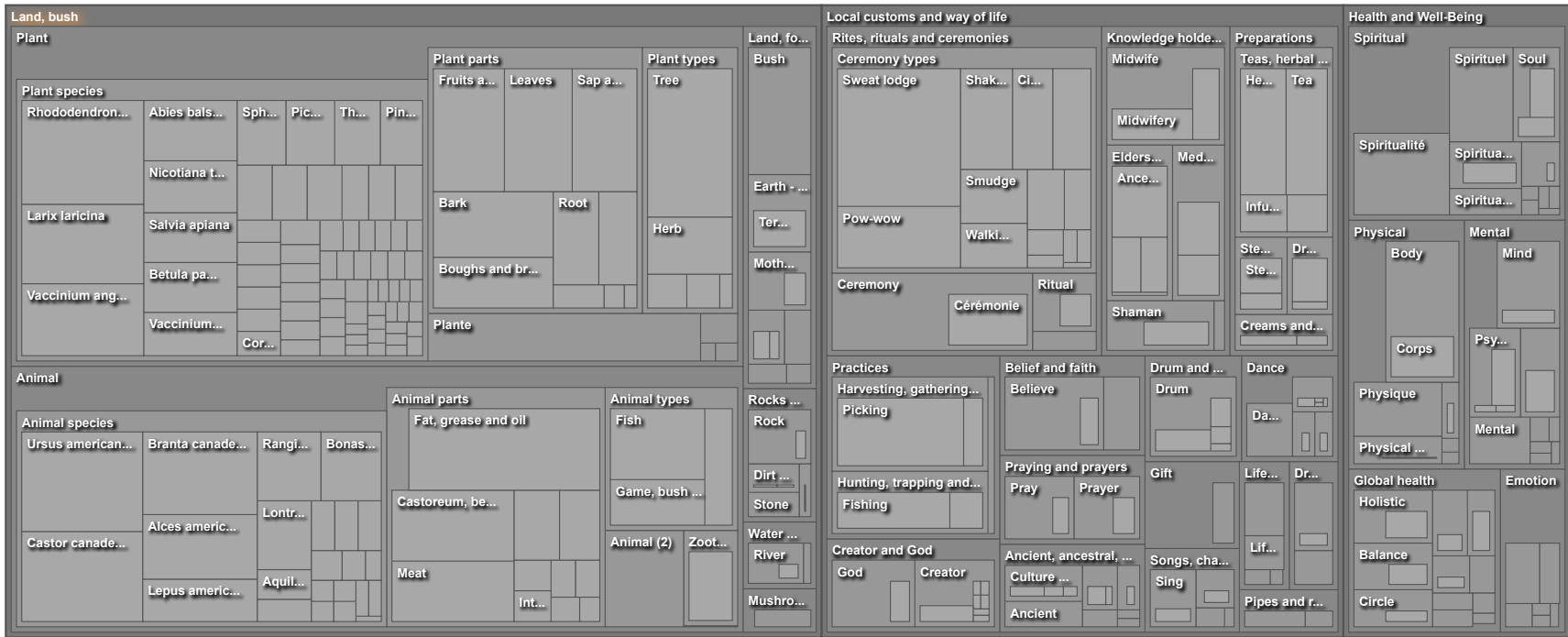


Figure 2.6. Hierarchy treemap of the classificatory structure of themes identified by “best-fit” framework synthesis. The size of each box corresponds to the number of coded transcripts that cite each theme or concept that are aggregated into it. For ease of visualization and interpretation, hierarchic levels beyond the fourth (e.g., 1-Land, bush, 2-Plant, 3-Plant species, 4-*Larix laricina*) are excluded from this diagram. Each level is color coded from dark grey, for higher order groups, to light grey, for lower order groups.

between themes, which are not presented here. For the purpose of this study, it is rather the structure of this classification that is of interest for using as a frame of reference to instruct the structure of datasets for ordinations and their use with diversity indices.

“Best-fit” framework synthesis of interview transcripts initially produced a large dataset that, before any focused coding, was characterized by a substantial number of zeros when themes were numerically represented as frequency counts. To demonstrate the typical use of ordinations that handle large quantities of zeros (tb-PCA and tb-RDA), we used a subset of the 12 most cited species by participants as their frequency counts best reflect the classical structure of community data tables, containing species abundance data, used in numerical ecology (**Figure 2.7** and **2.8**). Using tb-PCA, participants and species are reordered along virtual axes (principal components) whereby the first two produced explained over 30.9 % of the variation in the dataset (**Figure 2.7**). Species that varied the most within the dataset are characterized by long arrows that distinguish themselves from the rest. Participants are represented by points that are interpreted by projecting them at a 90° angle onto arrows defined by species.

The association of species to principal component axes is interpreted by observing the angle between the two. Hence, species 1, 7, 8 and 11, varied closely along the main principal component axis (PC1), whereas species 3, 5 and 10 were best associated with the second axis (PC2; **Figure 2.7a**). Species defined by prominent arrows that couldn't be strongly associated to neither PC1 or PC2, such as species 9 and 12, are most likely explained by other, less important principal component axes. This is illustrated by visualizing diagrams with the third principal component axis (PC3) that explains 12.8 % of the variation in the dataset, almost as much as PC2 (**Figure 2.7b** and **c**). Indeed, when observing the ordinations from the perspective of PC2 and PC3,

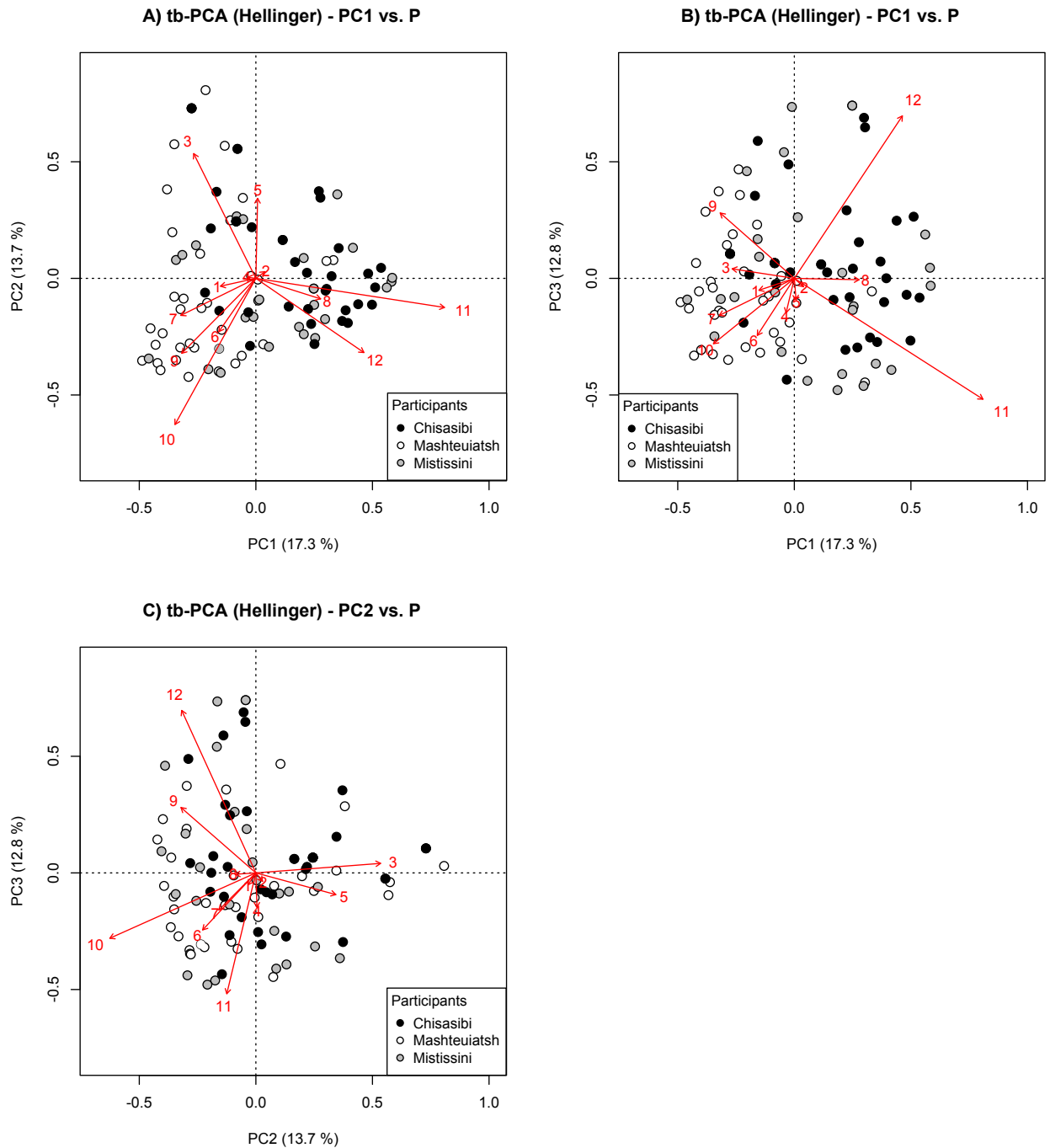


Figure 2.7. Ordination biplots in type 2 scaling of tb-PCA using Hellinger's transformation on the frequency count of animal and plant species. Species were cited by participants when describing local Indigenous medicines. Results from the three first principal components are presented in two-dimensional biplots. Participants from three First Nation communities (Mashteuiatsh, Mistissini and Chisasibi) are distinguished by different colors. Red arrows represent specific animal and plant species cited by participants.

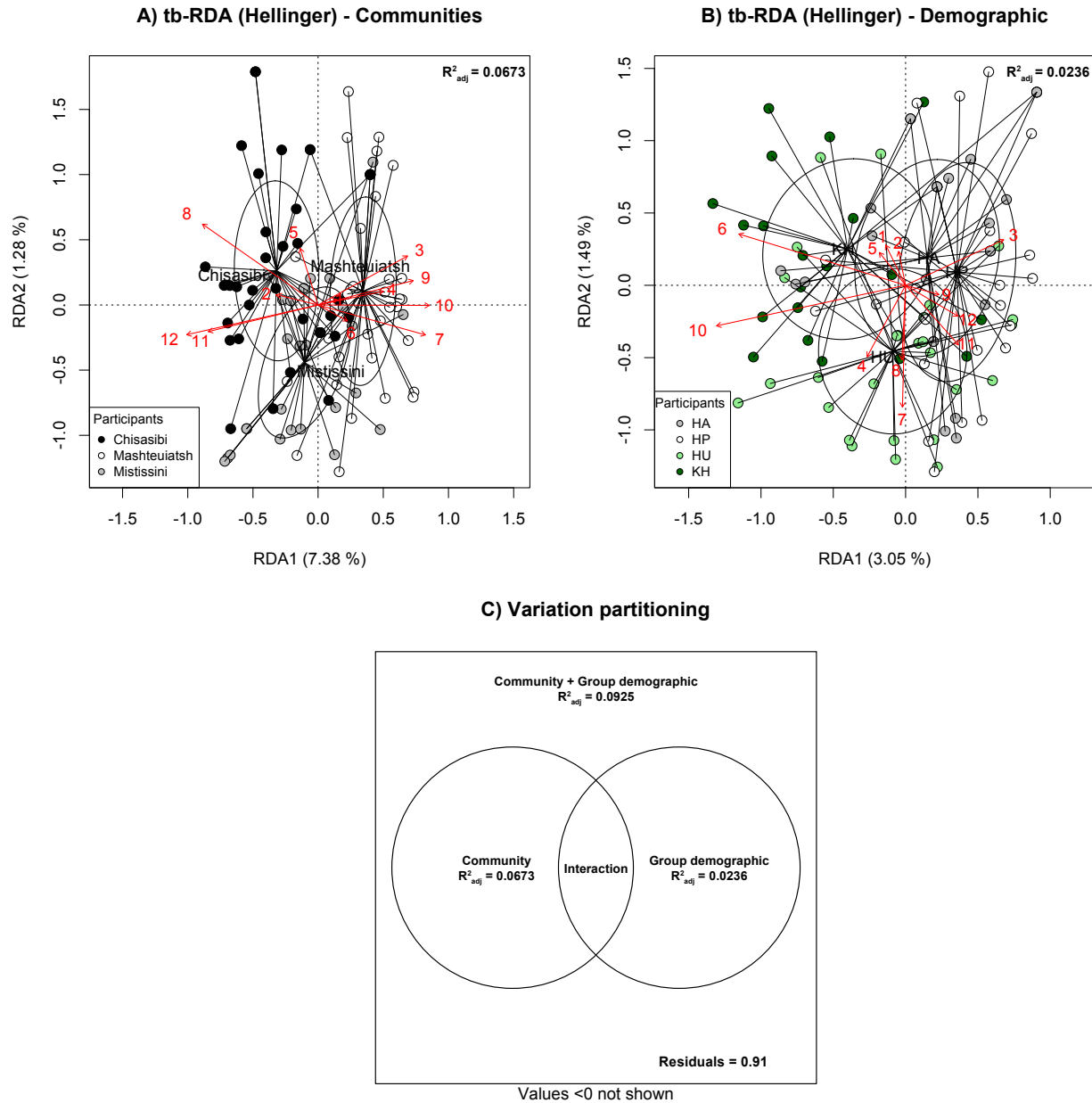


Figure 2.8. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of animal and plant species. Species were cited by participants when describing local Indigenous medicines. A) Variations in the distribution of species cited are tested in relation to the First Nation communities where participants reside and/or work, namely Mashteuiatsh, Mistissini and Chisasibi, as well as B) their relation to the healthcare sector, namely healthcare professionals (HP), healthcare administrators (HA), healthcare users (HU) and more specifically, knowledge holders (KH). Ellipses draw the standard deviations of participants around the centroids of each of their constraining factors. Red arrows represent specific animal and plant species cited by participants. C) Variation partitioning of the full MANOVA model showing no effect from an interaction between both factors (*i.e.*, community and group demographic)

species 12 varied more closely with this third axis (**Figure 2.7c**).

When participants are given a color based on the community from which they were interviewed, those from Mashteuiatsh (white) appear to group together on the left-hand side of the diagram, whereas those from Mistissini (grey) and Chisasibi (black) tend to overlap and group on the right-hand side (**Figure 2.7**). To verify if the observed pattern among participants is significant, the null hypothesis that there are no differences between responses is tested in tb-RDA, the constrained extension of tb-PCA (**Figure 2.8a**). Just as suggested by tb-PCA, participants grouped well according to their community. Although the strength of the relationship between communities and cited species was relatively weak, it was nonetheless significant ($p < 0.001$, $R^2_{\text{adj}} = 0.0673$) therefore rejecting the null hypothesis that these differences are simply random.

The same species that were highlighted by tb-PCA (**Figure 2.7**) also came up in this analysis (**Figure 2.8a**), whereby associations can now be drawn between response and explanatory variables. Hence, species 10, 9, 7 and 3 tend to be cited more frequently by participants from Mashteuiatsh. Furthermore, these species tend to be inversely related to species 11, and 12, which were more characteristic of participants from Chisasibi. None of the species included in the dataset tend to characterize participants from Mistissini more than the others. Instead, they seemed to position themselves in the middle of a gradient, expressed along the first canonical axis (RDA1) that separates Chisasibi, at one end, from Mashteuiatsh, at the other (**Figure 2.8a**). This axis, along which most species varied, was the only significant canonical axis ($p_{\text{RDA1}} < 0.001$, $p_{\text{RDA2}} = 0.197$), which means that the bulk of the results presented herein can be safely interpreted along RDA1, along with the association of species 8 and 5.

Based on pre-established questions of interest, the null hypothesis that there are no differences between responses from participants within and outside the healthcare sector is tested

in tb-RDA without exploring patterns in tb-PCA (**Figure 2.8b**). This relationship is weaker than what is observed when constraining by community, yet significant ($p = 0.00568$, $R^2_{\text{adj}} = 0.0236$); it is thus interpreted in a similar fashion to **Figure 2.8a**. Because the analysis produced three canonical axes of which the first was the only significant one ($p_{\text{RDA1}} = 0.0141$, $p_{\text{RDA2}} = 0.357$, $p_{\text{RDA3}} = 0.606$), it is safe to draw interpretations from associations made along the first canonical axis (RDA1). Hence, RDA1 distinguishes participants working within the healthcare sector from those who do not, suggesting a gradient opposing knowledge holders of local Indigenous medicines at one end, from healthcare professional at the other.

Associations with species are made just as with **Figure 2.8a**. While some of the same prominent response variables from **Figure 2.8a** may be prominent here (*e.g.*, species 10 and 3), other response variables may also be (*e.g.*, species 6; **Figure 2.8b**). Although species 4, 7 and 8 appear to be associated with healthcare user along the second canonical axis (RDA2), their noteworthiness exceed the capacities of the analysis as that axis is not statistically significant.

At this point, two separate hypotheses have been tested: one derived from observations made from tb-PCA and one derived from pre-established questions of interest. Because these were verified on the same dataset (**Figure 2.8a** and **b**), both can be tested in a single model to assess any interactions between the two main factors of interest. The full model, containing the effect of community, demographics and the interaction between the two, is significant ($p < 0.001$, $R^2_{\text{adj}} = 0.0867$) with no significant interaction ($p = 0.693$). Removing the interaction between communities and demographics can thus free up degrees of freedom for the calculation of statistics for a model that remained significant ($p < 0.001$, $R^2_{\text{adj}} = 0.0925$, **Figure 2.8c**).

The lack of a significant interaction between factors implies that the effect of one interferes minimally with the effect of the other. Hence, the general interpretation that participants from

within and outside the healthcare sector define and describe local medicines differently is applicable to all communities regardless of their distinctions, whereas a significant interaction would justify presenting results between demographics for each community separately. In other words, results presented in **Figure 2.8a** and **b** suggest that the factors tested explain different parts of the variation observed in species cited by participants. This is best represented using variation partitioning to visualize how R^2 varies in the combined model (**Figure 2.8c**).

Scaling the methods of tb-PCA and tb-RDA up to themes is no different if they are presented as frequency counts, just as for the dataset of species used in **Figure 2.7** and **2.8**. To demonstrate their application on this sort of dataset, tb-RDAs were performed on a subset of themes identified by “best-fit” synthesis (**Figure 2.6** and **2.9**). This expanded set of data was made up of the list of species cited by participants, as in **Figure 2.8**, as well as other themes pertaining to the land and local customs (**Figure 2.6**).

As evidence by the complex structure in themes (**Figure 2.6**), participants were quick to note that knowledge of local medicines is not only a question of knowing what plant and animal species to use and recognizing them ad hoc in their natural environment. It is also possessing a more comprehensive knowledge of plant and animal parts, such as barks, leaves, fat and flesh, or types in a greater classificatory scheme, namely shrubs, trees, fish and birds (**Table 2.3**). Furthermore, their use does not come without specific knowledge regarding preparations, practices and other elements of local customs (**Figure 2.6**). To capture these thematic elements without overloading our general RDA, we aggregated these themes into general categories and summarize their information using their total theme count (equivalent to species richness; **Table 2.1**) and the Shannon-Wiener index (**Table 2.3, Figure 2.9c-f**).

To demonstrate the improvement of applying these transformations in order of obtaining

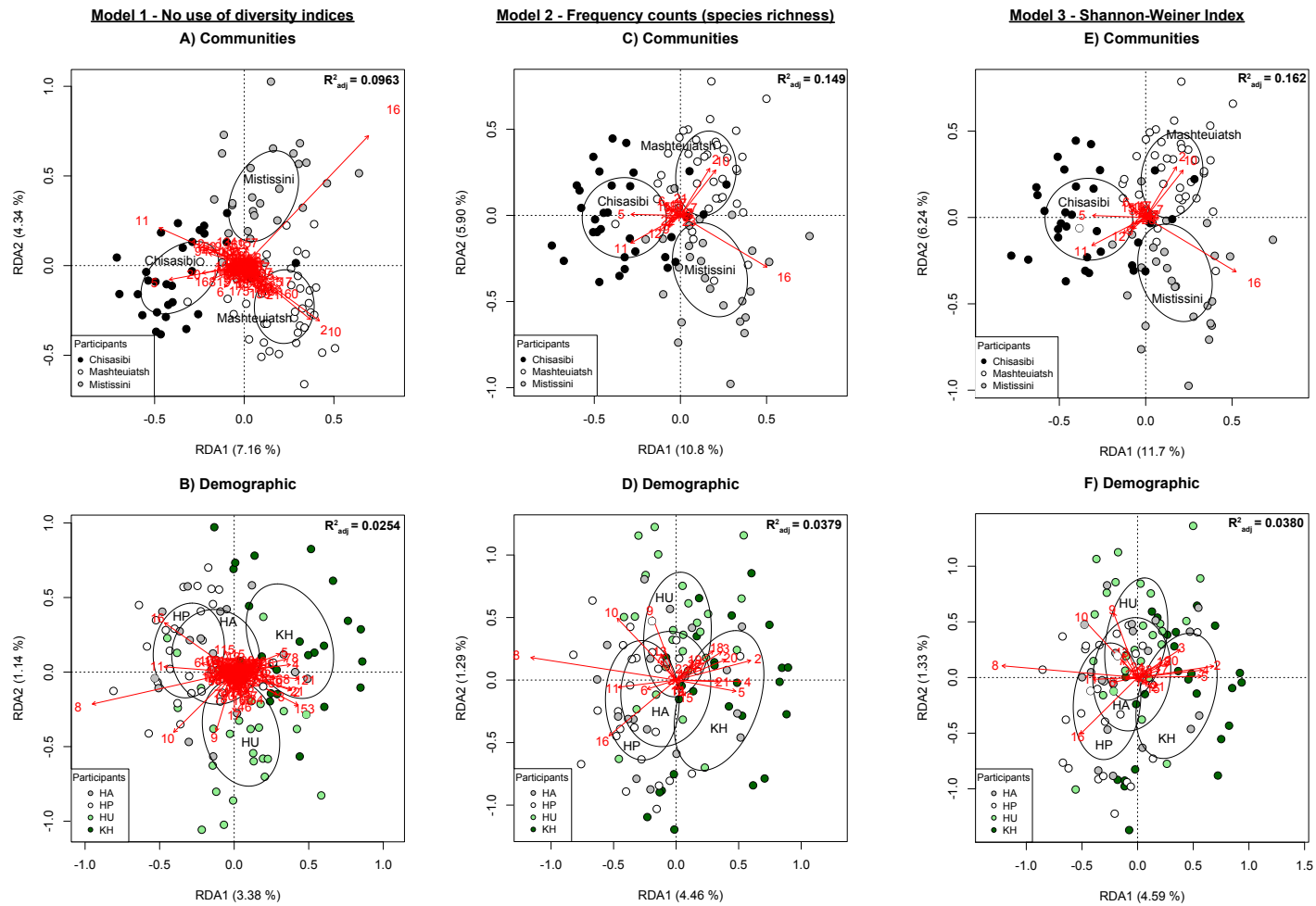


Figure 2.9. Ordination triplots in type 2 scaling of tb-RDA using Hellinger's transformation on the frequency count of themes. Themes were cited by participants when describing local Indigenous medicines. Results obtained from the raw data containing no reduced sub-categories (model 1) are presented with results obtained from using total counts (model 2) or the Shannon-Wiener indices (model 3) of sub-themes. Variations in the distribution of cited themes are tested in relation to the First Nation communities where participants reside and/or work (A, C and E), namely Mashteuiatsh, Mistissini and Chisasibi, as well as their relation to the healthcare sector (B, D and F), namely healthcare professionals (HP), administrators (HA), users (HU) and knowledge holders (KH). Ellipses draw the standard deviations of participants around the centroids of each of their constraining factors. Red arrows represent specific themes.

Table 2.3. Regrouped themes under general themes regarding plants and animals after focused coding during the thematic analysis step of “best-fit” synthesis.

General theme	Descriptors
Plant	
Species	72 different species
Type	1) Grass, 2) herb, 3) shrub, 4) tree, 5) conifers and evergreens
Part	1) Bark, 2) cone, 3) essential oil, 4) flower, 5) leaf, 6) root, 7) shoot, 8) branches, 9) fruits and berries, 10) sap and gum, 11) oil, 12) starch and flour
Animal	
Species	29 different species
Type	1) Birds and fowl, 2) fish, 3) game and bush meat, 4) shellfish
Part	1) Gizzard, 2) intestine, 3) liver, 4) meat and flesh, 5) bone, cartilage and marrow, 6) castoreum, beaver balls, 7) fat, grease and oil, 8) feathers and wings, 9) muzzle and snout, 10) faeces, 11) fur, 12) blood, 13) breastmilk, 14) tongue

meaningful ordinations, themes are loaded into a dataset without regards to any hierarchic categorization (**Figure 2.9a** and **b**). Results provide a meaningful detection of patterns between participant and groups (*i.e.*, communities or demographics), yet aside a few prominent themes (*e.g.*, theme 6 and 11, or theme 8 and 11; **Figure 2.9a** and **b**, respectively), the interpretation of associations with and within themes are muddled by a dense heap of responses near the center of the triplots. To eliminate the number of variables loaded into the dataset while retaining some their information, indices of diversity are subsequently applied to groups identified and instructed by

“best-fit” analysis (Figure 2.6, Table 2.3) and the new datasets then tested with tb-RDA (Figure 2.9c-d).

Table 2.4. Statistical results for three different models of tb-RDA on themes. Model 1 contains all themes without consideration of structure. Model 2 includes total theme count of categories formed to reduce the size of the dataset. Model 3 differs from Model 2 by using the Shannon-Wiener index (H) instead. The interaction refers to that between community and demographic, whereas the full model refers to that containing both community and demographic, the interaction having been removed due to no significant p -value (p).

	Community		Demographic		Interaction	Full Model	
	p	R^2_{adj}	p	R^2_{adj}	p	p	R^2_{adj}
Model 1 – All themes	< 0.001	0.0963	< 0.001	0.0254	0.269	< 0.001	0.126
Model 2 – Total theme count	< 0.001	0.149	< 0.001	0.0379	0.217	< 0.001	0.194
Model 3 – H	< 0.001	0.162	< 0.001	0.0380	0.250	< 0.001	0.207

All three models provide a meaningful detection of patterns between participants and groups; moreover, these patterns were similar all throughout with the significance of factors and their interaction leading to the same conclusions as those revealed in tb-RDA of the list of species (Figure 2.8 and 2.9, Table 2.4). More importantly, however, applying indices of diversity resulted in clearer ordinations that are easier to interpret and finally increased the strength of the relationship between themes and explanatory factors with the Shannon index giving the best results (Figure 2.9). Finally, whereas patterns detected, and hypotheses tested lead to the same conclusions regardless of the dataset used in Figure 2.8 or 2.9, the stories that they tell depend entirely on the response variables included in the analysis. If results presented in Figure 2.8b or 2.9b allows us to draw conclusions from associations with different species (*i.e.*, determine which species are predominantly cited by, or characteristic of, healthcare professionals and local

knowledge holders), their aggregation into the variable “animal species” or “plant species” tells us, on the other hand, whether the diversity of species cited by knowledge holders is greater than healthcare professionals (**Figure 2.9d and f**).

2.5 Discussion

2.5.1 Advantages and limits

The results presented here are discussed in the context of the practical application of ordinations on datasets produced from thematic analysis. Using the frequency count of species cited by participants as a proxy for themes in general, tb-PCA demonstrated how unconstrained ordination techniques can be used to visually represent multidimensional relationships between participants and interview responses in a 2D diagram (**Figure 2.7**). Although some studies have made use of PCA on such types of datasets, they do not all make use of the visual application of this method (Spiller et al. 2009; Ayiesah et al. 2014). Using MCA, Ponnampalath and Dawra (2013) have argued for the visual application of unconstrained ordinations on themes, calling their method “visual thematic analysis” and some studies have followed suit, such as presenting diagrams for CA (Sbalchiero and Tuzzi 2016). However apparent is this absence of the visual application of ordinations performed on thematic datasets, Mohler and Zuell (2001) were nonetheless graphically presenting results from multidimensional scaling at the turn of the millennium.

What does appear absent from studies using unconstrained ordinations on datasets built from themes and words is consideration regarding the meaning of absent themes. In their explanation on how to apply multidimensional scaling to datasets containing frequency counts of themes, Mohler and Zuell (2001) detail the use of the Euclidean distance, the same distance

preserved in PCA, which considers the absence of response (0) between two respondents as a measure of similarity (Orlóci 1978; Legendre and Gallagher 2001). Not only do we bring up the issue of double-zeros using the species abundance paradox as an example (Legendre & Gallagher, 2001; Orłóci, 1978; **Figure 2.3**), but we also provide a solution taken from the field of ecology. More specifically, transforming the data prior to performing PCA, hence tb-PCA.

Furthermore, we demonstrate with tb-PCA how detecting patterns amongst participant responses and interpreting these through the detection of key themes can lead to the development of hypotheses that can be tested in its constrained extension, tb-RDA (**Figure 2.7** and **2.8**). To the best of our knowledge, there are few studies, if any can be found, that make use of constrained ordination methods like RDA on thematic datasets, resorting instead to their unconstrained methods like PCA. Indeed, PCA and tb-PCA are highly descriptive and may be useful in exploring data, triangulating, as proposed by Fakis et al. (2014) and Greene et al. (1989), for patterns that may have rose during thematic analysis or even detecting unexpected patterns. As the natural progression of PCA and tb-PCA, however, we demonstrate how tb-RDA allows for tests of significance on hypotheses developed through the visual and largely qualitative assessment of tb-PCA results (*e.g.*, community; **Figure 2.7** and **2.8a**) and hypotheses developed to answer questions of prior interest (*e.g.*, group demographic; **Figure 2.8b**). Moreover, we demonstrate how tb-RDA manages to capture much of the information that can be derived from its unconstrained variation, tb-PCA, whilst combining additional information such as the effect of explanatory factors of interest (**Figure 2.7** and **2.8**). In consequence, the use of constrained ordinations, like RDA and tb-RDA, are much more versatile than their unconstrained counterparts, like PCA and tb-PCA, as tools to perform multivariate analyses on thematic datasets.

Though the R^2 may be small, this may still be used in interpreting specific questions and hypotheses of interest. R^2 results depend on investigator's *a priori* interests and research intent (Miller and Farr 1971); they do not account for factors that have not been included or considered in the model or study. Hence, low R^2 may merely suggest that other factors may very well influence interview responses. The inclusion or sole consideration of other explanatory factors of possible interest may provide larger R^2 values (*e.g.*, age, religion, gender, attendance in residential schools). They may also contribute very little if described ideas or phenomenon are highly complex and influenced by equally complex interactions with multiple factors.

Many papers have shown that the validity of working with numbers and statistics ultimately depend on the quality of the data used to generate them (Phillips 1996; Peroni et al. 2014). Thus, results obtained from using ordination techniques are just as good as the data included to be analyzed. As opposed to univariate analysis that are limiting and restricting in that they can only analyze one response variable at a time, ordinations are designed to capture all response variables from a dataset. In combining the hypothesis testing capacity of univariate analysis and the descriptive benefits of unconstrained ordinations like PCA, constrained ordinations become very interesting tools to analyzing complex ideas and topics. However, overzealous efforts to preserve as much information as possible may lead to datasets overloaded with data that generate statistical results that are harder to interpret (**Figure 2.9a** and **b**). A careful analysis of themes is therefore an essential step to constructing meaningful thematic datasets.

The use of “best-fit” framework synthesis was an effective tool at establishing a structure within themes by grouping them into overarching categories (**Table 2.3**). Combined with the use of diversity indices to meaningfully reduce the information contained in groups, we also demonstrate how “best-fit” framework synthesis makes a useful tool at instructing the content of

thematic datasets (**Table 2.3; Figure 2.9**). In an ironically fine balancing act of reducing the loss of information and optimizing meaningful statistical results in albeit reductive methods, the use of diversity measurements succeeded in providing meaningful results and interpretations while increasing the strength of the relationship (R^2_{adj}) between themes and the factors of interest (**Figure 2.9**). Furthermore, by considering the frequency counts of themes and their evenness within their category, the Shannon-Wiener minimizes information loss as opposed to total theme counts (*i.e.*, species richness), while providing similar visual results with stronger statistics (**Figure 2.9**).

The methods presented here are not without limitations. Firstly, despite their capacities to handle and analyze multidimensional relationships in large and complex data, visually interpreting the results of ordinations ultimately must be reduced to a 2D plane. Even if the creation of virtual axes is meant to capture as much variation in the data possible, researchers must choose which axes to represent and which relationships to prioritize in their displays (*i.e.*, between participants and interviews or themes). Secondly, Peroni et al. (2014) warn that the Shannon-Wiener index is highly sensitive to sample size (Magnussen and Boyle 1995). The minimum number of participants, or interviews, to be included in a study for the legitimate and accurate use of diversity indices depend on the size and heterogeneity of describing themes. One study found that an analysis of 50 participants citing 511 species in 6,285 citations was sufficient, though diversity indices captured most of the information with as little as 15-30 participants depending on the measure (Williams et al. 2000, 2005). On the other hand, the analysis of another dataset developed from 100 participants containing less response evenness suggested anywhere from 15-40 participants (Williams et al. 2005).

Depending on the surveying method, it can be much harder to reach comparable numbers in participants and interviews than what is expected from traditional quantitative disciplines. For

this reason, the use of statistics on data derived from interview response are commonly limited by small sample sizes, or number of participants and interviews. In consequence, this reduces the ability to reliably observe significant differences in statistical analyses and extrapolate those results to entire groups of people, communities or cultures (Phillips 1996; Fakis et al. 2014). Indeed, (Sbalchiero and Tuzzi 2016) argue that the use of multivariate methods like CA would be more useful with interviews increasing in number and size. Hence, the methods presented here are not meant to replace qualitative methods but used with their support; they become pertinent and useful with large datasets made up from many interviews.

2.5.2 What doors do these methods open?

In this paper, we demonstrate the use of PCA and more specifically RDA, its constrained extension, as tools for analyzing qualitative data retrieved from interviews. In doing so, this merely opens the door to a variety of other multivariate analyses. Other popular methods like CA and its constrained extension, canonical correspondence analysis (CCA), are frequently used in the ecological interpretation of species dataset (Legendre and Gallagher 2001), and have been described for quantitative ethnobotanical data (Höft et al. 1999). Sbalchiero and Tuzzi (2016) have used CA to detect similarities and differences between groups of participants based on the results of content analysis; by extension of the rational presented here for using RDA, they could have also made use of CCA in the next step of their analysis to test the significance of patterns observed. These operations, CA and CCA, differ from those presented here as they use the chi-square distance (X^2) and give higher weight to rare descriptors (Legendre and Gallagher 2001). The advantage of RDA, however, lies in its versatility. Similar results to CCA may be obtained by employing a X^2 transformation to the raw data before using db-RDA, a variation of RDA suited

for datasets with mixed levels of precision (*e.g.*, quantitative, semiquantitative and binary) that allows for the use of any measure of distance depending on the nature of the dataset (Legendre and Gallagher 2001; Legendre and Legendre 2012). Hence, here lies a place for innovation from the perspective of qualitative research to develop truly unique measures of distances adapted to the characteristics of data contained in thematic datasets.

The ordination methods presented here, namely PCA and RDA, but CA and CCA as well, are not only well suited for abundance data, or frequency counts, but also for binary data like presence-absence (Legendre and Gallagher 2001). Other unconstrained ordinations, such as principal coordinate analysis (PCoA) and nonmetric multidimensional scaling (NMDS), also allow for the analysis of datasets with mixed levels of precision and the use of any number of distance measurement (Legendre and Legendre 2012), but are merely descriptive. In the case of a dataset containing participant observations recorded in a semi-quantitative and binary format, we have used PCoA to be introduced in db-RDA for hypothesis testing (Rapinski et al. 2018a). Depending on the method utilized, a wide a variety of data type may be introduced into a dataset, allowing the researcher much space for creativity in their analysis from the qualitative phases to quantitative phases.

The choice of ordination used to analyze datasets depends on the type of data collected, the approach and the questions of interest. Methods using the X^2 distance (*e.g.*, CA, CCA) or X^2 transformation (*e.g.*, db-RDA) are of interest if the interview approach ensures rigor in identifying rare species or themes that can be used as good indicators of unique participant or community characteristics. If the likelihood that rare descriptors have been overlooked is high, then they may not be proper indicators of community structures and low weight can be given to them by using such transformation methods as Hellinger or Chord in tb-RDA (Legendre and Gallagher 2001).

Leduc et al. (2006), for example, found that “rare”, or infrequently mentioned, species cited in an ethnobotanical study on plants used to treat diabetes were in fact well known and used. Hence, it is important to consider and keep in mind what type of quantitative methods to use down the road at the moment of developing interview questionnaires and objectives. Whereas we’ve presented data built from participant responses to questions in semi-structured interviews, studies have presented ordination results on responses obtained from open-ended interviews to structured questionnaires (Mohler and Zuell 2001; Ayiesah et al. 2014). Though structured questionnaires and surveys, or other methods like free listing, may be more appropriate in ensuring that rare responses have not been overlooked, we show that tb-PCA and tb-RDA are robust enough to detect patterns from survey formats that allow for the effect of more random variables in responses.

Of larger concern is the number of interviews or questionnaire to include in a study. Indices based on aggregating, or summing uses, are also sensitive to the sampling effort, which may not represent a reliable reflection of reality if that effort is not spread evenly throughout interviews (Phillips 1996). This is arguably truer as interviews become more and more open, although such problems become less important for large scale studies producing large datasets (Phillips 1996). Other comprehensive measurements of diversity may be explored to reduce the loss of information implicated in such transformations. The ethnobiological literature, for example, abounds of indices developed from diversity measurement in ecology and used to assess and summarize plant use and knowledge by individuals, such as the relative use value (RUV_i), species diversity value (SD_i) and species equitability value (SE_i) (Byg and Balslev 2001; Araújo and Lopes 2012). Informant consensus indices have also been developed at length (Phillips 1996; Byg and Balslev 2001). Though these indices are arguably well suited for the quantitative and statistical analyses of interview data, these measurements offer vertical transformation that summarize the information

of multiple rows (*i.e.*, participants) into one, and are therefore not adapted to ordination techniques that require the information of each individual participant.

2.6 Conclusion and Final Considerations

Ordination techniques do not identify most frequently cited themes but highlights highly varying themes and how these are associated with other variables. If ordination techniques are used to analyze community structures based on species datasets, they may help identifying key indicator species of certain habitats (Dufrière and Legendre 1997). Similarly, if these methods are applied to thematic datasets, they may help identify indicator themes or notions specific to groups of people. In a similar approach to reducing datasets into meaningful ordinations, Tareau (2019) used the Dufrière-Legendre indicator value, developed for identifying indicator species (Dufrière and Legendre 1997), in order to select species cited in ethnobotanical surveys for RDA. Such translations of techniques and notions are akin to the development of the notion of cultural keystone species, which itself is derived from that of ecological keystone species when referring to cultural groups of people instead of ecosystems (Garibaldi and Turner 2004; Cristancho and Vining 2004).

Furthermore, these methods are frequently used in ecology in combination with other types of multivariate analyses such as cluster analysis (Legendre and Legendre 2012). Some studies have also made use of cluster analysis to identify groups of participants based on thematic datasets (Spiller et al. 2009; Sbalchiero and Tuzzi 2016). In a similar fashion to how we use multivariate analysis on responses from participants, Cuerrier, Brouillet and Barabé (1998) have used a combination of ordinations and cluster analysis to detect patterns amongst a number of taxonomists

based on their classification structure of plant families. Such an approach may very well be used to analyze patterns amongst participant responses based on their response structure rather than resorting to indices of diversity.

In conclusion, the use of “best-fit” framework synthesis along with statistical analyses involves a fine balancing act between minimizing the loss of information provided by participant responses to the benefit of clear, simple and comprehensive approaches of looking at data. Although quantitative transformations and statistics are generally perceived as objective approaches to analyzing data, these are presented here as tools amongst many others in a process that is inherently qualitative. Indeed, the use of ordinations and diversity indices, can be powerful tools for the analysis and interpretation of qualitative data, but they cannot be used as the sole tools or as replacements to qualitative approaches. These tools are sensitive to small datasets but become particularly advantageous when analyzing large datasets that are produced from and accompanied by a thorough and thoughtful analysis of participant responses. Though the diversity indices used in the demonstration of this method are common and frequently used in ecology, a focussed assessment and comparison of their applicability in terms of limits and benefits is warranted, along with the many and various other indices available in the literature. Finally, tb-PCA and tb-RDA are also common ordinations techniques, but they consist only of a small component of the large repertoire of methods available in multivariate statistics. There is undoubtedly much space for innovation and development, particularly in understanding the characteristics of thematic datasets and developing truly unique and well-adapted measurements of distance and diversity for the application of multivariate analyses.

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Chapitre 3 - Giving a voice to diabetes “the silent killer” in French Guiana’s Parikwene population

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3.1 Résumé / Abstract

Le département français d'outre-mer de la Guyane française, en Amérique du Sud, double presque l'incidence du diabète de type 2 (DT2) de son homologue européen, la France métropolitaine. Cette région est démographiquement diversifiée et comprend d'importants peuples autochtones. Bien que ces populations soient particulièrement exposées au risque de développer le DT2 dans les Amériques, on sait très peu de choses sur leur état de santé en Guyane française où il n'existe pas de nombre précis de diabétiques. À la lumière d'une crise potentielle de santé publique, nous avons mené une étude ethnomédicale du diabète vécu par le peuple Parikwene, ou Palikur, afin de mieux comprendre les connaissances, les attitudes et les pratiques (CAP) liées à cette maladie rapidement émergente. Nous avons mené 75 entrevues avec des membres de la communauté et des Aînés, ainsi qu'avec des professionnels et des administrateurs de la santé offrant des services à la population parikwene de Macouria et de Saint-Georges de l'Oyapock. Les résultats de ces entretiens suggèrent une incidence élevée de DT2 qui a augmenté rapidement depuis le milieu du 20^e siècle dans cette population. Ainsi, les participants Parikwene ont lié le développement de la maladie à des changements alimentaires, notamment à travers l'introduction d'aliments nouveaux et sucrés. Reconnaissant la complexité du diabète et de ses symptômes, les diabétiques ont souligné l'importance des traitements et des suivis biomédicaux, bien qu'ils les aient fréquemment alternés ou utilisés en concomitance avec les médicaments parikwene. À l'aide d'outils biomédicaux (par exemple, le glucomètre), les pratiques médicinales locales reflètent les approches biomédicales à travers l'adaptation alimentaire et l'utilisation d'animaux et de plantes médicinales pour le contrôle de la glycémie et le traitement de ces complications. En conclusion, les Parikwene s'approprient le DT2 dans leur système de connaissances et adaptent leurs soins. Une meilleure compréhension des pratiques et des perceptions locales par le personnel médical peut donc être bénéfique afin de répondre aux besoins des patients, d'offrir une plus grande autonomie dans leur parcours de soins et d'améliorer le résultat des traitements.

Mots-clés : diabète ; Palikur ; Guyane française ; ethnomédecine ; ethnobiologie.

The French overseas department of French Guiana, in South America, nearly doubles the incidence of type 2 diabetes (T2D) of its European counterpart, Metropolitan France. This region is demographically diverse and includes several populations of Indigenous Peoples. Although such populations are at particular risk of developing T2D across the Americas, very little is known about their health status in French Guiana, and accurate numbers of diabetics do not exist. In light of a potential public health crisis, we conducted an ethnomedicinal study of diabetes experienced by Indigenous Parikwene to provide better insight into the knowledge, attitudes and practices (KAP) related to this quickly emerging disease in French Guiana. We conducted 75 interviews with community members and Elders, as well as healthcare professionals and administrators providing services to the Parikwene population of Macouria and Saint-Georges de l'Oyapock. Results from these interviews suggest a high incidence of T2D in this population, with cases that have risen quickly since the mid-20th century. Parikwene participants linked the development of the illness to dietary changes, notably through the introduction of new and sweet foods. Recognising the complexity of diabetes and its symptoms, diabetics highlighted the importance of biomedical treatments and follow-ups, though frequently alternated or used them concomitantly with Parikwene medicines. With the help of biomedical tools (i.e., glucometer), local medicinal practices mirrored biomedical approaches through dietary adaptation and the use of medicinal animals and plants for glycemic control and the treatment of complications from the disease. In conclusion, Parikwene are appropriating T2D into their knowledge system and adapting their healthcare in response to this relatively new health concern. A greater understanding of local practices and perceptions relating to T2D by the medical staff may therefore be beneficial in meeting patients' needs, providing greater autonomy in their health path, and improving treatment outcomes.

Key words: diabetes; Palikur; French Guiana; ethnomedicine; ethnobiology.

3.2 Introduction

The number of people pharmacologically treated for diabetes nearly doubled in France from 2000 to 2015, from 2.6 % to 5.0 % of the population, affecting nearly 3.3 million individuals (Ricci et al. 2010; Mandereau-Bruno and Fosse-Edorh 2017). The prevalence of diabetes, however, is notably higher in French overseas departments, in particular in French Guiana, where 8.08 % of the population, age-adjusted, was estimated to be diabetic in 2015, a rate that has more than doubled within a 10 year span (Mandereau-Bruno et al. 2014; Richard et al. 2015; Clarke 2016; Mandereau-Bruno and Fosse-Edorh 2017). With a rate of T2D estimated at 8.12 % by the International Diabetes Federation (IDF), French Guiana placed itself amongst South and Central America's 10 regions with the highest prevalence of diabetes in 2013, just below Brazil (IDF 2013; Aschner et al. 2014), which borders the French department (**Figure 3.1**).

The demographic composition of French Guiana includes a large number of diverse Creole, Maroon and Indigenous cultural groups characterized by considerable movement and migration from Surinam, Brazil and Haiti (Renault-Lescure and Goury 2009). As elsewhere on the American continents where Afro-Descendants and Indigenous Peoples were subject to colonization, these populations are considered among those with the highest risk of developing diabetes (WHO and IDF 2004; Yu and Zinman 2007; King et al. 2009; Herman 2017; Jacklin et al. 2017; Crowshoe et al. 2018b; Voaklander et al. 2020; Creatore et al. 2020). High rates are associated with several factors, including changes in lifestyle (*e.g.*, food transition and sedentarization), possibly some high genetic risks, as well as historical, political and psychosocial factors, as evidenced by colonial history that has undermined family values, and societal structures as well as cultural and spiritual practices (Downs et al. 2009; Ricci et al. 2010; Mandereau-Bruno et al. 2014; Clarke 2016).

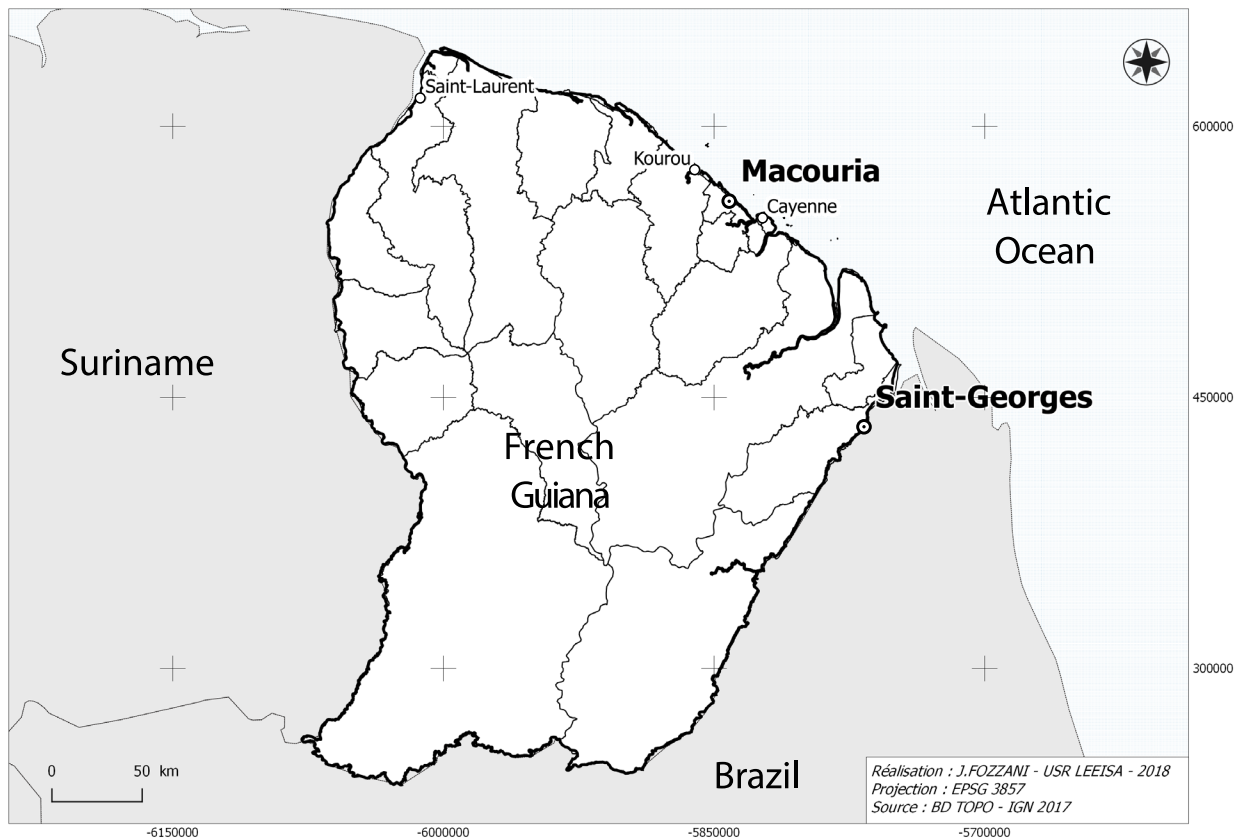


Figure 3.1. Map showing the location of Parikwene villages in French Guiana, namely in the communes of Macouria (5° 00' N, 52° 28' W) and Saint-Georges de l'Oyapock (3° 53' N, 51° 48' W). Cartography: Jérôme Fozzani – USR LEEISA. Projection in pseudo-Mercateur.

Epidemiological statistics on Creole, Maroon and Indigenous populations are not available in French Guiana due to French legislation preventing ethnic discrimination in national studies. It is therefore difficult to make appropriate comments on the issue of diabetes in these cultural groups at risk, but data suggest that some of them are more affected than others. Medical dispensaries, locally called Delocalized Centers for Prevention and Care (*Centres Délocalisés de Prévention et de Soins*; CDPS), of the Andrée Rosemon Hospital Center (*Centre Hospitalier de Cayenne Andrée Rosemon*; CHC) in Cayenne report the largest numbers of diabetic patients in Saint-Georges de l'Oyapock and Maripasoula (Guarmit et al. 2017), municipalities characterized by high populations of Parikwene, also named Palikur (Indigenous group) and Aluku (Maroon group), respectively.

Nevertheless, an overall look at French Guiana suffices for various epidemiological studies of diabetes in France to associate its exceptional rates with the peculiarities of geographic isolation and indices of socio-economic performance, all of which tend to vary along cultural grounds (Ndong et al. 2010; Fosse-Edorh et al. 2016; Mandereau-Bruno and Fosse-Edorh 2017; Fuentes et al. 2020).

Nimuendajú ([1926] 2008) and Fernandes (1950) report relatively good health status among the Parikwene from 1925 to 1950, though by 1978, the first reports of diabetes were recorded amongst those living in Brazil (Vieira-Filho 1978). Although the Parikwene have been in contact with the occidental world since the 16th century, as for many colonized groups, the speed of lifestyle changes has accelerated since the mid-1960s (Grenand 1981). Changes relating to lifestyles include evangelisation, monetisation, participation in the wage economy, sedenterization, industrialization, schooling and dietary changes, especially since 2003 with the opening of the region along the Brazilian border through road access (Ouhoud-Renoux 2000a; Capiberibe et al. 2009; Vincent 2013). Such lifestyle changes have led to a growing reliance on store-bought and manufactured foods (*i.e.*, powdered milk, coffee, condiments, oil, cookies, rice, butter, bread and soda) to the detriment of food production activities such as hunting, fishing and swidden-fallow cultivation of manioc, or cassava (*Manihot esculenta* Crantz ; Euphorbiaceae), which remains a staple of the diet nonetheless (Capiberibe et al. 2009; Davy et al. 2011; Ogeron et al. 2018; Richard-Hansen et al. 2019).

In light of growing concerns for an emerging public health crisis, we conducted an ethnomedicinal study of diabetes experienced by French Guiana's Parikwene population, thus applying methods of ethnobiology and medical anthropology to provide a better insight into the knowledge, attitudes and practices (KAP) related to this quickly emerging illness. The primary

objective of this study was to document KAP related to diabetes from an emic perspective (*i.e.*, from the point of view of Parikwene people). Tangentially to documenting knowledge regarding diabetes, we compare the perceived causes of the illness to those expressed by workers associated with the healthcare sector in order to assess how these align with the biomedical perspective.

3.3 Materials and Methods

3.3.1 Ethnographic background

Known as the Palikur in French and English, the self-denominated Parikwene or Pahikwene, using the Parikwaki language, belong to the Maipuran sub-family of the Arawak language family (Capiberibe et al. 2009). During the 19th century, the majority of Parikwene inhabited the banks of the Rio Urucauá, now located in the Amapá state of Brazil, though oral history points to a small presence on both sides of the Oyapock River that now makes the border between France and Brazil (Dreyfus 1981). Migration into their current settlements in French Guiana began after the state was conceded to Brazil in 1900. However, major migrations are traced back to the 1960s with the creation of the village of Espérance I, in Saint-Georges de l'Oyapock (Ouhoud-Renoux 2000a), and later on with the village of Kamuyene in Macouria. Due to French legislation preventing the recording of census data distinguishing ethnicity, there are no precise numbers on the Parikwene population in French Guiana. Self-reported numbers from Parikwene leaders in Saint-Georges de l'Oyapock and Macouria bring the estimates in these communes closer to 1800 Parikwene in French Guiana in 2018, doubling their estimated numbers from 850 people in 2001 (Capiberibe et al. 2009).

Included in this study are the villages of Kamuyene and Norino in the commune of Macouria, as well as the villages of Espérance I and Espérance II in the commune of Saint-Georges de l'Oyapock (**Figure 3.1**). Due to their size and proximity from one another, inhabitants of each village are referred to in association with their commune (*i.e.*, the Parikwene of Macouria and the Parikwene of Saint-Georges de l'Oyapock). Vehicular languages in these communities include Parikwaki, French Guianese Creole, French and Portuguese.

3.3.2 Biomedical Systems

Public and private biomedical care is available to the Parikwene villages in both the communes of Macouria and Saint-Georges de l'Oyapock. Parikwene individuals holding French papers have access to French social services and assistance as well as a publicly funded and free medical infrastructure (Ouhoud-Renoux 2000a; Capiberibe et al. 2009). In Saint-Georges de l'Oyapock, both public and private healthcare systems are within walking distances from most households. At the time of the study, a public health centre, or dispensary, with two doctors and eight nurses, operated alongside a private clinic, managed by one doctor, and a private practice for homecare nursing, managed by three nurses. The publicly operated dispensary, or CDPS, operates as a delocalized pole for health and prevention of the CHC, a hospital in Cayenne where patients are sent for surgery and emergency treatment.

In Macouria, healthcare services are within a short drive's reach. The CHC is the closest public healthcare centre available to the Parikwene of Macouria. Doctors, however, operate private practices in nearby towns and villages, namely two in Macouria, and another in Cayenne, along with a private homecare nursing service. Access and use of biomedicine are well integrated in the

contemporary Parikwene way of life. However, local medicinal practices remain and are well documented (Grenand et al. 1987, 2004).

3.3.3 Consultations

Fieldwork took place from June 2017 to July 2018. Altogether, 75 interviews were completed with 101 participants with a sex ratio (men/women) of 0.87. The breakdown of interviews is presented in **Table 3.1**. These were held in French and French Guianese Creole, as well as Parikwaki, with the help of an interpreter.

3.3.4 Data collection

Data was collected based on methods described in **Chapter 2**, namely via semi-structured interviews and participant observation (*i.e.*, observation and participation in community activities). Participants were selected based on their association to one of four group demographics (**Table 3.1**), and were first identified by snowball sampling. Names were initially provided through existing relationships between community members and one of the authors (Davy 2002, 2007; Ogeron et al. 2018) and by consulting with local *Chefs coutumiers* (*i.e.*, village Chiefs).

Interview questions related to people's knowledge and definition of diabetes and medicine, as well as attitudes and practices related to both the local and biomedical systems. We recorded names, terms and affiliated concepts in Parikwaki. Because various writing systems have been developed over time, we opted to write terms according to the system developed by Green et al. (2019), preferred by participants from Macouria and Saint-Georges. We returned to the communities in 2019 to validate and confirm terminology, nomenclature and various other associated concepts.

Table 3.1. Interview breakdown by communities and description of participant categories.

Community	# of interviews	# of participants	Mean age (\pm SD)
Saint-Georges	32	43	53.4 (\pm 15.8)
Macouria	28	42	51.1 (\pm 15.4)
Cayenne*	15	16	42.3 (\pm 10.6)
<i>Total</i>	<i>75</i>	<i>101</i>	<i>50.4 (\pm 15.2)</i>

Category	Example
<i>Community members and healthcare users</i>	
Knowledge holders (KH)	Elders, healers.
Healthcare users (HU)	All other community members.
<i>Healthcare network staff</i>	
Healthcare administrators (HA)	Directors, administrators.
Healthcare professionals (HP)	Doctors, nurses, nutritionists.

* Interviews conducted with participants in or with the healthcare sector.

Participants who preferred to be interviewed together were considered as n=1, reducing participant sample size. Finally, we used verbatim quotes from participants to further elucidate local concepts relevant to health and diabetes.

Ethics

Informed consent was obtained from participants prior to each interview. Consent forms and questionnaires were approved by each village's *Chef coutumier*, along with the Ethics

Committee of the Université of Montréal (Certificate #: CERAS-2016-17-081-P; **Annex 1**). Overall, the working approach was conducted with respect to the International Society of Ethnobiology's Code of Ethics (International Society of Ethnobiology 2006). Furthermore, France's ratification of the Nagoya protocol during the development of this study led to a legislative limbo regarding the collection of biological specimens. In the absence of administrative procedures and forms to obtain national consent for the collection of specimens, species were tentatively identified through pictures and seeing live specimens. Whereas species commonly used and known, to both human populations at large and the scientific communities, are presented, new ethnobiological species which could not be verified against accessible listings were anonymized, as discussed in the **Introduction** with respect to issues regarding the French legislation on access and benefit sharing, in order to include them in this study as taxonomic units.

3.3.5 Data Analyses

All interviews were transcribed verbatim. Transcripts were then stored and handled with NVivo qualitative data analysis software (QSR International 2015) to identify, manage, link and retrieve coded data. Thematic analysis and sequential focused coding were used to identify key themes, terms and concepts from interview transcripts pertaining to each major aspect of the KAP study.

KAP

Upon review, interview transcripts were first analysed to elucidate 1) knowledge, 2) attitudes and 3) practices associated with diabetes, based on the approach described by Odonne et al. (2011).

- 1) *Knowledge of disease and treatments.* To characterize Parikwene knowledge around diabetes, we focused on parts of the discussions pertaining to the naming of the disease, its definition, past and present, perceived symptoms, its origin and causes, as well as knowledge of treatments, both biomedical and Parikwene.
- 2) *Attitudes towards disease and treatments.* To characterize attitudes, we focused on parts of discussions that pertained to the therapeutic path taken by participants in the case of diabetes.
- 3) *Healing practices.* To characterize healing practices, we focused on parts of discussions that pertained to therapeutic approaches adopted by participants to treat and manage diabetes.

Quantitative data transformation and statistical analysis

Relative frequencies of citation (FC), expressed as a percentage, were employed to express the number of participants or interviews that discuss or refer to specific themes, terms or concepts. Causes of diabetes expressed by Parikwene participants and workers associated with the healthcare sector were compared by using Spearman's rank correlation to determine if these were correlated. This nonparametric univariate statistical analysis was performed in IBM SPSS (IBM Corp. 2019). Testing for the significance of Spearman's correlation coefficient (ρ) was established at a threshold of $\alpha = 0.05$ (Legendre and Legendre 2012).

3.4 Results

3.4.1 Knowledge of the disease

All participants interviewed were familiar with diabetes. A diabetic was present at more than half of the interviews conducted with Parikwene participants (56.3 %; 27/48), representing 42.5 % (31/73) of these individuals. Only 2.74 % (2/73) claimed there were no diabetics in their immediate household (*i.e.*, spouse, child or parent), including themselves. The remainder had at least one family member with diabetes and one participant said that she was no longer diabetic. Indeed, participants specified that the disease was particularly present, being one of the major health problems in their communities along with cancer, high blood pressure and cardiovascular diseases. Participants observed that the number of diabetics was increasing, that their age was decreasing and that it historically killed many community members.

Naming and definition

Regardless of the language of communication, Parikwene participants most frequently referred to diabetes by the name **diabet** (100 %), a contemporary borrowing of the French and Portuguese words *diabète* and *diabetes*, respectively. However, the terms **sugku** (sugar) and **karyt sugku** (sugar disease) were employed in 50.0 % (24/48) of interviews. One elderly couple specified that Elders used to call it **unbeivye karyt** (Elders' disease) because it used to primarily affect elderly people.

According to the Parikwene of Saint-Georges and Macouria, there were traditionally no names for diabetes in Parikwaki due to the relatively recent discovery of the disease. However, participants surmise that diabetes may have been around much longer than reported and mistakenly referred to as **imasiunti** in the past, an illness of shamanic origin sent through spells. Participants

now recognized multiple forms of diabetes named according to various criteria of classifications whereby two are intricately related (**Table 3.2**). These include:

- two forms based on the biomedical nomenclature, *i.e.*, type 1 diabetes (T1D) and T2D;
- three forms of diabetes based on colour, *i.e.*, **diabet seyne** (white diabetes), **priye** (black) and **duhen** (red);
- two forms of diabetes based on sexes, *i.e.*, **diabet awaig** (male diabetes) and **tino** (female);
- two forms of diabetes based on age, *i.e.*, **diabet himano** (young diabetes) and **kapye** (old).

Table 3.2. Types of diabetes based on sex and colour in the local Parikwene classification. The colour attributed to a person's type of diabetes, namely **diabet seyne** (white diabetes) and **diabet priye** (black diabetes), may represent the manifested interaction between a person's sex and the underlying sex of their illness: **diabet awaig** (male diabetes) and **diabet tino** (female diabetes).

Person's sex Sex of diabetes	Female (♀)	Male (♂)
Diabet tino (♀)	♀/♀ (Diabet priye)	♀/♂ (Diabet seyne)
Diabet awaig (♂)	♂/♀ (Diabet seyne)	♂/♂ (Diabet priye)

Symptoms and classification

The current Parikwene classification of diabetes is based on the observation of symptoms and complications encountered by diabetics. First and foremost, 35 symptoms and complications associated with diabetes, which could be grouped into 15 overarching categories, were listed by Parikwene participants (**Table 3.3, Figure 3.2**). The 10 most cited symptoms were: 1) weakness and fatigue, 2) weight loss, 3) troubled vision, 4) fever, 5) polyurea, 6) pain, 7) slow healing wounds, 8) polydipsia, 9) diarrhea and 10) increased hunger.

Table 3.3. Symptoms, complications and problems associated with diabetes listed by Parikwene participants from the communes of Saint-Georges and Macouria. The name of symptoms and complications, ranked according to their relative frequency of citations (FC), expressed as a percentage, are given in English and Parikwaki.

Rank	FC (%)	English	Parikwaki	Description
1	93.6	Weakness	<i>Mabimnaki</i>	General feeling of weakness and lack of strength
8	55.3	• Fatigue	<i>Mabika</i>	Chronic fatigue and feeling of tiredness.
16	19.1	• Dizziness	<i>Mitiwkemniki</i>	Feeling of faintness at the peak of weak spells.
2	78.7	Weight loss	<i>Keviki</i>	Quick or sudden weight loss regardless of appetite. Often associated with severe cases of diabetes.
3	72.3	Blurry vision	<i>Iwtyakti ka hiyep</i>	Literally “the eyes cannot see” from <i>iwtyakti</i> “eye”, <i>ka</i> “negation” and <i>hiyep</i> “to see”. Blurry vision can be temporary, coming and going with poor glycemic control, or permanent, leading to blindness.
4	68.1	Fever	<i>Nawaki</i>	Feeling of increased body heat, notably after bouts of hard work or weak spells.
5	66.0	Excessive urination	<i>Ahinapka un kiberevut</i>	From <i>ahinapka</i> “to go to the washroom”, <i>un</i> “water” and <i>kiberevut</i> “often”; generally accompanies excessive drinking.
6	63.8	Pain	<i>Katiwka</i>	Pain occurring throughout the body.
13	25.5	• Headache	<i>Katiwka itewtiy</i>	From <i>katiwka</i> “pain” and <i>itewtiy</i> “head”.
17	17.0	• Back pain	<i>Katiwka idunhyat</i>	From <i>katiwka</i> “pain” and <i>idunhyat</i> “back”.
27	6.4	• Lower back pain	<i>Katiwka idakat</i>	From <i>katiwka</i> “pain” and <i>idakat</i> “the lower back”; generally employed when referring to pain in the kidney area.
34	2.1	• Kidney pain	<i>Katiwka ibukategat</i>	From <i>katiwka</i> “pain” and <i>ibukategat</i> “kidney”; specifically employed when it is known that the kidneys hurting, e.g., dialysis.

Rank	FC (%)	English	Parikwaki	Description
35	2.1	• Chest pain	<i>Katiwka idukti</i>	From <i>katiwka</i> “pain” and <i>idukti</i> “chest”; generally employed when pain is felt in the chest or heart area.
31	4.3	• Heart pain	<i>Katiwka iyaknit</i>	From <i>katiwka</i> “pain” and <i>iyaknit</i> “heart”; specifically employed when it is known that the heart is hurting.
18	17.0	• Leg pain	<i>Katiwka ibagwanti</i>	From <i>katiwka</i> “pain” and <i>ibagwanti</i> “leg”.
28	6.4	• Arm pain	<i>Katiwka iwanti</i>	From <i>katiwka</i> “pain” and <i>iwanti</i> “arm”.
19	17.0	• Whole body	<i>Katiwvitka</i>	Specifically when general pain is felt throughout the body.
22	12.8	• Rheumatism	<i>Wasew</i>	Specifically when pain is felt in the joints and articulations.
7	63.8	Slow healing wound	<i>Busukne kani kabayntiwatma</i>	Literally “the wound is not well” from <i>busukne</i> “wound”, <i>kani</i> “negation” and <i>kabayntiwatma</i> “well”.
21	17.0	• Diabetic foot	<i>Busukke ikugkut</i>	Literally “foot sore/wound” from <i>busukke</i> “sore/wound” and <i>ikugkut</i> “foot”; this refers to the ulcers developing on the feet of diabetics.
23	12.8	• Boils/abscesses	<i>Kakayvye</i>	From <i>gakay</i> “pus”; this is the general term for any boil-like or abscess-like wound. There are different types like <i>kume</i> , <i>wahagu</i> and <i>wagewni</i> .
9	53.2	Thirst	<i>Agabyuki</i>	Increased, excessive and continuous drinking without the feeling of hydration.
10	51.1	Diarrhea	<i>Digiki</i>	Reoccurring symptom; can accompany the consumption of a food item that does not agree with the disease. <i>Pamahaki</i> meaning “salty fish” may be used to be discrete.
11	42.6	Hunger	<i>Mativwaki</i>	Increased, excessive and continuous eating without the feeling of satiety.
12	31.9	Heat	<i>Awahanka</i>	Feeling of increased body heat, akin to fever, notably after bouts of hard work.
14	21.3	Numbness	<i>Tagatgaki</i>	Feeling of numbness or discomfort occurring namely in the extremity of limbs or in the mouth.

Rank	FC (%)	English	Parikwaki	Description
25	8.5	• Numb feet	<i>Tagatgaki ikugkut</i>	From <i>tagatgaki</i> “numbness” and <i>ikugkut</i> “foot”; of particular concern when injuries are implicated.
30	6.4	• Numb hands	<i>Tagatgaki iwakti</i>	From <i>tagatgaki</i> “numbness” and <i>iwakti</i> “hand”.
24	10.6	• Numb mouth	<i>Tagatgaki ibiyiti</i>	From <i>tagatgaki</i> “numbness” and <i>ibiyiti</i> “mouth”; occurring namely after eating something not agreeing with the disease.
15	21.3	Vomiting	<i>Hikaka</i>	Recurring vomiting particularly at the peak of heat and weak spells.
20	17.0	Swelling/inflammation	<i>Wagawgaki</i>	Quick and lasting swelling and inflammation from bumps and bruises, as well as general swelling in the limbs.
29	6.4	• Swollen legs	<i>Wagawgaki ibagwanti</i>	From <i>wagawgaki</i> “inflammation” and <i>ibagwanti</i> “leg”.
32	4.3	• Swollen arms	<i>Wagawgaki iwanti</i>	From <i>wagawgaki</i> “inflammation” and <i>iwanti</i> “arm”.
33	4.3	• Whole body	<i>Wagawgaptiki</i>	Specifically when the whole body is inflamed and swollen.
26	8.5	Perspiration	<i>Univuki</i>	Excessive perspiration particularly at the peak of heat and weak spells.

MATEGBETKA ADAH DIABET AY UVIT (Symptoms of diabetes in the body)

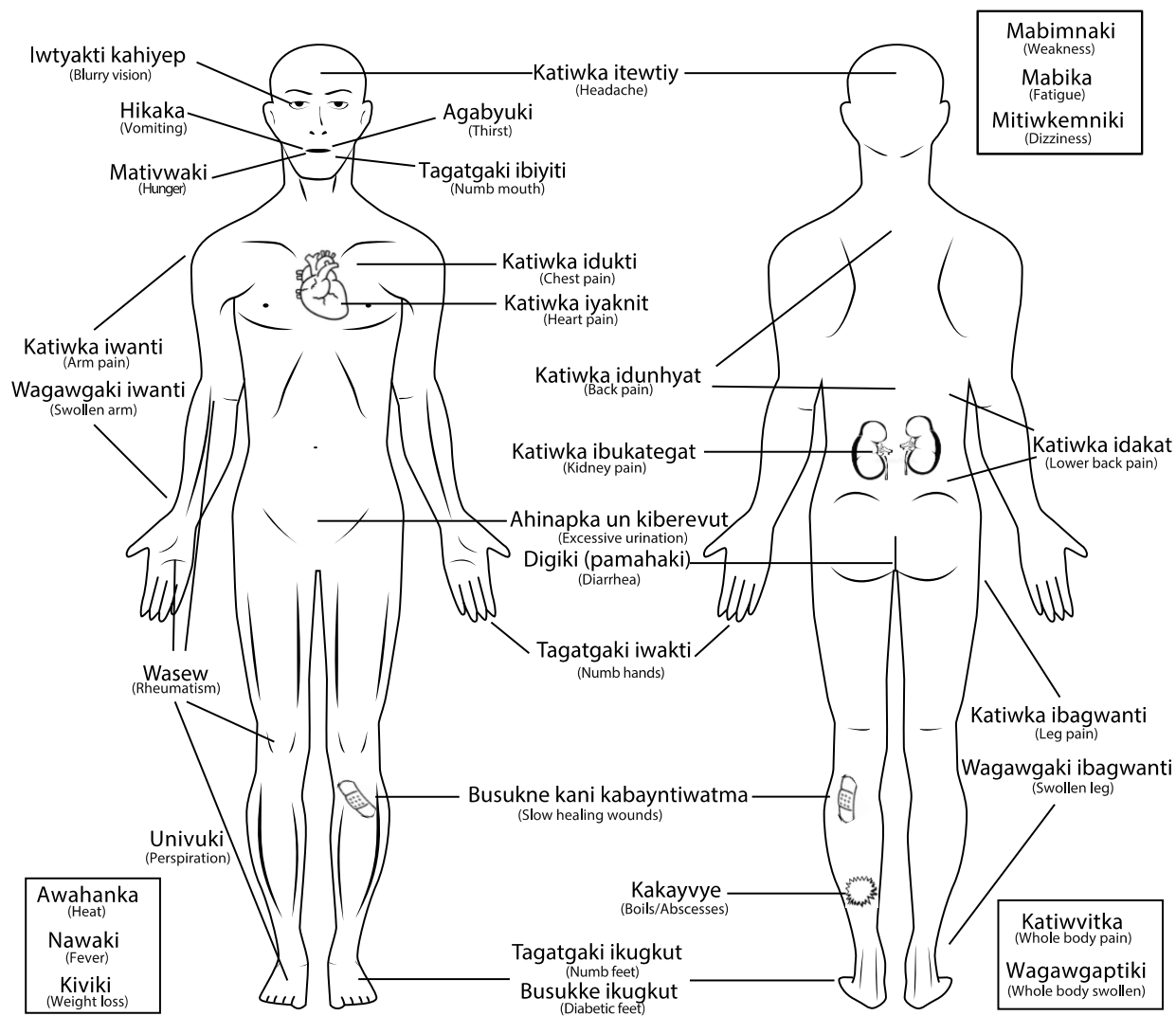


Figure 3.2. Symptoms, complications and problems associated with diabetes listed by Parikwene participants from the communes of Saint-Georges and Macouria. See **Table 3.3** for details on symptoms and terms in Parikwaki.

Though some Parikwene participants could name the biomedicinally recognized forms of diabetes, namely type 1 and type 2 (14.6 %; 7/48), the majority of those interviewed (72.9%; 35/48) identified various forms and classifications of the disease depending on how these appeared in an individual and the severity of their outcome (**Table 3.2**). The most commonly cited classificatory criterion, recognized in Saint-Georges and Macouria, was colour (60.4%; 29/48). Diabetes was primarily distinguished between its black form (**diabet priye**) and white form (**diabet seyne**), though some participants recognized a red form (**diabet duhen**). In all cases, **diabet seyne** was the least severe; marked by little complications and a slow progression of the disease, it is the easiest to manage and treat. Moreover, people reportedly have more dietary freedom, gain weight as expected and, in the best-case scenario, can be cured.

Diabet priye is more severe and deadlier than its white counterpart. It manifests itself suddenly with rapidly devolving symptoms like polyuria, diarrhea and vomiting that quickly lead to rapid weight loss and a dry emaciated look. It is hard to treat and manage; without biomedical intervention from the hospital or dispensary it may quickly lead to death. Furthermore, people with this form of diabetes can find their skin turning black. Though unheard or not recognized by most, **diabet duhen** is the most dangerous and deadliest according to some. Due to limited citations of this form, how it differed from **diabet priye** could not be clarified.

The second most cited classificatory system, described solely by participants from Macouria, was based on sexes (27.1%; 13/48), whereby the illness was personified as being male (**diabet awaig**) or female (**diabet tino**; **Table 3.2**). As LS6020 from Macouria explains “*si tu vois, tu es avec le diabète femelle, c’est que elle, elle te prend pour son mari. C’est pour ça qu’elle te tue pas.*” In other words, **diabet awaig** and **diabet tino** were considered to be incompatible with diabetics of the opposite sex (*i.e.*, men and women, respectively). Hence, distinguishing the gender

of the disease was determined by evaluating the severity of the illness. Diabetics responding poorly to treatments and characterized by a considerable loss in energy and weight, as well as rapidly devolving health were believed to have diabetes of the same sex. On the other hand, diabetics responding well to treatments, living long and comfortably well with little dietary restrictions were believed to have diabetes of the opposite sex.

In comparison to the criteria of colour, the distinction of diabetes based on sexes was not as concise as their explanation was frequently intertwined with those of colour. One participant went as far as to explain that **diabet awaig** was in the bone, and hard to treat, **diabet tino** was in the blood, and hard to treat, **diabet seyne** was in the skin, and easy to treat, and finally that **diabet priye** and **diabet duhen** were increasingly worse to treat than **diabet seyne**. The most concise picture drawn by participants from Macouria was that the colour of a person's diabetes was ultimately explained by its gender (**Table 3.2**). Hence, a person with diabetes of the opposite sex manifests the white form, **diabet seyne**, whereas **diabet priye** is manifested in the opposite relationship.

Some participants (4.17 %; 2/48), notably from Macouria, distinguished a young form of diabetes (**diabet himano**) and an old (**diabet kapye**), though these could not be concisely described. In one interview, participants explained that old diabetes kills a person faster whereas young diabetes does not, a statement contradicted by the reversed affirmation from other participants.

Although most participants recall having learnt these terms from other members of their community, some specified having acquired these terms from doctors as well. Indeed, those who cited T1D and T2D either stated that they were synonymous to **diabet priye** and **diabet seyne**, respectively, or disregarded the local classificatory system as something different.

Historic and current etiology of the disease

Although the current Parikwene classification of diabetes is based on observations of symptoms and complications, it's the evolving nomenclature of the disease that reveals the most on its perceived origin and cause. Participants explained that diabetes probably existed in their communities prior to contemporary knowledge of this illness. Pointing to a series of illnesses and deaths in the 1950s in Kumene (Urucaua), in the Brazilian state of Amapá, nearly half of Parikwene participants (47.9%; 23/48) surmised that these, mistakenly taken for another illness of shamanic origin called **imasiunti**, were likely some of the first cases of diabetes in their community. One participant from Macouria explains:

*“Les gens disaient que c’est le chaman qui donnait ce sort-là. Comme **imasiunti**, il rendait les gens qui étaient gros et devenir tout maigre, tout sec, tout ça. Après, il meurt. C’était quasiment faux, quoi. C’était quand il a eu le diabète. Le diabète, lui, il agit tellement vite que la personne ne prend pas conscience du sujet que c’est vraiment le diabète. Lui, il mange, il mange, il mange. Et puis quand il mange beaucoup, et puis voilà. Il voit qu’il maigrit et puis il perd l’appétit, tout ça.”*

Meaning literally a rack used for storing, cleaning, or grilling food, **imasiunti** was ascribed to people afflicted by weakness, and more characteristically, sudden weight loss. Resulting in the loss of fluids through polyuria and diarrhea in people exhibiting extreme thirst, as well as a darkening of the skin, **imasiunti** was believed to have dried out the afflicted akin to smoked or grilled flesh (*i.e.*, meat and fish). Moreover, **imasiunti** was contracted through spells (**timnaka**), of malicious intent sent by a shaman (**ihamwi**) or a jealous acquaintance by such means as performing an incantation (**avigi**) and blowing into a glass of water meant for ingestion by the recipient in question, or blowing into wood burning for grilling or smoking food. As one Elder

from Saint-Georges explains : “*imasiunti* peut dire que les gens connaissent souffler ça. Comme un vent qui va boucaner. C’est lui qu’ils appellent *imasiunti*. Tu deviens maigre, maigre, maigre ; tu deviens sec.”

The increasing incidence of **imasiunti** and growing distrust is believed to have culminated in the late 1950s with the assassination of a shaman in 1959 at the hands of over a dozen family heads in retribution for his perceived implication in the death of another. Though this led to the capture and imprisonment of some implicated actors by Brazilian law enforcement, many others fled with their families, taking refuge on the French Guianese border. Indeed, an Elder recalls how her mother, pregnant with her at the time, fled to French Guiana after her father who had been involved in the incident, left the family. Further corroborating this, Roger Labonté, the current chief of Espérance 1, estimates that eight families, fleeing repercussions, established themselves in French Guiana to later found the department’s first Parikwene village in 1963, Espérance 1. Antonio Felicio, the past chief of Kumeyene, confirms this incidence and adds that over 20 families subsequently settled on the French side of the Oyapock river in Ouanary, Trois-Palétuviers and Saint-Georges.

Parikwene oral history subsequently tends to suggest various paths by which the Parikwene came to learn of diabetes in the biomedical sense. The most influential and predominant path appears to be attributed with the arrival of the American evangelical missionaries, linguistic scholars and academic authorities of the Palikur language: Diana and Harold Green in the 1960s. Witnessing the devastating effect of diabetes, it was through council in seeking biomedical interventions that the implication of supernatural forces was eventually discredited, the biomedical concept of diabetes was slowly integrated and subsequently exported to French Guiana in subsequent migration events.

Though at the time of the study some Parikwene participants believed that **imasiunti** still exists as a separate illness to diabetes, most associated its prevalence in their community to a dietary origin (**Table 3.4**). The most commonly cited causes of diabetes were the introduction and increased accessibility to sugar and sweet food items, namely sweet and carbonated beverages (*i.e.*, juice and soda pop), candies and treats, as well as manufactured coffee and chocolate, thus highlighting their commercial provenance. When listing coffee and chocolate, consumed typically as breakfast beverages, participants pointed to the common practice of sweetening these. Nonetheless, unsweetened and particularly homemade products derived from the coffee (*Coffea arabica* L.; Rubiaceae) and cacao plant (*Theobroma cacao* L.; Malvaceae), both cultivated by some Parikwene, were not thought to exacerbate diabetes as bitterness was generally associated with health benefits.

Table 3.4. Relative frequency of citations (%) of the factors responsible with the development of diabetes. Values are provided for all interviews ($n = 75$) and compared to those conducted with Parikwene participants ($n = 48$) and workers connected with the healthcare sector ($n = 29$).

Cause of diabetes	Frequency of citations (%)		
	Parikwene	Healthcare	All
Sugar and sweet foods	100.00	93.10	97.33
Sugar	97.92	86.21	93.33
Sweet and carbonated beverages	66.67	51.72	61.33
Coffee (<i>Coffea arabica</i>)	37.50	6.90	25.33
Candies and treats	22.92	13.79	20.00
Chocolate (<i>Theobroma cacao</i>)	29.17	0.00	18.67
Starch and starchy foods	91.67	82.76	88.00
Cassava tubers (<i>Manihot esculenta</i>)	91.67	79.31	86.67
Rice (<i>Oryza sativa</i>)	20.83	41.38	28.00
Red beans (<i>Phaseolus vulgaris</i>)	12.50	27.59	17.33
Starch	6.25	37.93	18.67
Wheat-based pasta and bread (<i>Triticum aestivum</i>)	10.42	10.34	10.67
Potatoes (<i>Solanum tuberosum</i>)	4.17	0.00	2.67

Cause of diabetes	Frequency of citations (%)		
	Parikwene	Healthcare	All
Fat and fatty foods	50.00	51.72	49.33
Fat	37.50	34.48	36.00
Oil	31.25	17.24	26.67
New recipes	8.33	17.24	10.67
Salt and salty foods	37.50	34.48	36.00
Salt	33.33	20.69	28.00
Salty foods	8.33	20.69	13.33
Alcohol	18.75	44.83	28.00
Beer	12.50	17.24	13.33
Cachiri	8.33	3.45	6.67
Rum	4.17	3.45	4.00
Genetics	12.50	41.38	22.67
Industry produced and conserved foods	16.67	20.69	18.67
Chicken (<i>Gallus gallus domesticus</i>)	12.50	13.79	13.33
Beef (<i>Bos taurus</i>)	4.17	0.00	2.67
Coconut milk (<i>Cocos nucifera</i>)	2.08	0.00	1.33
Various new food items	22.92	0.00	14.67
Onions (<i>Allium cepa</i>)	14.58	0.00	9.33
Garlic (<i>Allium sativum</i>)	12.50	0.00	8.00
Spices	12.50	0.00	8.00
Pepper (<i>Piper nigrum</i>)	4.17	0.00	2.67
Pancreas failure	10.42	13.79	10.67
Insulin resistance and deficiency	10.42	13.79	10.67
Pancreatitis	2.08	3.45	1.33

Starch and starchy foods were the second most common cited cause of diabetes. Although most Parikwene participants drew a link between cassava tubers (*Manihot esculenta*) and its food derivatives (*i.e.*, cassava flour [**kwak**], tapioca [**kayut**], cassava juice [**karahu**]) with the development of diabetes (**Table 3.4**), they were quick to add that it was not the cause of the illness. More precisely, participants explained this to be the introduction of new food items like rice (*Oryza sativa* L.; Poaceae), red beans (*Phaseolus vulgaris* L.; Fabaceae), wheat-based pasta and bread (*Triticum aestivum* L.; Poaceae) and potatoes (*Solanum tuberosum* L.; Solanaceae), which

increasingly accompany **kwak**, the staple food-derivative of cassava roots. The link between **kwak** and diabetes was contentious, as participants frequently repeated that healthcare professionals explained this to be the cause. This is best resumed by a participant, LS5012, from Saint-Georges:

*“C’est vrai, ils ont fait une recherche sur le **kwak** et ils ont dit : ‘Le **kwak** a beaucoup de sucre.’ Ça fait qu’ils disent : ‘C’est le **kwak** qui donne le diabète.’ C’est le médecin quand il fait campagne, il prévient. C’est pour ça qu’ils mettent dans leur tête, ils disent que c’est le **kwak** qui donne le diabète. Pour moi, ce n’est pas vrai. Pour moi, ça ne rentre pas dans ma tête, ce n’est pas vrai. (...) [Les Anciens] vont mourir à 100 ans, 90 ans, ils n’ont même pas le diabète. Maintenant, pourquoi maintenant nous, les descendants maintenant, même pas à 15 ans, à 20 ans on est diabétique? Pour quelle raison? Pourquoi? Parce qu’on ne mange pas que du **kwak**. On consomme tout qui n’est pas bon pour le corps.”*

Another participant, LS5030, from Saint-Georges explains:

*“**Kwak**, c’est la base de l’alimentation. On boit du **kwak** dans le café. On trempe la mangue dans le **kwak**, tout ! Beaucoup de médecins disent que les diabétiques peuvent pas manger le **kwak**. Mais si tu protèges ton corps, tu peux le manger, le **kwak** ! [...] c’est important d’avoir l’abattis pour avoir à manger. Mais on nous dit qu’on peut pas manger ça ou on aura le diabète. Mais si tu ne manges pas le **kwak**, tu manges pas. Mais les docteurs comprennent pas ça. Ce que les Palikur ont, c’est ce qu’ils peuvent manger. Les Palikur sont obligés de manger le **kwak**. C’est ce que nous savons faire pousser ! Nous pouvons laisser le **kwak** de côté peut-être un jour, mais après, nous voulons en manger !”*

The general sentiment about **kwak** could be best resumed by LS6022 from Macouria: “*Si on lâche le kwak, on ne peut pas manger. Le problème c’est que nous allons mourir.*” In fact, new food items to the current Parikwene diet were the common denominators to most factors associated with the development of diabetes, from fat and fatty foods, often associated with new cooking practices requiring oil, to salt and salty foods (*i.e.*, chips), to commercially processed foods and meats (*i.e.*, frozen chicken [*Gallus gallus domesticus* (Linnaeus, 1758); Phasianidae] and beef [*Bos taurus* Linnaeus, 1758; Bovidae]), to easily accessible market foods like onions (*Allium cepa* L.; Amaryllidaceae), garlic (*Allium sativum* L.; Amaryllidaceae), black pepper (*Piper nigrum* L.; Piperaceae) and spices, which are omnipresent in the local creole cuisine.

The causes of diabetes cited by Parikwene participants were positively correlated with those cited by participants from the healthcare sector ($\rho = 0.631$, $p < 0.001$; **Table 3.4**). Nonetheless, the ranking of alcohol and genetics were some of the causes that were markedly different between the two groups whereby these were some of the least frequently cited causes of diabetes by Parikwene participants. Nonetheless, in discussing genetics, participants questioned how this could be transmitted from one generation to next and the role of pregnancy. Alternatively, some participants provided another description to the development of the illness. As LS5030 from Saint-Georges explains, diabetes, embodied by sugar, was already in the body; if you nourish it by eating poorly, it grows and manifests itself. This is supported by LS6020 from Macouria who explains “*Quand tu es né, tu as déjà du sucre dans le sang. Et en grandissant, si tu sais pas te contrôler avec les sucreries, bien, après ça devient du diabète.*”

The contemporary naming **diabet** is only supplanted in longevity by the naming **sugku**, in reference to sugar, the predominantly perceived caused of diabetes. As LS6025 explains:

“Sugku, c’est... c’est pareil [que le diabète], en fait. C’est quand... Par exemple, on se rend chez le médecin pour faire des analyses sanguines. Eh bien... Je sais pas si fréquemment, on peut voir du sucre dans le sang. Bien... C’est ça. Et puis c’est ça qui provoque tout simplement. C’est ça qui provoque le diabète.”

Hence, sweetness is a major component in the description of the disease. Nonetheless, some participants had a hard time consolidating sugar with diabetes due to the lack of access to it when it first appeared, as put forth by LS6027: *“Peut-être qu’au Brésil, il y a [du sucre] ... Macapá peut-être. Mais à Urucaua, on avait pas ça. Mais comment les Indiens attrapent le diabète si ils mangent pas de sucre ?”*

3.4.2 Knowledge of treatment

Biomedical treatments

In Parikwaki, biomedicine is called **nautunie giveykis**, which translates to “foreign medicine”. Overall, Palikur participants recognized that diabetes was treated through a number of its remedies. Pharmacotherapy through injections (81.2 %; 39/48) and pills (70.8 %; 34/48) were the most cited treatments (87.5 %; 42/48). Most Palikur participants could name insulin as a biomedical remedy to diabetes (62.5 %; 30/48), whereas only some could name at least one antidiabetic pill, *i.e.*, metformin, stagid, amaryl, velmetia and glibenclamide (8.33 %; 4/48). Participants noted how these medications target blood sugar levels, such as insulin, and a number of comorbidities such as high blood pressure and cholesterol.

Dietary interventions were cited by 83.3 % (40/48) of Parikwene participants who inevitably recognized the dietary origins of diabetes and the necessity of paying attention to diet

along with pharmacotherapies. Although dietary recommendations cited by Parikwene participants included increasing the consumption of vegetables like tomatoes (*Solanum lycopersicum* L.; Solanaceae), cucumbers (*Cucumis sativus* L., Cucurbitaceae) and lettuce (*Lactuca sativa* L.; Asteraceae), most cited practices related to food items already well integrated in Palikur diet. Hemodialysis was the least cited biomedical intervention (8.33 %; 4/48). Though some participants did discuss the benefits of physical exercise, this was not quantified due to the difficulty of associating this as a biomedical treatment, strictly speaking.

Parikwene Treatments

The Parikwene call their medicine **Parikwene giveykis**, translating directly to “Parikwene medicine” or the “Peoples’ medicine”. Nearly all Parikwene participants were able to cite at least one local remedy against diabetes (91.7 %; 44/48), targeting the control of blood sugar levels, other than biomedical treatments. Although these were solely plant based, 89.6 % (43/48) used both animal and plant remedies against specific symptoms of diabetes (*e.g.*, aches and pains, diarrhea, polyuria and infected wounds).

3.4.3 Attitudes towards the illness

Parikwene participants often associated diabetes with heat, whereby some diabetics experienced hot flashes and sometimes fevers. Symptoms like headaches were compared to the head being hot and the expression of certain symptoms like inflammation, polydipsia and the evacuation of fluids through polyuria, diarrhea and perspiration were linked to the body being hot and needing to be cooled by replenishing with water. Due to its association with sugar, sweetness is a recurring characteristic attributed to diabetes by Parikwene participants. The notions that sugar and diabetes are in the blood were used interchangeably to describe glycemic control, whereas

hunger was linked to the illness being voracious for sugar. LS5012 goes as far to specify that sugar even finds itself in urine, having observed ants being attracted to it. These hot and sweet attributes given to diabetes are important factors driving current attitudes towards the illness particularly because the organoleptic and physical properties of Parikwene remedies were often discussed. When discussing the bitterness of certain Parikwene treatments, one participant, LS5007, draws a parallel with biomedical treatments: *“Moi, j’ai toujours les cachets pour boire. Je bois, je bois, je bois. Mais... Parce que là, les cachets et les comprimés... Quand tu bois, c’est amer, amer, amer, amer dans ma bouche.”*

As if to make a case in point, a number of diabetic participants were thus willing to try and experiment with local remedies alongside biomedical treatments. Amongst diabetics, 88.9 % (24/27) were using biomedical treatments and 88.9 % (24/27) named a Parikwene treatment, whereas 88.9 % (24/27) used Parikwene treatments (at the moment of the study or in the past). Of the three who did not use Parikwene medicines, two had used or tried them in the past. Only 11.1 % (3/27) claimed only using local treatments. One person who did not use biomedical treatments reported no longer having diabetes, having healed from it with Parikwene treatments. One diabetic who used biomedical treatments reported that their spouse had also healed himself with Parikwene treatments. Finally, one participant who only used Parikwene treatments reported to have never been to the doctor, nor received a diagnostic, having self-diagnosed themselves by borrowing a glucometer.

In general, diabetics (77.8 %; 21/27) used both biomedical and local Parikwene treatments, either at the same time or in alternance, to manage their diabetes. Despite an overwhelming lack of confidence in the healthcare sector and an apprehension to receive biomedical treatments, diabetic participants recognized that there were too many barriers to relying

solely on Parikwene treatments. Acknowledging the seriousness of diabetes as an illness, diabetics underscored the importance of obtaining a diagnostic when the first signs were detected and to continue medical consultations to get examination results, as well as regular use of glucometers. Hence, detection was performed directly at a doctor's clinic, or more conveniently in the village either when home nurses visit a household or by borrowing a glucometer from a family member or friend. These were essential as evaluation tools of the success of Parikwene treatments as biomedical treatments were sometimes put aside and not taken for months at a time, thus replaced entirely by local medicines. These remedies were all prepared in the household by diabetics themselves or another member of their household. Although knowledge of medicinal practices and treatments remained largely familial, sharing of knowledge between households was not uncommon. Only one diabetic consulted a knowledge holder who had come to French Guiana from Brazil for that purpose.

3.4.4 Practices

Practices regarding the management of diabetes revolved around a combination of dietary adaptations and surveillance, as well as locally practiced medicines and remedies (**Table 3.5**). Due to the dietary nature of diabetes, a number of animal and plant species were cited by Parikwene participants for dietary purposes. Specifically, 52 species of animals were cited as dietary and 10 were medicinal in relation to diabetes in one form or another. Of these, seven animal species applied to both contexts for a total of 55 animals cited. As for plants, 83 species were cited as foods, 97 as medicines, 33 had dual use for a total of 147 plant species.

Table 3.5. Dietary and medicinal animal and plant species cited by Parikwene participants from Macouria and Saint-Georges. Species names are provided in French Guianese Creole (Cr) or Brazilian Portuguese (Br) if none were provided in Parikwaki. Species used as food (F) that were noted to have an impact on glycemic control are marked by an asterisk (*) with precisions provided in **Table 3.6**. Species used as medicine (M) were employed in the treatment of diabetes and/or associated complications. Species with no specified uses are known representatives of higher taxonomic units, such as genus of family, which can be referred to in more generic terms. The origin (AF: Africa, AM: Americas, AS: Asia, EU: Europe, OC: Oceania) and agricultural status, or setting, of animals and plants (C: cultivated, D: domesticated, I: imported/purchased at markets, R: ruderal, W: wild) are also provided.

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Animals					
<i>Fish</i>					
Wayabra	<i>Acestrorhynchus</i> spp.	Acestrorhynchidae	F*	AM	W
Kihiuri	<i>Arapaima gigas</i> (Schinz, 1822)	Arapaimidae	F*	AM	W
Pasan	<i>Sciades passany</i> (Valenciennes, 1840)	Ariidae	F*	AM	W
Kariwu	See family	Callichthyidae	F*	AM	W
Lubin	<i>Centropomus</i> spp.	Centropomidae	F	AM	W
Ihka	<i>Tetragonopterus</i> spp.	Characidae	F*	AM	W
Masug	<i>Astronotus ocellatus</i> (Agassiz, 1831)	Cichlidae	F	AM	W
Wakay	<i>Chaetobranchus flavescens</i> Heckel, 1840	Cichlidae	F	AM	W
Kunan	<i>Cichla monoculus</i> Spix, 1831	Cichlidae	F*	AM	W
Duway	<i>Heros efasciatus</i> Heckel, 1840	Cichlidae	F*	AM	W
Be	See family	Cichlidae	F*	AM	W
Karaht	See family	Clupeidae/Pristigasteridae	F*	AM	W
Pune	<i>Hoplerythrinus unitaeniatus</i> (Spix, 1829)	Erythrinidae	F*	AM	W
Yivu	<i>Hoplias aimara</i> (Valenciennes, 1846)	Erythrinidae	F*	AM	W
Iigl	<i>Hoplias malabaricus</i> (Bloch, 1794)	Erythrinidae	F*	AM	W
Uwak, kuraht (Cr)	<i>Electrophorus electricus</i> (Linnaeus, 1766)	Gymnotidae	F, M	AM	W

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Suwiki, palika (Cr)	<i>Megalops atlanticus</i> Valenciennes, 1847	Megalopidae	F*	AM	W
Parasi	<i>Mugil incilis</i> Hancock, 1830	Mugilidae	F*	AM	W
Pwason liman (Cr)	<i>Syacium</i> spp.	Paralichthyidae	F	AM	W
Aharakwan, torch (Cr)	<i>Brachyplatystoma filamentosum</i> (Lichtenstein, 1819)	Pimelodidae	F*	AM	W
Akup	See family	Sciaenidae	F*	AM	W
Umayan, piraya (Cr)	See family	Serrasalmidae	F*	AM	W
Tigagu	Animal 6	Unknown	F	AM	W
<i>Reptiles</i>					
Pareine	See family	Alligatoridae	F*	AM	W
• Punamna	<i>Caiman crocodilus</i> (Linnaeus, 1758)	Alligatoridae	F	AM	W
• Waatuwa	<i>Paleosuchus palpebrosus</i> (Cuvier, 1807)	Alligatoridae	F	AM	W
• Pareine seyne (?)	<i>Paleosuchus trigonatus</i> (Schneider, 1801)	Alligatoridae	F	AM	W
Datka	<i>Eunectes murinus</i> (Linnaeus, 1758)	Boidae	F, M	AM	W
Wakra	<i>Mesoclemmys nasuta</i> (Schweigger, 1812)	Chelidae	F	AM	W
Iwan	<i>Iguana iguana</i> (Linnaeus, 1758)	Iguanidae	F	AM	W
Mehuka	<i>Podocnemis unifilis</i> Troschel, 1848	Podocnemididae	F	AM	W
Wayam	<i>Chelonoidis</i> spp.	Testudinidae	F, M	AM	W
<i>Birds</i>					
Kanar (Cr)	See family	Anatidae	F	AM	W
• Uvayan	<i>Cairina moschata</i> (Linnaeus, 1758)	Anatidae		AM	W
• Masiugu	<i>Dendrocygna autumnalis</i> (Linnaeus, 1758)	Anatidae		AM	W
Ugu	<i>Leptotila rufaxilla</i> (Richard & Bernard, 1792)	Columbidae	F*, M	AM	W
Timuvu	<i>Crax alector</i> Linnaeus, 1766	Cracidae	F*	AM	W
Maras	<i>Penelope marail</i> (Statius Müller, 1776)	Cracidae	F*	AM	W

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Takarak, takarak priye	<i>Gallus gallus domesticus</i> (Linnaeus, 1758)	Phasianidae	F*, M	AS	D
Kwekwe	<i>Amazona</i> spp.	Psittacidae	F*	AM	W
Ara, jako	See family	Psittacidae	F*	AM	W
Maytu	<i>Psophia crepitans</i> Linnaeus, 1758	Psophiidae	F*	AM	W
Yahok	See family	Ramphastidae	F*	AM	W
Inam, perdri-poul (Cr)	<i>Tinamus major</i> (Gmelin, 1789)	Tinamidae	F*, M	AM	W
<i>Mammals</i>					
Maoksi	<i>Alouatta macconnelli</i> (Elliot, 1910)	Atelidae	F*	AM	W
Kwat	<i>Ateles paniscus</i> (Linnaeus, 1758)	Atelidae	F, M	AM	W
Pak	<i>Bos taurus</i> Linnaeus, 1758	Bovidae	F*, M	AS	D
Muton	<i>Ovis aries</i> Linnaeus, 1758 (?)	Bovidae	M	EU/AS	D
Psuk	<i>Hydrochoerus hydrochaeris</i> (Linnaeus, 1766)	Caviidae	F, M	AM	W
Wakukwa	See family	Cebidae	F*, M	AM	W
• Wakukwa	<i>Cebus olivaceus</i> Schomburgk, 1848	Cebidae		AM	W
• Wakukwa-keuru	<i>Sapajus apella</i> (Linnaeus, 1758)	Cebidae		AM	W
Yit	<i>Mazama</i> spp.	Cervidae	F*	AM	W
• Yit duweh	<i>Mazama americana</i> (Erxleben, 1777)	Cervidae		AM	W
• Yit seyne	<i>Mazama gouazoubira</i> (Fischer, 1814)	Cervidae	F*	AM	W
Uwan	<i>Cuniculus paca</i> (Linnaeus, 1766)	Cuniculidae	F*	AM	W
Tat	<i>Dasypus</i> spp.	Dasypodidae	F*, M	AM	W
• (?)	<i>Dasypus kappleri</i> Krauss, 1862	Dasypodidae		AM	W
• (?)	<i>Dasypus novemcinctus</i> Linnaeus, 1758	Dasypodidae		AM	W
Bukutru	<i>Dasyprocta leporina</i> (Linnaeus, 1758)	Dasyproctidae	F*	AM	W
Kawukwine	<i>Panthera onca</i> (Linnaeus, 1758)	Felidae	M	AM	W
Wakukwa-terimie	<i>Potos flavus</i> (Schreber, 1774)	Procyonidae	F*	AM	W

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Kochon	<i>Sus domesticus</i> Erxleben, 1777	Suidae	F*	EU/AS	D
Audiki	<i>Tapirus terrestris</i> (Linnaeus, 1758)	Tapiridae	F*	AM	W
Kavine, pakih	See family	Tayassuidae	F*	AM	W
• Kavine	<i>Pecari tajacu</i> (Linnaeus, 1758)	Tayassuidae	F*	AM	W
• Pakih	<i>Tayassu pecari</i> (Link, 1795)	Tayassuidae	F*, M	AM	W
<i>Insects</i>					
Abèy (Cr)	Animal 7 (Honey bees)	Apoidea (Superfamily)	F	AM	W
Tanagi	Animal 12 (Ants)	Formicidae	M	AM	W
Yaraira	<i>Atta</i> spp.	Formicidae	M	AM	W
Mun	Animal 11 (Termites)	Isoptera (Infraorder)	M	AM	W
<i>Crustaceans, mollusks and others</i>					
Tuu	<i>Pomacea guyanensis</i> (Lamarck, 1822)	Ampullariidae	F	AM	W
Takes	Animal 1 (Shrimps)	Decapoda (Order)	F*	AM	W
Tuwebu	Animal 10 (Earthworms)	Lumbricina (Suborder)	M	AM	W
Kuwa	<i>Callinectes exasperatus</i> (Gerstaecker, 1856)	Portunidae	F*	AM	W
Plants					
Zohyoh	<i>Allium cepa</i> L.	Amaryllidaceae	F*	AS	C/I
Ilay	<i>Allium sativum</i> L.	Amaryllidaceae	F*	AS	C/I
Mihitui	<i>Anacardium occidentale</i> L.	Anacardiaceae	F, M	AM	R/C
Mahk, mahk Michel, mahk sabo	<i>Mangifera indica</i> L.	Anacardiaceae	F*, M	AS	C
Prin-siter	<i>Spondias dulcis</i> Parkinson	Anacardiaceae	F, M	AM	C
Kahambag	<i>Spondias mombin</i> L.	Anacardiaceae	F*, M	AM	W/C

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Ara	<i>Tapirira</i> spp.	Anacardiaceae	M	AM	W
Manig, manigu	<i>Annona montana</i> Macfad.	Annonaceae	F	AM	W
Manig	<i>Annona mucosa</i> Jacq.	Annonaceae	F	AM	W
Korosol	<i>Annona muricata</i> L.	Annonaceae	F, M	AM	C
Kasim	<i>Annona paludosa</i> Aubl.	Annonaceae	F	AM	W
Awaguvan	<i>Eryngium foetidum</i> L.	Apiaceae	F*, M	AM	C
Inuvra	<i>Ambelania acida</i> Aubl.	Apocynaceae	F	AM	W
Avukyu	<i>Bonafousia angulata</i> (Mart. ex Müll. Arg.) Boiteau & L. Allorge	Apocynaceae	M	AM	W
Ukum	<i>Couma guianensis</i> Aubl.	Apocynaceae	F*, M	AM	W
Gongo	<i>Geissospermum</i> spp.	Apocynaceae	M	AM	W
Wakukwa arivra	<i>Pacouria guianensis</i> Aubl.	Apocynaceae	M	AM	W
Pakih etni	<i>Parahancornia fasciculata</i> (Poir.) Benoist	Apocynaceae	M	AM	W
Saig	<i>Tabernaemontana siphilitica</i> (L. f.) Leeuwenb.	Apocynaceae	M	AM	W/C
Daxin	<i>Colocasia esculenta</i> (L.) Schott	Araceae	F*	AS	C
Muumuu	<i>Astrocaryum paramaca</i> Mart.	Arecaceae	F, M	AM	W
Wahatwi	<i>Astrocaryum vulgare</i> Mart.	Arecaceae	F*, M	AM	W
Kahikti	<i>Attalea maripa</i> (Aubl.) Mart.	Arecaceae	F*, M	AM	W/C
Pagip	<i>Bactris gasipaes</i> Kunth	Arecaceae	F	AM	C
Kameuyu	<i>Bactris major</i> Jacq.	Arecaceae	F, M	AM	W
Kuk, kuk duweh	<i>Cocos nucifera</i> L.	Arecaceae	F*, M	AS	C
Ihip	<i>Desmoncus</i> spp.	Arecaceae	M	AM	W
Was	<i>Euterpe oleracea</i> Mart.	Arecaceae	F*, M	AM	W/C
Tuuvan	<i>Manicaria saccifera</i> Gaertn.	Arecaceae	M	AM	W
Isaw	<i>Mauritia flexuosa</i> L. f.	Arecaceae	F, M	AM	W
Woki	<i>Oenocarpus bacaba</i> Mart.	Arecaceae	F*	AM	W/C

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Pataw	<i>Oenocarpus bataua</i> Mart.	Arecaceae	F*, M	AM	W/C
Kurip, kwip	<i>Syagrus inajai</i> (Spruce) Becc.	Arecaceae	M	AM	W
Bukuti	<i>Aristolochia</i> spp.	Aristolochiaceae	M	AM	W
Aloé vera (Cr)	<i>Aloe vera</i> (L.) Burm. f.	Asphodelaceae	M	AS/AF	C/I
Umeruvan, bom seles	<i>Mikania</i> spp.	Asteraceae	M	AM	R
Tumauwi	<i>Crescentia cujete</i> L.	Bignoniaceae	M	AM	C
Kwik	<i>Tabebuia serratifolia</i> (Vahl) G. Nicholson	Bignoniaceae	M	AM	W
Ihap	<i>Bixa orellana</i> L.	Bixaceae	F, M	AM	C
Kawah	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	F*	AM	C
Ayay	<i>Tetragastris altissima</i> (Aubl.) Swart	Burseraceae	M	AM	W
Pareine gama	<i>Calophyllum brasiliense</i> Cambess.	Calophyllaceae	M	AM	W
Pavay	<i>Carica papaya</i> L.	Caricaceae	F*	AM	C
Sawa	<i>Caryocar glabrum</i> (Aubl.) Pers.	Caryocaraceae	F	AM	W
Asiwa, pikia	<i>Caryocar villosum</i> (Aubl.) Pers.	Caryocaraceae	F	AM	W
Prune (Warahu)	<i>Chrysobalanus icaco</i> L.	Chrysobalanaceae	F	AM	R/C
Patakwik	<i>Clusia</i> spp.	Clusiaceae	M	AM	W
Wiwis, zamahd	<i>Terminalia catappa</i> L.	Combretaceae	F, M	AS	C
Kayg	<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	F*	AM	C
Tagub, tagubavan	<i>Cordia</i> spp.	Cordiaceae	M	AM	R
Tuwigu	<i>Costus</i> spp.	Costaceae	F*, M	AM	R
Mulohdo	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Cucurbitaceae	F*	AF	C
Kohkohm pikah	<i>Cucumis anguria</i> L.	Cucurbitaceae	F	AF	C/I
Kohkohm	<i>Cucumis sativus</i> L.	Cucurbitaceae	F	AS	C/I
Irum	<i>Cucurbita moschata</i> Duchesne	Cucurbitaceae	F	AM	C
Sorosi	<i>Momordica charantia</i> L.	Cucurbitaceae	M	AF	R
Samugne	<i>Doliocarpus</i> spp.	Dilleniaceae	F, M	AM	W

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Parasu	<i>Dioscorea cayenensis</i> Lam.	Dioscoreaceae	F	AM	C
Kavar	<i>Dioscorea trifida</i> L. f.	Dioscoreaceae	F*	AM	C
Meksehvye, mekse seyne	<i>Jatropha curcas</i> L.	Euphorbiaceae	M	AM	C
Meksehvye, mekse duweh	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	M	AM	C
Kiniki (plant)	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	F*, M	AM	C
• Kaneg (bitter cassava tuber)	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	F*, M	AM	C
• Awava (sweet cassava tuber)	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	F	AM	C
Dilwil, pamaskriti	<i>Ricinus communis</i> L.	Euphorbiaceae	M	AF/EU/ AS	C
Itey gavan	<i>Sapium argutum</i> (Müll. Arg.) Huber	Euphorbiaceae	M	AM	W
Pak gawak	<i>Bauhinia forficata</i> Link	Fabaceae	M	AM	C
Magauga	<i>Copaifera guianensis</i> Desf.	Fabaceae	M	AM	W/I
Kaukwi akat	<i>Dalbergia monetaria</i> L.f.	Fabaceae	M	AM	R
Wap	<i>Eperua falcata</i> Aubl.	Fabaceae	M	AM	W
Simig	<i>Hymenaea courbaril</i> L.	Fabaceae	M	AM	W/C
Platno miumiu	<i>Inga capitata</i> Desv.	Fabaceae	F	AM	W/C
Miumiu	<i>Inga edulis</i> Mart.	Fabaceae	F*	AM	W/C
Avukun	<i>Inga</i> spp.	Fabaceae	M	AM	W
Kumat	<i>Phaseolus vulgaris</i> L.	Fabaceae	F*, M	AM	C/I
Muhut	<i>Pterocarpus officinalis</i> Jacq.	Fabaceae	M	AM	W
Wahamwi vie	<i>Senna</i> spp.	Fabaceae	M	AM	R
Suwimba	<i>Vismia</i> spp.	Hypericaceae	M	AM	W
Mahiki	<i>Cipura paludosa</i> Aubl.	Iridaceae	M	AM	C
Migat vey	<i>Eleutherine bulbosa</i> (Mill.) Urb.	Iridaceae	M	AM	C

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Yarayapna	<i>Marsypianthes chamaedrys</i> (Vahl) Kuntze	Lamiaceae	M	AM	R
Basivan	<i>Ocimum campechianum</i> Mill.	Lamiaceae	F, M	AM	R/C
Kuskus gusuyum	<i>Orthosiphon aristatus</i> (Blume) Miq.	Lamiaceae	M	AS	C
Doliprane (Cr)	<i>Plectranthus neochilus</i> Schltr.	Lamiaceae	M	AS/AF	C
Loryé (Cr)	<i>Laurus nobilis</i> L.	Lauraceae	M	EU	I
Avuk	<i>Persea americana</i> Mill.	Lauraceae	F*, M	AM	C
Castanha (Br)	<i>Bertholletia excelsa</i> Bonpl.	Lecythidaceae	F, M	AM	W
Irimwi	<i>Couratari multiflora</i> (Sm.) Eyma	Lecythidaceae	M	AM	W
Wakukwa adava	<i>Lecythis zabucajo</i> Aubl.	Lecythidaceae	M	AM	W
Waigusis, waigusvan	See family	Loranthaceae	M	AM	R
Mariuga	<i>Byrsonima crassifolia</i> (L.) Kunth	Malpighiaceae	M	AM	W
Siriz (Cr)	<i>Malpighia emarginata</i> DC.	Malpighiaceae	F	AM	C
Lozey	<i>Hibiscus sabdariffa</i> L.	Malvaceae	F	AF	C
Waravru	<i>Theobroma cacao</i> L.	Malvaceae	F*	AM	C
Kupu	<i>Theobroma grandiflorum</i> (Willd. ex Spreng.) K. Schum.	Malvaceae	F	AM	C
Asaki	<i>Bellucia grossularioides</i> (L.) Triana	Melastomataceae	F	AM	W
Awa kateu	Plant 24	Melastomataceae	M	AM	R
Tivigu	<i>Carapa</i> spp.	Meliaceae	M	AM	W
Friapeh (Cr)	<i>Artocarpus altilis</i> var. <i>non-seminiferus</i> (Duss) Fournet	Moraceae	F	OC	C
Chatengn (Cr)	<i>Artocarpus altilis</i> var. <i>seminiferus</i> (Duss) Fournet	Moraceae	F	OC	C
Babbay	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	F	AS	C
Tauni	<i>Brosimum acutifolium</i> subsp. <i>acutifolium</i> Huber	Moraceae	M	AM	W
Amap	<i>Brosimum parinarioides</i> Ducke	Moraceae	F*, M	AM	W
Platno	<i>Musa paradisiaca</i> L.	Musaceae	F*, M	AS	C
Wahus, wahusi	<i>Virola</i> spp.	Myristicaceae	M	AM	W
Pirimavan	<i>Campomanesia aromatica</i> (Aubl.) Griseb.	Myrtaceae	M	AM	R

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Inamhetni	<i>Eugenia patrisii</i> Vahl	Myrtaceae	F	AM	W
Siriz karé (Cr)	<i>Eugenia uniflora</i> L.	Myrtaceae	F, M	AM	C
Arak	Plant 3	Myrtaceae	F	AM	W
Kwiyau	<i>Psidium guajava</i> L.	Myrtaceae	F, M	AM	R/C
Pomroza	<i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry	Myrtaceae	F, M	AS	C
Kuskus awak	<i>Ouratea impressa</i> (Tiegh.) Lemée	Ochnaceae	M	AM	W
Aneku	<i>Ptychopetalum olacoides</i> Benth.	Olacaceae	M	AM	W
Karahbol	<i>Averrhoa carambola</i> L.	Oxalidaceae	M	AS	C
Marakuda	<i>Passiflora edulis</i> Sims	Passifloraceae	F	AM	C
Mahiktamu	<i>Passiflora laurifolia</i> L.	Passifloraceae	F	AM	R/C
Kavunma	<i>Passiflora nitida</i> Kunth	Passifloraceae	F*	AM	R/C
Kuskus arib	<i>Coix lacryma-jobi</i> L.	Poaceae	M	AS	C
Dug	<i>Oryza sativa</i> L.	Poaceae	F*	AS	I
Siku	<i>Saccharum officinarum</i> L.	Poaceae	F	AS	C
Bugut (bread), pat (pasta)	<i>Triticum aestivum</i> L.	Poaceae	F*	AS	I
Mahik	<i>Zea mays</i> L.	Poaceae	F	AM	C
Makanano	<i>Moutabea guianensis</i> Aubl.	Polygalaceae	F	AM	W
Pom	<i>Malus domestica</i> (Suckow) Borkh.	Rosaceae	F*	AS	I
Wadidga	<i>Capirona decorticans</i> Spruce	Rubiaceae	M	AM	W
Kinuwup, puwayt	<i>Chimarrhis turbinata</i> DC.	Rubiaceae	M	AM	W
Kafe	<i>Coffea arabica</i> L.	Rubiaceae	F*, M	AF	C/I
Loni, noni	<i>Morinda citrifolia</i> L.	Rubiaceae	M	AS/OC	C
Situru	<i>Citrus aurantifolia</i> Swingle	Rutaceae	F*, M	AS	C
Mahdarin	<i>Citrus reticulata</i> Blanco	Rutaceae	F*	AS	C
Uwas	<i>Citrus sinensis</i> (L.) Osbeck	Rutaceae	F*, M	AS	C

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Pirinu	<i>Citrus</i> sp.	Rutaceae	F	AS	C
Puduku wakau	<i>Zanthoxylum rhoifolium</i> Lam.	Rutaceae	M	AM	W
Kaymit	<i>Chrysophyllum cainito</i> L.	Sapotaceae	F, M	AM	C
Wakukwa adudu	<i>Chrysophyllum cuneifolium</i> (Rudge) A. DC.	Sapotaceae	F	AM	W
Zoliv	See family	Sapotaceae	F	AM	C
Tuu kamwi	<i>Picrolemma sprucei</i> Hook. f.	Simaroubaceae	M	AM	W
Kwasvan	<i>Quassia amara</i> L.	Simaroubaceae	M	AM	W/C
Kwevan	<i>Simaba orinocensis</i> Kunth	Simaroubaceae	M	AM	W
Yariwamna	<i>Siparuna</i> spp.	Siparunaceae	M	AM	W
Atit	<i>Capsicum annuum</i> L.	Solanaceae	F*	AM	C
Aig	<i>Nicotiana tabacum</i> L.	Solanaceae	M	AM	C
Matut	<i>Physalis pubescens</i> L.	Solanaceae	M	AM	R
Puduku (puduku seino)	<i>Solanum stramoniiifolium</i> Jacq.	Solanaceae	M	AM	R
Pom de tèt	<i>Solanum tuberosum</i> L.	Solanaceae	F*	AM	I
Puduku priye	<i>Solanum vanheurckii</i> Müll. Arg.	Solanaceae	M	AM	W
Tukuwi	<i>Cecropia</i> spp.	Urticaceae	M	AM	R
• Tukuwi tino	<i>Cecropia obtusa</i> Trécul	Urticaceae	M	AM	R
• Tukuwi awayg,	<i>Cecropia sciadophylla</i> Mart.	Urticaceae	M	AM	W
tukuwi duweh					
Arakau garib	<i>Cissus erosa</i> Rich.	Vitaceae	M	AM	W
Isuu	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	M	AS	C/I
Wakukwa itaybe	Plant 1	Unknown	F	AM	W
Maoksi adudu	Plant 2	Unknown	F	AM	W
Aaku	Plant 5	Unknown	M	AM	W
Itaybi	Plant 8	Unknown	M	AM	W
Kaneg aneg, kaniki gahauki	Plant 9	Unknown	M	AM	C

Name		Family	Use	Origin	Status
Parikwaki	Latin				
Kari	Plant 10	Unknown	M	AM	W
Kawap	Plant 13	Unknown	M	AM	W
Piduke punawi	Plant 17	Unknown	M	AM	W
Pirimavan ahuwakban	Plant 18	Unknown	M	AM	W
Awayo	Plant 19	Unknown	M	AM	W

3.4.5 Dietary adaptations

Amidst reporting a dietary transition characterized by an increased consumption of introduced store-bought foods, cassava roots remain the staple food item in Parikwene households, though not unscathed from changes through time. The most notable change reported by Parikwene participants is the historically widespread practice of consuming cassava flatbread (**kasav**), which has now largely been replaced by the transformation of cassava roots into a torrefied semolina locally called **kwak** (Creole) or **puveye** (Parikwaki). The shift was reported to have happened in the early 1940s and Parikwene participants did not link this to a rising incidence of diabetes. The consumption of cassava flatbread can now be characterized as an occasional practice whereas **kwak** is commonly consumed in nearly every Parikwene household.

Kwak and cassava root was discussed by participants in 93.3 % of all interviews. Palikur participants (83.3 %), however, reported two principal types of **kwak**, whereas this was only brought up by one non-Palikur participant working as a home nurse. These were called sweet **kwak** (**puveye kiteye**) and acidic **kwak** (**puveye sweine**), whose names characterize their organoleptic properties. Although most considered acidic **kwak** to be better for diabetics, some believed that it did not affect diabetes any differently from sweet **kwak**. Nonetheless, many diabetics interviewed switched from sweet **kwak** to acidic **kwak** in an effort to keep their glycemic levels lower.

Slight variations to the operational sequence, or *chaîne opératoire*, of **kwak** production led to the preparation of sweet or acidic **kwak** (**Figure 3.3** and **3.4**). Though the main characteristic distinguishing the latter from the former involves retting the cassava tubers for a minimum of two days, as opposed to torrefying freshly grated and pressed tubers, acidic **kwak** can be produced through one of two ways. Firstly, retted tubers may be grated, pressed then torrefied. Secondly, retted tubers may be grated and mixed with freshly grated tubers. The mixed aqueous mass is left

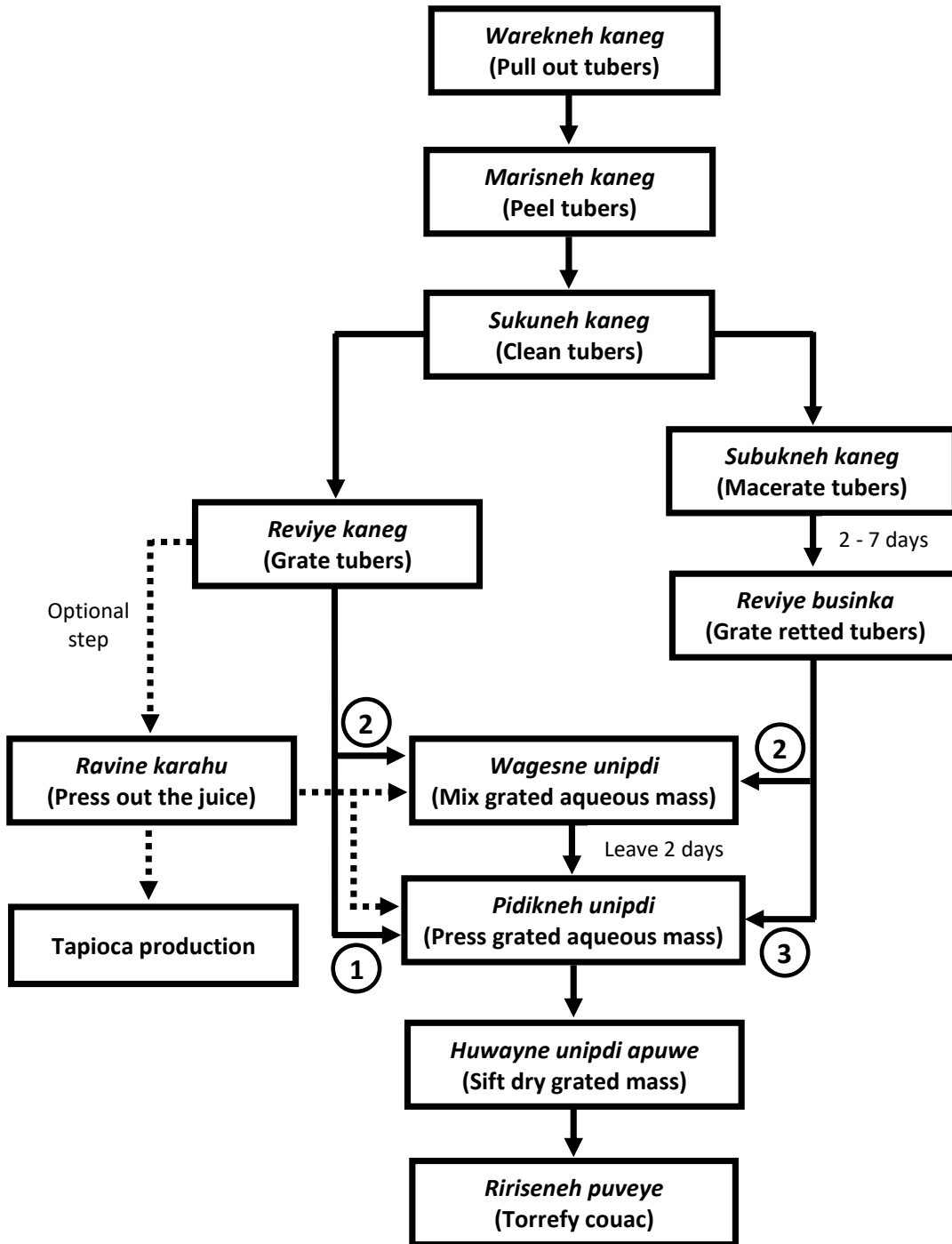


Figure 3.3. The operational sequence, or *chaîne opératoire*, of **kwak** production. Pathway 1 results in sweet **kwak** (**puveye kiteye**), whereas pathways 2 and 3 result in acidic **kwak** (**puveye sweine**). Pathway 2 differs from pathway 3 by mixing the grated mass of fresh cassava tubers with that of retted cassava tubers. This method allows for fresh starch (**kayut**) to be extracted from cassava juice (**karahu**) for later dietary purposes before the grated mass is reintroduced into the operational sequence of **kwak** production (dotted arrows).



Figure 3.4. Illustrations of the retting process of cassava tubers (*Manihot esculenta*). Cassava tubers cleaned (A) and retting for three days (B). This step, which last from two days to one week, distinguishes acidic **kwak** from sweet **kwak**. The water used to ret the tubers is then discarded (C) along with a sizeable amount of starch, which can be observed in the bottom of the recipient (D) and on the ground (E). Photo credits: M. Rapinski.

to rest for another two days before being pressed and torrefied. In both cases, the number of days allowed for cassava tubers to macerate in water depends on the level of acidity desired in the end results. This may vary from a minimum of two days up to one week for a very acidic tasting **kwak**. Due to its undesired organoleptic properties, a sizeable amount of starch is discarded following the maceration of the tubers (**Figure 3.4**). For that reason, the method of mixing retted tubers with fresh tubers allows for the optional step of extracting starch (**kayut**), subsequently used for culinary purposes, from the fresh tubers before they are left to ferment with the retted aqueous mass (**Figure 3.3**).

Other dietary changes reported by diabetic participants are adopted on a personal basis. These choices generally result from adverse reactions following the consumption of specific food item. The symptoms felt include:

- numbness in the mouth;
- dry mouth;
- sudden fatigue and weakness;
- perspiration;
- increase in body heat;
- diarrhea;
- polyuria.

Blood glucose levels were often measured during such events, either personally or assisted by a family member or nurse, to confirm whether or not there is hyperglycemia. Food items, plants and animals alike, most frequently advised against by participants are listed in **Table 3.6**.

Table 3.6. Food items (animals and plants) cited by Parikwene participants from Macouria and Saint-Georges. Food items are distinguished based on their effect, when explicitly reported by participants, on glycemic control; those cited in passing without remarks on their effect on glycemia are also included. Species are ranked according to their relative frequency of citations (FC), expressed as a percentage, regarding their negative effects on glycemic control. Glycemic indices (GI) have been retrieved from the International Tables of Glycemic Index when available (Atkinson et al. 2008): values below 56 are considered low (L), medium (M) between 56 and 69 inclusively, and high (H) above 69. References for to prior knowledge of these food items in the dietary system are provided for the Parikwene (Pa) and French Guiana (FG), all populations confounded.

Species	FC (%)		Part	GI	Literature*	
	Bad	Good/No effect			Pa	FG
Animals						
Tayassuidae	27.1	12.5	Flesh	-	5	4-5
• <i>Tayassu pecari</i>	25.0	12.5	Flesh	-	5	4-5
• <i>Pecari tajacu</i>	8.33	8.33	Flesh	-	5	4-5
<i>Gallus gallus domesticus</i>	16.7	10.4	Flesh	-		
<i>Mazama</i> spp.	10.4	8.33	Flesh	-		4
• <i>Mazama gouazoubira</i>	2.08	4.17	Flesh	-		4
<i>Sus domesticus</i>	10.4	8.33	Flesh	-		
<i>Tapirus terrestris</i>	10.4	4.17	Flesh	-	5	4-5
<i>Bos taurus</i>	8.33	4.17	Flesh	-		
Sciaenidae	6.25	10.4	Flesh	-		
<i>Alouatta macconnelli</i>	6.25	-	Flesh	-		4
<i>Cuniculus paca</i>	4.17	8.33	Flesh	-	5	4-5
<i>Hoplerhynchus unitaeniatus</i>	4.17	4.17	Flesh	-		
Alligatoridae	4.17	-	Flesh	-		4-5
Clupeidae-Pristigasteridae	4.17	-	Flesh	-		
<i>Dasypus</i> spp.	4.17	-	Flesh	-		4
Psittacidae	4.17	-	Flesh	-	5	4-5
<i>Psophia crepitans</i>	4.17	-	Flesh	-		4
<i>Dasyprocta leporina</i>	2.08	8.33	Flesh	-	5	4-5
<i>Acestrorhynchus</i> spp.	2.08	2.08	Flesh	-		

Species	FC (%)		Part	GI	Literature*	
	Bad	Good/No effect			Pa	FG
Callichthyidae	2.08	2.08	Flesh	-		
Cichlidae	2.08	2.08	Flesh	-		
<i>Sciades passany</i>	2.08	2.08	Flesh	-		
<i>Amazona</i> spp.	2.08	-	Flesh	-		4
Animal 1	2.08	-	Flesh	-	7	
<i>Arapaima gigas</i>	2.08	-	Flesh	-		
<i>Callinectes exasperatus</i>	2.08	-	Flesh	-	5	5
Cebidae	2.08	-	Flesh	-		4-5
<i>Mugil incilis</i>	2.08	-	Flesh	-		
<i>Potos flavus</i>	2.08	-	Flesh	-		4
Serrasalminidae	2.08	-	Flesh	-		
<i>Crax alector</i>	-	6.25	Flesh	-		4-5
<i>Tinamus major</i>	-	6.25	Flesh	-		4
<i>Hoplias malabaricus</i>	-	4.17	Flesh	-		
<i>Penelope marail</i>	-	4.17	Flesh	-		4
Ramphastidae	-	4.17	Flesh	-		4-5
<i>Brachyplatystoma filamentosum</i>	-	2.08	Flesh	-		
<i>Cichla monoculus</i>	-	2.08	Flesh	-		
<i>Heros efasciatus</i>	-	2.08	Flesh	-		
<i>Hoplias aimara</i>	-	2.08	Flesh	-		
<i>Leptotila rufaxilla</i>	-	2.08	Flesh	-		4
<i>Megalops atlanticus</i>	-	2.08	Flesh	-		
<i>Tetragonopterus</i> spp.	-	2.08	Flesh	-		
Anatidae	-	-	Flesh	-		4
<i>Astronotus ocellatus</i>	-	-	Flesh	-		
<i>Ateles paniscus</i>	-	-	Flesh	-		4
<i>Caiman crocodilus</i>	-	-	Flesh	-		4
<i>Centropomus</i> spp.	-	-	Flesh	-		

Species	FC (%)		Part	GI	Literature*	
	Bad	Good/No effect			Pa	FG
<i>Chaetobranchus flavescens</i>	-	-	Flesh	-		
<i>Chelonoidis</i> spp.	-	-	Flesh	-		4
<i>Electrophorus electricus</i>	-	-	Flesh	-		
<i>Eunectes murinus</i>	-	-	Flesh	-		4
<i>Hydrochoerus hydrochaeris</i>	-	-	Flesh	-		4
<i>Iguana iguana</i>	-	-	Flesh	-	5	4-5
<i>Mesoclemmys nasuta</i>	-	-	Flesh	-		
<i>Paleosuchus palpebrosus</i>	-	-	Flesh	-		4
<i>Paleosuchus trigonatus</i>	-	-	Flesh	-		4
<i>Podocnemis unifilis</i>	-	-	Flesh	-		4
<i>Pomacea guyanensis</i>	-	-	Flesh	-	5	5
<i>Syacium</i> spp.	-	-	Flesh	-		
Animal 6	-	-	Flesh	-		
Animal 7	-	-	Honey	-		
Plants						
<i>Manihot esculenta</i>	89.6	83.3	Tuber	H	1-2; 7	1-3
<i>Coffea arabica</i>	37.5	10.4	Seed	-	1	1; 3
<i>Theobroma cacao</i>	29.2	6.25	Seed, seed pulp	L - H	1-2; 7	1-3
<i>Oenocarpus bataua</i>	29.2	4.17	Fruit	-	7	6
<i>Oenocarpus bacaba</i>	27.1	6.25	Fruit	-		6
<i>Oryza sativa</i>	27.1	6.25	Seed	L - H		3
<i>Euterpe oleracea</i>	20.8	14.6	Fruit	-	1; 7	1; 6
<i>Musa paradisiaca</i>	14.6	6.25	Fruit	L - H	1; 7	1; 3
<i>Allium cepa</i>	14.6	-	Bulb	-		3
<i>Capsicum annuum</i>	14.6	-	Fruit	-	1; 7	1; 3
<i>Allium sativum</i>	12.5	-	Bulb	-	1; 7	1; 3
<i>Ananas comosus</i>	12.5	-	Fruit	M	1-2; 7	1-3
<i>Phaseolus vulgaris</i>	12.5	-	Seed	L - H		3

Species	FC (%)		Part	GI	Literature*	
	Bad	Good/No effect			Pa	FG
<i>Triticum aestivum</i>	10.4	-	Seed	L - H	5	5
<i>Attalea maripa</i>	6.25	-	Fruit	-	1; 7	1; 6
<i>Citrullus lanatus</i>	6.25	-	Fruit	H	7	3
<i>Citrus sinensis</i>	6.25	-	Fruit	L	1; 7	1-3
<i>Mangifera indica</i>	4.17	2.08	Fruit	L	1; 7	1; 3
<i>Colocasia esculenta</i>	4.17	-	Tuber	M - H	7	3
<i>Ipomoea batatas</i>	4.17	-	Tuber	L - H	7	3
<i>Solanum tuberosum</i>	4.17	-	Tuber	H		
<i>Cocos nucifera</i>	2.08	4.17	Fruit, water	-	1; 7	1; 6
<i>Passiflora nitida</i>	2.08	4.17	Fruit	-	1-2; 7	1-2
<i>Carica papaya</i>	2.08	2.08	Fruit	M	1-2; 7	1-3
<i>Citrus reticulata</i>	2.08	2.08	Fruit	-		3
<i>Persea americana</i>	2.08	2.08	Fruit	-	7	3
<i>Dioscorea trifida</i>	2.08	-	Tuber	H	7	3
<i>Inga edulis</i>	2.08	-	Fruit	-	7	3
<i>Spondias mombin</i>	2.08	-	Fruit	-	1; 7	1; 3
<i>Costus</i> spp.	-	6.25	Stem	-		
<i>Astrocaryum vulgare</i>	-	4.17	Fruit	-	1; 7	1-3; 6
<i>Citrus aurantifolia</i>	-	4.17	Fruit	-	1; 7	1-3
<i>Couma guianensis</i>	-	4.17	Latex, fruit	-	2; 7	2
<i>Eryngium foetidum</i>	-	4.17	Leaf	-	1	1-3
<i>Brosimum parinarioides</i>	-	2.08	Latex	-	5	5
<i>Malus domestica</i>	-	2.08	Fruit	L		
<i>Ambelania acida</i>	-	-	Fruit		2; 7	2
<i>Anacardium occidentale</i>	-	-	Fruit, seed		1; 7	1; 3
<i>Annona montana</i>	-	-	Fruit		2	2
<i>Annona mucosa</i>	-	-	Fruit			3
<i>Annona muricata</i>	-	-	Fruit		7	2-3

Species	FC (%)		Part	GI	Literature*	
	Bad	Good/No effect			Pa	FG
<i>Annona paludosa</i>	-	-	Fruit			
<i>Artocarpus altilis</i> var. <i>non-seminiferus</i>	-	-	Fruit			2-3
<i>Artocarpus altilis</i> var. <i>seminiferus</i>	-	-	Seed			2-3
<i>Artocarpus heterophyllus</i>	-	-	Fruit		7	3
<i>Astrocaryum paramaca</i>	-	-	Fruit		1	1; 6
<i>Bactris gasipaes</i>	-	-	Fruit		2; 7	2-3; 6
<i>Bactris major</i>	-	-	Fruit			6
<i>Bellucia grossularioides</i>	-	-	Fruit			
<i>Bertholletia excelsa</i>	-	-	Seed			3
<i>Bixa orellana</i>	-	-	Seed		1	1
<i>Caryocar glabrum</i>	-	-	Seed		7	
<i>Caryocar villosum</i>	-	-	Seed			
<i>Chrysobalanus icaco</i>	-	-	Fruit			2
<i>Chrysophyllum cainito</i>	-	-	Fruit			3
<i>Chrysophyllum cuneifolium</i>	-	-	Fruit			
<i>Citrus</i> sp.	-	-	Fruit		7	
<i>Cucumis anguria</i>	-	-	Fruit			3
<i>Cucumis sativus</i>	-	-	Fruit			3
<i>Cucurbita moschata</i>	-	-	Fruit		1; 7	1; 3
<i>Dioscorea cayenensis</i>	-	-	Tuber		1; 7	1; 3
<i>Doliocarpus</i> spp.	-	-	Sap		1	1
<i>Eugenia patrisii</i>	-	-	Fruit			
<i>Eugenia uniflora</i>	-	-	Fruit			
<i>Hibiscus sabdariffa</i>	-	-	Flower			3
<i>Inga capitata</i>	-	-	Fruit			
<i>Malpighia emarginata</i>	-	-	Fruit			3
<i>Mauritia flexuosa</i>	-	-	Fruit		2; 7	2; 6
<i>Moutabea guianensis</i>	-	-	Fruit			

Species	FC (%)		Part	GI	Literature*	
	Bad	Good/No effect			Pa	FG
<i>Ocimum campechianum</i>	-	-	Leaf		1	1; 3
<i>Passiflora edulis</i>	-	-	Fruit			3
<i>Passiflora laurifolia</i>	-	-	Fruit		2; 7	2-3
Plant 1	-	-	Fruit			
Plant 2	-	-	Fruit			
Plant 3	-	-	Fruit			
<i>Psidium guajava</i>	-	-	Fruit		1; 7	1; 3
<i>Saccharum officinarum</i>	-	-	Stem		1; 7	1-3
Sapotaceae	-	-	Fruit			2
<i>Spondias dulcis</i>	-	-	Fruit			3
<i>Syzygium samarangense</i>	-	-	Fruit			3
<i>Terminalia catappa</i>	-	-	Fruit, seed			
<i>Theobroma grandiflorum</i>	-	-	Fruit		7	
<i>Zea mays</i>	-	-	Seed		1-2; 7	1-3

* 1) Berton 1997; 2) Grenand et al. (1987) 2004; 3) Hoff and Cremers 2005; 4) Hansen and Richard-Hansen 2007; 5) Vincent 2013; 6) de Granville and Gayot 2014; 7) Iaparrá et al. 2017

Amongst the top 10 plant-based foods cited by participants included most cited species originally listed in the development of diabetes (e.g., coffee [*Coffea arabica*], chocolate [*Theobroma cacao*], rice [*Oryza sativa*], garlic [*Allium cepa*]; **Table 3.4**). Nectars from the fruits of the patawa (*Oenocarpus bataua*), bacaba (*Oenocarpus bacaba*) and açai (*Euterpe oleracea*) palms (Arecaceae) were the most cited species considered to be classically traditional Parikwene foods. Participants explained this to be related to their high fat content. A number of notably sweet fruits, locally grown or harvested, were also known, to a lesser extent, for their negative impact on glycemic control. Though adverse reactions and poor glycemic readings of these food items have prompted some diabetic participants to avoid these altogether, others explained that these could also be good, or have no effect on diabetes (**Table 3.6**), citing for one, that these had to be consumed in moderation. Furthermore, some fruits could also be consumed unripe (e.g., bananas [*Musa paradisiaca* L.; Musaceae], mangoes [*Mangifera indica* L.; Anacardiaceae] and papayas [*Carica papaya*; Caricaceae]). Finally, hot peppers (*Capsicum annuum* L.; Solanaceae) were advised against, especially when mixed with cassava juice as a condiment (**atit karahu**) with some suggesting that hot peppers should be avoided altogether when sick and undergoing intense treatments, biomedical or Parikwene.

Although the consumption of domesticated animals was ill-advised against diabetes (i.e., chicken [*Gallus gallus domesticus*], swine [*Sus domesticus*; Suidae], beef [*Bos taurus*]), a number of wild animals were also cited for their adverse effects in diabetics when eaten. The most cited were species of Tayassuidae, namely the collared peccary (*Pecari tajacu*) and the white-lipped peccary (*Tayassu pecari*); the Amazonian tapir (*Tapirus terrestris*; Tapiridae) and species of Cervidae, namely the red brocket (*Mazama americana*) and the grey brocket (*Mazama gouazoubira*). Though cited infrequently, the number of fish mentioned by participants testifies to

a variety of fish in the Parikwene diet and participants were quick to generalize that white skin coloured fish were compatible with diabetes (e.g., banded cichlid [*Heros efasciatus*; Cichlidae] and passany sea-catfish [*Sciades passany*; Ariidae]), whereas red fish with scales were not (e.g., golden wolf fish³ [*Hoplerythrinus unitaeniatus*; Erythrinidae], freshwater barracudas [*Acestrorhynchus* spp.; Acestrorhynchidae], arapaima [*Arapaima gigas*; Arapaimidae], several cichlids generically called **be** [Cichlidae], and several piranhas generically called **umayan** [Serrasalminidae]). For the most part, the effect of animal foods on diabetes was fairly divided. Overall, participants stated that the reaction to food items was personal and could be different from one person to the next, as LS6006 from Macouria exemplifies:

“Donc par rapport aux aliments qu’elle va consommer, donc sa bouche va... comment dire ? Va s’engourdir. Ouais. Ça va s’engourdir et... et les symptômes vont apparaître. Elle va se sentir mal après, quoi. Donc tout ça. Que ça soit... mais le plus souvent, c’est des... du poisson. Du poisson de la mer. Ou sinon... cochon, autres... Ouais, biche, tout ça. Mais c’est par rapport à la personne. Ouais, c’est chaque personne. Donc elle, elle peut manger... Elle peut manger et ça va avec elle. Mais il y a d’autres personnes que le manger, il y aura des symptômes.”

Paying attention to body signals and to glucometer readings were the primary practices in establishing which food items to avoid or consume in moderation. Out of all species that were not cultivated, but harvested from primary and secondary forest, none of them was reported for a negative effect on diabetes.

³ Although Parikwene call this fish **pune** in Parikwaki and **koulan** in Creole, these names could also refer to, and include, the red wolf fish, *Erythrinus erythrinus* (Bloch & Schneider, 1801), a relatively small species of Erythrinidae that is called **pune agagbu** and **pune waimrak** in Parikwaki, as well as **koulan** and **ti-koulan** in Creole according to (Grenand et al. 2015).

3.4.6 Animal and plant-based medicines and remedies

Species cited and used

Out of 48 interviews with Parikwene people, participants were able to cite at least one plant used to treat diabetes in 44 interviews, reporting a total of 70 species (**Table 3.7**). The most cited species used against diabetes were the following: **gongo** (*Geissospermum* spp.; Apocynaceae), quassia (*Quassia amara*; Simaroubaceae), crabwoods (*Carapa* spp.; Meliaceae), sour canes (*Costus* spp.; Costaceae) and **kinuwup** (*Chimarrhis turbinata*; Rubiaceae). Although the following were mentioned by people in two interviews only, the Great Tinamou (*Tinamus major*; Tinamidae) and the Gray-fronted Dove (*Leptotila rufaxilla*; Columbidae), these two bird species were cited as being specifically sought out for consumption by seriously ill people, including those with diabetes. On the other hand, 10 other animal species were more frequently cited for treating symptoms associated with diabetes. More precisely, the grease of animals was used alone or mixed with various plant oils to make creams and cataplasms to treat such ailments as muscle pains, arthritis, swellings and inflammation. Overall, 55 animal and plant species were cited in 43 interviews for treating a number of symptoms associated with diabetes, such as polyuria, diarrhea, abscesses and infected wounds. Though more than half of the plant species cited were not used against diabetes (27/45), five of the top 10 plants listed in the treatment of diabetes were also used for treating related complications (*i.e.*, crabwoods [*Carapa* spp.], sour canes [*Costus* spp.], cecropias [more precisely *Cecropia sciadophylla*; Urticaceae], noni [*Morinda citrifolia*; Rubiaceae], tropical almond [*Terminalia catappa*; Combretaceae]).

Just as for food items, participants specified that the response to specific remedies targeting diabetes in particular was not the same for everyone. Once again, glucometer readings, taken individually or assisted, were used to assess a remedy's efficacy along with the absence of

Table 3.7. Animal and plant species cited by Parikwene participants from Macouria and Saint-Georges in the treatment of diabetes and its symptoms. Species are ranked according to their relative frequency of citations (FC), as a percentage, against diabetes and marked by an X if they are used to treat various symptoms that can be associated with diabetes. References for prior knowledge of these species in the French Guianese pharmacopoeia (FG), all populations confounded, including known uses against diabetes are provided for the Parikwene (Pa) and French Guianese Creole (Cr). Some literature references regarding their antidiabetic potential are also provided.

Species	Diabetes		Part	Literature		
	FC	Symptoms		Diabetes	Pharmacopoeia*	Antidiabetic potential
Animals						
<i>Leptotila rufaxilla</i>	2.08		Flesh			
<i>Tinamus major</i>	2.08		Flesh			
<i>Ateles paniscus</i>	-	X	Fat, scent glands			
<i>Atta</i> spp.	-	X	Whole animal			
<i>Bos taurus</i>	-	X	Fat			
Cebidae	-	X	Fat, scent glands			
<i>Chelonoidis</i> spp.	-	X	Fat, shell			
<i>Dasypus</i> spp.	-	X	Fat			
<i>Electrophorus electricus</i>	-	X	Bones, fat			
<i>Eunectes murinus</i>	-	X	Fat			
<i>Gallus gallus domesticus</i>	-	X	Fat			
<i>Hydrochoerus hydrochaeris</i>	-	X	Bones, fat			
<i>Ovis aries</i> (?)	-	X	Fat			
<i>Panthera onca</i>	-	X	Fat, scent glands			
<i>Tayassu pecari</i>	-	X	Scent glands			
Animal 10	-	X	Whole animal			
Animal 11	-	X	Whole animal			
Animal 12	-	X	Sting			
Plants						
<i>Geissospermum</i> spp.	29.2		Bark	2-3 (Pa)	2-3; 9-10 (Pa, FG)	

Species	Diabetes		Part	Literature		
	FC	Symptoms		Diabetes	Pharmacopoeia*	Antidiabetic potential
<i>Quassia amara</i>	27.1		Leaf	2-3 (Pa, Cr)	2-4; 8-10 (Pa, FG)	Husain et al. 2011
<i>Carapa</i> spp.	25.0	X	Bark, seed oil		2-3; 5; 8-10 (Pa, FG)	Alves de Souza et al. 2017
<i>Costus</i> spp.	20.8	X	Whole plant	3 (Pa)	1-3; 9-10 (Pa, FG)	
<i>Cecropia</i> spp.	16.7	X	Bark, leaf, leaf bud		2-3; 5; 10 (Pa, FG)	
<i>Chimarrhis turbinata</i>	14.6		Bark	2 (Pa)	2 (Pa)	
<i>Averrhoa carambola</i>	12.5		Leaf		10 (FG)	Xu et al. 2014
<i>Cecropia sciadophylla</i>	10.4	X	Bark, leaf bud		2; 10 (Pa, FG)	
<i>Euterpe oleracea</i>	10.4		Seed, unripe fruit	2-3 (Pa)	2-3; 5; 7; 10 (Pa, FG)	de Bem et al. 2018
<i>Morinda citrifolia</i>	10.4	X	Fruit, leaf		4; 8-10 (FG)	Algenstaedt et al. 2018
<i>Terminalia catappa</i>	10.4	X	Leaf	2 (Pa)	2; 10 (Pa, FG)	Nagappa et al. 2003
<i>Anacardium occidentale</i>	8.33	X	Bark, leaf		1-3; 9-10 (Pa, FG)	Kamtchouing et al. 1998
<i>Bixa orellana</i>	8.33	X	Leaf, seed		2-3-5; 10 (Pa, FG)	Teles et al. 2014
<i>Campomanesia aromatica</i>	8.33	X	Leaf		2-3; 10 (Pa, FG)	
<i>Inga</i> spp.	8.33	X	Bark		2-3; 5; 10 (Pa, FG)	
<i>Dalbergia monetaria</i>	6.25		Branch, stem		2-3; 9-10 (Pa, FG)	
<i>Doliocarpus</i> spp.	6.25	X	Bark, sap	3 (Pa)	2-3 (Pa)	
<i>Lecythis zabucajo</i>	6.25		Fruit husk		3 (Pa)	
<i>Siparuna</i> spp.	6.25	X	Leaf		1-3; 8-10 (Pa, FG)	
<i>Spondias mombin</i>	6.25	X	Bark		1-3; 10 (Pa, FG)	Adediwura and Kio 2009
<i>Syzygium samarangense</i>	6.25	X	Leaf		8; 10 (FG)	Khamchan et al. 2018
<i>Annona muricata</i>	4.17	X	Bark, fruit, leaf		2-3; 8-10 (Pa, FG)	Alwan et al. 2020
<i>Brosimum parinarioides</i>	4.17	X	Latex		3 (Pa)	
<i>Byrsonima crassifolia</i>	4.17	X	Bark		2-3 (Pa, FG)	Perez-Gutierrez et al. 2010
<i>Cissus erosa</i>	4.17		Aerial parts		2-3 (Pa)	
<i>Citrus aurantifolia</i>	4.17	X	Fruit, leaf		2-3; 5; 8-10 (Pa, FG)	Ibrahim et al. 2019

Species	Diabetes		Part	Literature		
	FC	Symptoms		Diabetes	Pharmacopoeia*	Antidiabetic potential
<i>Cocos nucifera</i>	4.17	X	Liquid albumen, fruit oil		2-3; 7; 8-10 (Pa, FG)	Preetha et al. 2013
<i>Couma guianensis</i>	4.17	X	Latex		3 (FG)	
<i>Crescentia cujete</i>	4.17		Bark, leaf		2-3-5; 8; 10 (Pa, FG)	
<i>Eryngium foetidum</i>	4.17	X	Leaf		2-4; 8-10 (Pa, FG)	
<i>Eugenia uniflora</i>	4.17		Leaf		8; 10 (FG)	Arai et al. 1999
<i>Jatropha curcas</i>	4.17	X	Aerial parts, latex		2-3; 5; 8-10 (Pa, FG)	
<i>Laurus nobilis</i>	4.17		Leaf			Khan et al. 2009
<i>Manihot esculenta</i>	4.17		Tuber		2-3; 9-10 (Pa, FG)	
<i>Marsypianthes chamaedrys</i>	4.17		Aerial parts		3; 10 (Pa, FG)	
<i>Momordica charantia</i>	4.17		Leaf	3 (Cr)	3; 8-10 (FG)	Peter et al. 2019
<i>Parahancornia fasciculata</i>	4.17	X	Latex	6 (Pa)	3 (Pa)	
<i>Picrolemma sprucei</i>	4.17		Branch	2-3 (Pa)	2-3; 9-10 (Pa, FG)	
Plant 13	4.17	X	Bark			
Plant 5	4.17		Bark			
<i>Simaba orinocensis</i>	4.17		Bark	2-3 (Pa)	3 (Pa, FG)	
<i>Solanum stramonifolium</i>	4.17	X	Root		2-3 (Pa)	
<i>Virola</i> spp.	4.17		Bark		1-3; 9 (Pa, FG)	
<i>Vismia</i> spp.	4.17		Bark		2-3 (Pa, FG)	
<i>Aloe vera</i>	2.08		Aerial parts	2-3 (Pa)	2-3; 8-10 (Pa, FG)	Yongchaiyudha et al. 1996
<i>Bactris major</i>	2.08		Root			
<i>Bauhinia forficata</i>	2.08		Leaf			Oliveira et al. 2020
<i>Bertholletia excelsa</i>	2.08		Fruit husk			
<i>Bonafousia angulata</i>	2.08		n.d.		1;3 (Pa, FG)	
<i>Brosimum acutifolium</i> subsp. <i>acutifolium</i>	2.08		Bark		2-3 (Pa, FG)	
<i>Calophyllum brasiliense</i>	2.08		Bark	3 (Pa)	3 (Pa)	

Species	Diabetes		Part	Literature		
	FC	Symptoms		Diabetes	Pharmacopoeia*	Antidiabetic potential
<i>Capirona decorticans</i>	2.08		Bark		2-3 (Pa, FG)	
<i>Chrysophyllum cainito</i>	2.08		Leaf	3 (Cr)	3 (FG)	Doan et al. 2018
<i>Citrus sinensis</i>	2.08		Fruit peel		2-3 (Pa, FG)	
<i>Coffea arabica</i>	2.08		Leaf		2; 8; 10 (Pa, FG)	
<i>Coix lacryma-jobi</i>	2.08		Seed		3 (FG)	
<i>Couratari multiflora</i>	2.08		Inner bark		3 (Pa, FG)	
<i>Desmoncus</i> spp.	2.08		Stem			
<i>Hymenaea courbaril</i>	2.08		Bark		2-3; 10 (Pa, FG)	
<i>Mangifera indica</i>	2.08	X	Bark		2-3; 5; 8-10 (Pa, FG)	Villas Boas et al. 2020
<i>Mikania</i> spp.	2.08	X	Aerial parts		2-3; 10 (Pa, FG)	
<i>Nicotiana tabacum</i>	2.08		Leaf		2-3-5; 8-10 (Pa, FG)	
<i>Orthosiphon aristatus</i>	2.08		Leaf	2-3 (Pa, Cr)	3-4; 8; 10 (Pa, FG)	Mohamed et al. 2013
<i>Ouratea impressa</i>	2.08	X	n.d.		3 (FG)	
<i>Pacouria guianensis</i>	2.08	X	Latex		3 (FG)	
<i>Persea americana</i>	2.08	X	Fruit oil, leaf		8; 10 (FG)	Kouamé et al. 2019
<i>Physalis pubescens</i>	2.08		Root		2-3 (Pa, FG)	Chen et al. 2019
Plant 10	2.08		n.d.			
Plant 17	2.08		n.d.			
Plant 19	2.08		n.d.			
Plant 8	2.08		n.d.			
Plant 9	2.08		Tuber			
<i>Plectranthus neochilus</i>	2.08		Leaf		3-4; 8; 10 (FG)	
<i>Pterocarpus officinalis</i>	2.08		Resin	2-3 (Pa)	2-3 (Pa)	
<i>Ptychopetalum olacoides</i>	2.08		Branch, stem	2 (Pa)	2-3 (Pa, FG)	
<i>Senna</i> spp.	2.08	X	Leaf	2-3 (Pa)	1-3; 5; 8; 10 (Pa, FG)	

Species	Diabetes		Part	Literature		
	FC	Symptoms		Diabetes	Pharmacopoeia*	Antidiabetic potential
<i>Solanum vanheurckii</i>	2.08		Root		3 (FG)	
<i>Tabebuia serratifolia</i>	2.08		Bark	3 (Pa)	2-3; 10 (Pa, FG)	
<i>Tetragastris altissima</i>	2.08		n.d.		2-3 (Pa)	
<i>Zanthoxylum rhoifolium</i>	2.08		Bark		2-3 (Pa, FG)	
<i>Aristolochia</i> spp.	-	X	Stem	2 (Pa, Cr)	1-3; 9; 10 (Pa, FG)	
<i>Astrocaryum paramaca</i>	-	X	Stem		2; 7 (Pa, FG)	
<i>Astrocaryum vulgare</i>	-	X	Fruit oil		2-3; 7; 9-10 (Pa, FG)	
<i>Attalea maripa</i>	-	X	Seed oil		2 (Pa)	
<i>Cecropia obtusa</i>	-	X	leaf bud		2-3; 5; 10 (Pa, FG)	
<i>Cipura paludosa</i>	-	X	n.d.		2-4 (Pa, FG)	
<i>Clusia</i> spp.	-	X	Aerial roots, latex		2-3 (Pa, FG)	
<i>Copaifera guianensis</i>	-	X	Resin		2-3; 8-10 (Pa, FG)	
<i>Cordia</i> spp.	-	X	Leaf		3; 10 (Pa, FG)	
<i>Eleutherine bulbosa</i>	-	X	Bulb		2-3-5; 8; 10 (Pa, FG)	
<i>Eperua falcata</i>	-	X	n.d.		3 (FG)	
<i>Jatropha gossypifolia</i>	-	X	Aerial parts, latex		2-3; 9; 10 (Pa, FG)	
Loranthaceae	-	X	Aerial parts		2-3 (Pa, FG)	
<i>Manicaria saccifera</i>	-	X	Liquid albumen		3; 7 (FG)	
<i>Mauritia flexuosa</i>	-	X	Fruit oil		3; 7 (Pa, FG)	
<i>Musa paradisiaca</i>	-	X	Root		2-3; 5; 10 (Pa, FG)	
<i>Ocimum campechianum</i>	-	X	Aerial parts		2-3-4; 8; 10 (Pa, FG)	
<i>Oenocarpus bataua</i>	-	X	Fruit oil		3; 7 (Pa, FG)	
<i>Phaseolus vulgaris</i>	-	X	Seed			
Plant 18	-	X	Leaf			
Plant 24	-	X	Leaf		2 (Pa)	
<i>Psidium guajava</i>	-	X	Bark, fruit, leaf		2-3; 8-10 (Pa, FG)	

Species	Diabetes		Part	Literature		
	FC	Symptoms		Diabetes	Pharmacopoeia*	Antidiabetic potential
<i>Ricinus communis</i>	-	X	Seed oil		2-3; 8-10 (Pa, FG)	
<i>Sapium argutum</i>	-	X	Latex		3 (Pa)	
<i>Spondias dulcis</i>	-	X	Fruit		3; 10 (FG)	
<i>Syagrus inajai</i>	-	X	Seed oil		2-3; 7 (Pa, FG)	
<i>Tabernaemontana siphilitica</i>	-	X	Leaf, latex		2-3 (Pa)	
<i>Tapirira</i> spp.	-	X	Bark		3; 8 (FG)	
<i>Zingiber officinale</i>	-	X	Rhizome		2-3; 8-10 (Pa, FG)	

n.d. = not determined

*1) Grenand and Grenand 1991; 2) Berton 1997; 3) Grenand et al. (1987) 2004; 4) Hoff and Cremers 2005; 5) Odonne et al. 2011; 6) Vincent 2013; 7) de Granville and Gayot 2014; 8) Tareau et al. 2017; Tareau et al. 2019b; Tareau et al. 2020

symptoms. If a person experienced any of the adverse reactions listed for foods, this remedy was not deemed appropriate for that person.

Due to the sweet and hot characteristics attributed by the Parikwene to diabetes, Parikwene treatments were frequently described based on their organoleptic (*i.e.*, sour and bitter tasting) and caloric (*i.e.*, cold, cool and refreshing) properties. This was particularly true of plants species, although it was noted that the flesh of the Great Tinamou (*Tinamus major*) was characterized by a bitter taste due to the medicinal bird's diet. How these two properties are linked together is best represented by sour canes (*Costus* spp.) whose noticeably acidic taste, resembling lemon, is thought to cause a cool and refreshing effect when used internally and externally. Hence, a maceration or decoction of sour canes (*Costus* spp.) not only stabilizes diabetes, but also relieves the body from excess heat that leads to headaches, polydipsia and polyurea. Furthermore, the remainder of the top five species cited against diabetes were noted for their bitter taste (*i.e.*, **gongo** [*Geissospermum* spp.], quassia [*Quassia amara*], crabwoods [*Carapa* spp.], and **kinuwup** [*Chimarrhis turbinata*]), and how they were used for other problems that the Parikwene associate with heat, such as polyuria, fever and malaria.

Remedy administration

Remedies were used internally as macerations, infusions or decoctions, and externally as washes, tinctorial rubs, steam baths, cataplasms and creams. Remedies were either made up of a single species or of a mix containing up to six species as LS6003 from Macouria specifies. Though remedies could be prepared from fresh plant parts, barks were often dried and kept for later use. Some methods of preparation also acted as preservation methods whereby creams and tinctorial extractions could also be stored. Unless deemed inefficient, plant remedies targeting diabetes were rarely treated as single use cures for this illness and seldom used only once. Instead, these were

consumed for short or long periods of time, going from a week to a month, to daily use. In such cases where remedies are used for long periods of time, posology is akin to biomedical remedies against diabetes: these are taken two to three times a day (*i.e.*, morning, noon and evening) or simply like water when one is thirsty. Remedies prepared for these uses are water-based, resulting from macerations, infusions or decoctions, and are generally stored frozen or refrigerated for later use.

3.4.7 Spiritual interventions

When recounting the history of diabetes in relation to shamanism, Parikwene participants added that shamans were no longer part of the Parikwene medicinal system, having now been replaced by doctors or church pastors. When taking into account the remainder of Parikwene participants, what remains clear is that if Parikwene shamans still exist, they are marginalized and live excised from the community. People who visit them do so discreetly. Though the preparation and use of Parikwene medicines appear widespread, people are modest regarding their knowledge so as to not give off the wrong impression.

Not surprisingly, none of the diabetics interviewed reported to have consulted a shaman for their diabetes. However, one elderly participant who had begun the initiation rites to become one in his youth had resorted to some of these practices for his diabetes. More precisely, a number of plants were used (*i.e.*, **avukyu** [*Bonafousia angulata*; Apocynaceae], **tauni** [*Brosimum acutifolium* subsp. *acutifolium*; Moraceae], **wadidga** [*Capirona decorticans*; Rubiaceae], **irimwi** [*Couratari multiflora*; Lecythidaceae], tobacco [*Nicotiana tabacum*; Solanaceae]; **Table 3.7**), not to target diabetes and glucose control *per se*, but to harness the strength of the spiritual relationship he had long stopped cultivating with *Brosimum acutifolium* subsp. *acutifolium* and *Capirona*

decorticans specifically. These involved smoking ceremonies and prayers, as well as the respect of strict preparatory guidelines and dietary restrictions.

To a certain extent, some participants did evoke the power of prayers in their remedies (27.1 %; 13/48), whether they be for diabetes and its symptoms or for any other problem. These may have a Christian undertone due to the presence of, and the participation in, Evangelical churches in the communities, although we were reminded by some participants that prayers, chants and incantations were also traditional Parikwene practices. LS5017 from Saint-Georges explains: “Pour *kume* et *wagewni* (types of abscesses), *il y a sa prière. Après avoir fait la prière, on met les remèdes et ça décale. C’est des prières Parikwene, c’est les Anciens qui connaissaient ça. Les jeunes ne connaissent plus ça.*”

Despite this intergenerational gap in practices, knowledge of medicinal plants was primarily transmitted between individuals within the Parikwene community. Knowledge from neighboring populations (*i.e.*, Indigenous, Creole, Brazilian) was also transmitted and integrated into new practices. Finally, three participants revealed an oneiric origin to some medicines used to treat diabetes, like carambola (*Averrhoa carambola*; Oxalidaceae); two participants had dreamt their remedy themselves whereas another had been dreamt by a Brazilian who then shared his knowledge. LS6015 explains how this was revealed in a dream:

“Mais je vois pas le monsieur ! Il me parlait comme ça, il me dit : 'Regarde les plantes.' J'ai dit : 'Ah, je connais ça.' Il m'a dit : 'Bien prends ça ! Lave... Lave-toi avec ça et prends les racines. Bois tous les jours. Six mois, il m'a dit, tu vas voir. Toutes les... Toutes les maladies que tu as, ça va passer.' Bien, c'est vrai, hein. Je croyais et puis... je sais pas... On est tellement traumatisé par maladie, je sais pas qu'on avait des... des effets sur ses songes. Comment dire ?”

3.5 Discussion

3.5.1 Knowledge

The history of diabetes amongst the Palikur provides a nearly impeccable reflection of the shifting worldview that marks their history. The historic representation of diabetes as the result of spells subscribes to documented Parikwene conceptions of illnesses that result from supernatural forces (Fernandes 1950; Arnaud 1970; Grenand et al. [1987] 2004), whereas its current links to dietary changes and blood glucose have taken a biomedical undertone. Furthermore, the notion of hot and cold that underlines the description of the disease and the effect of some of its remedies is similar to that apparent in the local Creole medicinal system (Grenand et al. [1987] 2004; Tareau et al. 2017). These notions have notably been traced back to neo-Hippocratic trends popular in European medical spheres in the 16th and 17th opposing hot and cold in an alteration of Hippocrates' theory of the four humours (Grenand et al. [1987] 2004). Though Descola (2005) denotes an authentic Mesoamerican origin to hot-cold polarities and discredits a European inheritance as coincidence in Indigenous practices, he concedes that such forms of inclusive classification are typical traits of analogic ontologies. Whether or not this dichotomy regarding diabetes is indigenous to the Parikwene is up for debate, but it represents their medicinal system in a light different to one historically described (Fernandes 1950; Arnaud 1970), and ascribed to animistic or perspectivistic ontologies (de Castro 1998; Grenand et al. [1987] 2004; Descola 2005b). What is evident, however, is that the integration of diabetes into Palikur ethnomedicine appears to be one born out of incompatibility with exclusive animism but requiring the coexistence of different ontological schemes.

In illustrating the role of **ihamwi** in manipulating the supernatural forces that lead to disease, Grenand et al. ([1987] 2004) recollect the 1961 murder of a shaman, a story that bears a striking resemblance to the attributed catalyst of the discovery, or the acknowledgment, of diabetes reported here. Dreyfus (1981) recollects a similar event from the late 50s whereby a number of Parikwene families took refuge in French Guiana to avoid persecution from Brazilian police and vengeful allies of the assassinated shaman. Although participants estimate at least a decade or two before “diabetes” becomes a household name, this was done through the gradual acknowledgement that **imasiunti** was not the result of malice through the manipulation of supernatural forces, but one related to diet. Indeed, by the end of the 1960s, shamans were still present on both sides of the Oyapock River along with the appearance of Evangelical Parikwene pastors in Brazil (Arnaud 1970).

The description of a dietary origin to diabetes amongst Parikwene populations is reflective of a dietary shift already recorded in literature. Such changes as the inclusion of sugarcane (*Saccharum officinarum*; Poaceae) and an increase in the consumption of cassava flour were reported in the late 1970s, whereby hunting and fishing decreased at the expense of the agriculture of manioc with which they supplied the city of Oiapoque (Vieira-Filho 1978). Ouhoud-Renoux (2000a) links the increased reliance on manioc production for economic reasons to an increased reliance of its consumption at the expense of historically more diverse plant cultivation, exploitation and consumption. However, Vincent (2013) reports rice and pasta, along with **kwak**, amongst the top three staple foods in Saint-Georges, attributing this competitiveness to a decreased production of **kwak**, its increased market value and a noted appropriation of biomedical discourse linking it to diabetes.

However, we found that cassava roots remain a relevant staple food item to the Parikwene (Ouhoud-Renoux 2000b, 2000a), as evidenced by the important discussion around diabetes and current adaptations adopted for its production (**Table 3.4, Table 3.6, Figure 3.4**). Though **kwak** production is visibly still present in Saint-Georges, it occurs at a considerably smaller scale in Macouria where agricultural space and production compete with urban development and cattle farms. Nonetheless, both acidic and sweet **kwak** were purchased and supplied directly to Parikwene villages in Macouria through a distribution network beginning in Saint-Georges. Although the number of people growing cassava for **kwak** production may be diminishing overall (Koné 2012; Vincent 2013), we are seeing an apparent specification of roles in Parikwene society through the formation of classes of semi-professional cassava farmers in a similar fashion to what has been observed amongst Parikwene hunters and their hunting activities (Ouhoud-Renoux 2000b), or those concerning basketry (Davy 2007). Despite numerous factors, such as access to cultivable land (Koné 2012), local farmers' associations like Wacapou may facilitate the professionalization of agricultural activities by helping to provide the means and resources to tend large cassava fields and mechanise their production with new tools.

The origin behind the Parikwene classification of diabetes is ambiguous. Whereas some participants contend that these notions are Parikwene in origin, others trace its various nomenclature to healthcare professionals. Though this could not be verified in this study, it is possible to hypothesize that this heterogeneous classification results from the consolidation of biomedical explanations provided by healthcare professionals and notions proper to the Parikwene. As a result, old diabetes, young diabetes, black diabetes and white diabetes may be a tacit appropriation of the biomedical classification (type 1 vs. type 2) and explanation for the disease's evolution through time (pre-diabetes vs. diabetes). Indeed, insulin resistance is known to cause

acanthosis nigricans (Hermanns-Lê et al. 2004), the darkening of the skin ascribed by participants to **diabet priye**. Such an observation, supported by biomedical explanations, is not incompatible to Parikwene classificatory systems, accustomed to distinguish similar plants and animal species based on the colour of their bark, skin or fur (Grenand et al. [1987] 2004, 2015; Cristinoi and Cance 2018). Furthermore, the first reported cases of diabetes amongst the Parikwene were published in 1978 after the author had been informed by community members of deaths following emaciation, polydipsia, and polyuria (Vieira-Filho 1978). As some of the first symptoms historically associated with diabetes, it is not surprising that these remain some of the most cited complications of the disease and have become defining characteristics of its different kinds.

As distant as the Parikwene classificatory system of diabetes appears to be from the biomedical one, recent research suggests that a revised classification of diabetes may lead to more efficient and targeted treatments (Ahlqvist et al. 2018). Based on 6 biological markers measured at diagnosis from 14,755 diabetics, Ahlqvist et al. (2018) proposed redefining T1D and T2D into five novel subgroups characterized by the time of onset (early vs. late), body-mass index (low vs. high), metabolic control (poor vs. moderate) and insulin production (deficient vs. resistant).

3.5.2 Attitudes

The Parikwene Peoples have shown demonstrable resilience to the appearance of diabetes amidst a rapidly changing way of life. This is demonstrated in the attitudes towards the illness which are strongly linked to change and foreign contact. This transpires through language, in integrating the foreign name of the disease into Parikwaki and distinguishing the origin of medicines (*i.e.*, foreign [**nautunie**] and Parikwene). The same observation can be made with the Desana of the Upper Rio Negro in Brazil who associated multiple infectious diseases, such as

smallpox, measles and influenza, to contact with European populations and have given them names etymologically derived from Portuguese (Buchillet 1995). Despite its intrinsic and almost personified nature, lying in wait in an individual's blood and luring them with the temptation of sugar, the Parikwene very much view diabetes as an introduced disease through dietary and lifestyle changes that have increased by way of contact with non-Indigenous populations.

When a new disease is introduced, the knowledge system to which it is linked comes into contact with the local knowledge system. This can lead to mutual exclusion and cause the displacement of one system of knowledge and practices at the expense of the other (Ngokwey 1995; Saethre 2007; Giovannini et al. 2011). However, it can also lead to medical pluralism whereby both systems can coexist and even mix (Hausmann Muela et al. 2002; Calvet-Mir et al. 2008; Byg et al. 2010; Giovannini et al. 2011; Odonne et al. 2011). Just as with the Tsimane' of the Bolivian Amazon (Calvet-Mir et al. 2008), Parikwene medicinal practices appear to coexist with biomedical practices as two discrete and separate entities, which is in line with observations made regarding the treatment of malaria (Mosnier et al. 2020; Odonne et al. 2021a). However, the contemporary Parikwene concepts of diabetes appear to result from a process of syncretism with biomedical notions in a similar fashion to that observed with the integration of concepts on malaria in a Tanzanian community (Hausmann Muela et al. 2002). In other words, it appears evident that biomedical messages regarding diabetes are well understood, but their meanings are interpreted through Parikwene concepts. We see here the creation of an authentic Parikwene theory on the nature of diabetes.

The hot and sweet attributes given to diabetes are important factors driving current attitudes towards the illness as these inadvertently bridge together biomedical and Parikwene concepts. Sweetness connects sugar, the main measure and target of diabetes treatments, to a large repertoire

of Parikwene medicines characterized by their organoleptic properties (*e.g.*, acid, bitter). The symptoms connect the pathological explanations of diabetes to Parikwene concepts of physical properties (*i.e.*, heat, refreshing); hot symptoms being treated by numerous acidic and bitter plants. This translates into a large number of diabetics using both biomedical and Parikwene approaches in a systematic way that incorporates the acute awareness of signs related to hyperglycemia and biomedical tools. Hence, biomedical remedies remain at arm's length, whereas sensible observation of glycemic control is used to assess the effect of homegrown dietary and therapeutic approaches with the ultimate goal of optimising autonomy and reducing the reliance on pharmacotherapy.

Despite this, proper glycemic control is challenging for all diabetics, plain and simple. The ontological framework that allows for the convergence of biomedical concepts with Parikwene concepts may begin with analogic concepts that overlap, but it also may end in a very different place, as illustrated by the attempt of LS5017 to employ the spiritual powers of **tauni** (*Brosimum acutifolium* subsp. *acutifolium*) and **wadidga** (*Capirona decorticans*) to treat his diabetes. In humanising plants through the possession of a spirit and maintaining a relation of communication, this exhibits the typical markings of animism according to Descola (2005) and Amazonian perspectivism described by de Castro (1998). Just as Descola (2005) concedes that his ontologies are not mutually exclusive, our assessment of Parikwene medicine highlights how one does not exclude the other. If therapeutic options fail to perform, biomedical or Parikwene, one may resort to the ways of the Elders.

3.5.3 Practices

The majority of edible plants cited by participants have previously been cited as components of the Parikwene diet (Grenand 1980; Grenand et al. [1987] 2004; Hoff and Cremers 2005; de Granville and Gayot 2014; Barabé and Gibernau 2015; Iaparrá et al. 2017; Green et al. 2019). As for species whose Parikwaki names could not be verified in the literature, most of these were derived from the French and Creole names of plants cultivated in French Guianese gardens and available at local markets (*i.e.*, **zamahd** [*amande-pays*; *Terminalia catappa*], **kohkohm pikah** [*concombre piquant*; *Cucumis anguria*, Cucurbitaceae], **karahbol** [*carambole*; *Averrhoa carambola*], **mahdarin** [*mandarine*; *Citrus reticulata*, Rutaceae], **zoliv** [Sapotaceae], **chatengn** [*chataigne*; *Artocarpus altilis* var. *seminiferous*, Moraceae], **kaymit** [*caïmite*; *Chrysophyllum cainito*, Sapotaceae], **siriz** [*cerise*; *Malpighia emarginata*, Malpighiaceae], **pomroza** [*pomme rosa*; *Syzygium samarangense*, Myrtaceae], **friapen** [*fruit à pain*; *Artocarpus altilis* var. *non-seminiferus*, Moraceae], **lozey** [*oseille-pays*; *Hibiscus sabdariffa*, Malvaceae], **prin-siter** [*prune de Cythère*; *Spondias dulcis*, Anacardiaceae], **korosol** [*corossol*; *Annona muricata*, Annonaceae]; Grenand et al. [1987] 2004; Hoff and Cremers 2005). This is not uncommon for the names of introduced species and foods to be incorporated in the Parikwaki language (*e.g.*, **situru** [*citron*; *Citrus aurantifolia*, Rutaceae], **kafe** [*café*; *Coffea arabica*], **mulohdo** [*melon d'eau*; *Citrullus lanatus*, Cucurbitaceae], **kohkohm** [*concombre*; *Cucumis sativus*], **daxin** [*dachine*; *Colocasia esculenta*, Araceae], **mahk** [*mangue*; *Mangifera indica*], **ilay** [*ail*; *Allium sativum*], **zohyoh** [*oignon*; *Allium cepa*]; Grenand et al. [1987] 2004; Hoff and Cremers 2005; Iaparrá et al. 2017; Green et al. 2019). Exceptions to this were the names of **castanha** for *Bertholletia excelsa* (Lecythidaceae) and **siriz karé** for *Eugenia uniflora* (Myrtaceae), the two of which are indeed Amazonian species, but likely introduced to French Guiana for cultivation (Muséum national

d'Histoire Naturelle 2021). **Wakukwa adudu** (*Chrysophyllum cuneifolium*; Sapotaceae) was the only indigenous plant that had not previously been cited as used by the Parikwene. These vernacular names testify to the close contact and exchanges between cultural groups like the French Guianese Creole, processes known to occur in French Guiana (Grenand et al. [1987] 2004; Tareau et al. 2019b, 2020).

Although Parikwene participants attributed the rising prevalence and incidence of diabetes in their communities mainly to introduced food items that are primarily market sourced, such as rice, wheat-derived foods, potatoes and red beans (**Table 3.4**), they did not refrain from observing the effects of indigenous or introduced food items on diabetes in general. Vincent (2013) notes a similar link between diabetes and purchased foods yet underscoring how traditional foods could not be the cause since no one used to be sick. Nonetheless, this did not prevent participants from noticing their effect on glycemic control, suggesting that participants provided greater importance to market foods in causing the development of diabetes as opposed to foods that can be harvested or successfully cultivated at home or in the community. This dichotomy is further strengthened by the fact that no negative effects on diabetes were reported for plant-based food items solely harvested in secondary and primary forest. Amidst these distinctions between cause and effect, however, restrictions given to the consumption of cultivated hot peppers (*Capsicum annum*) and certain animals, such as red scaled fish, are noteworthy. *Capsicum annum*, for example, also appear in dietary restrictions that the Chayahuita of the Peruvian Amazon award to the treatment of leishmaniasis (Odonne et al. 2013). These dietary restrictions, or distinctions of positive and negative foods on the management of diabetes, also resemble notions of food strength and the *reima* system, where foods are classified as dangerous or inoffensive, which are documented throughout various societies of the Brazilian Amazon (Maués and Maués 1978; Piperata 2008;

Dufour et al. 2016). Perhaps the practice of observing the effect of foods on diabetes may stem from authentically ancient practices and beliefs on dietary restrictions regarding illness, common to Peoples of the Amazon, that may see themselves legitimized by the biomedical system, which also provides dietary restrictions in the management of diabetes.

Regardless, some of the food items advised to avoid by diabetics are known to have medium to high glycemic indices (GI) (**Table 3.6**). Because the calculation of insulin doses largely depends on carbohydrate consumption (Wolpert et al. 2013; Howard and Watts 2017; Sievenpiper et al. 2018b), GI are helpful tools in making dietary choices as replacing high GI food items with foods of low GI has shown improvement of glycemic control (Sievenpiper et al. 2018b). Foods that are low in carbohydrates but high in proteins and fats, like animal products, are therefore considered to have a low GI (Biesalski 2005), and are not included in such tables, with the added benefits that dietary fats have been found to delay gastric emptying, thus leading to a delayed rise in blood glucose (Gentilcore et al. 2006; Lodefalk et al. 2008). However, plasma free fatty acids have also been found to increase insulin resistance in muscles and liver and to enhance hepatic glucose production amongst type 2 diabetics (Roden et al. 1996; Boden 2006; Savage et al. 2007). In T1D, meals with carbohydrates and a high fat content have been found to cause sustained late postprandial hyperglycemia (Bell et al. 2015), though Wolpert et al. (2013) found great individual variability in the effect of dietary fat on insulin requirements, which adds credence to the Parikwene perspective that people's reaction to food varies from one person to the next. Considering the challenges in preventing postprandial hyperglycemia, however, this highlights one of the short-comings of the carbohydrate-based approach to calculating mealtime bolus insulin doses (Wolpert et al. 2013; Bell et al. 2015), which has prompted a revision of these algorithms to consider the effects of dietary fat (Sievenpiper et al. 2018b).

Naturally, GIs for a food item are highly variable, depending on species variety, increasing with ripeness in fruits and cooking time with starchy foods (Atkinson et al. 2008). Furthermore, the GIs of renowned staple foods are highly variable due to a number of transformations, refining and cooking practices (Atkinson et al. 2008). This is particularly true of rice, wheat and red beans, whereas cassava, appearing as a boiled root, seemed relatively underrepresented in the International Tables of Glycemic Index and arguably overlooked despite being one of the five largest staple crops cultivated worldwide (Parmar et al. 2017). Although these tables focus on a number of commercially available and transformed food products, fruits and starchy foods available worldwide, caution is advised when interpreting GIs with few data points (Atkinson et al. 2008). Despite their shortcomings, GIs can be useful in guiding dietary choices; in the absence of data for a specific food item, information is extrapolated to assign low GIs to vegetables and high GIs to flour products (Atkinson et al. 2008). Although foods and food items specific to certain regions are included, knowledge of local foods is required (Atkinson et al. 2008). Hence, a great deal of work is needed to make these tables fully comprehensive, as evidenced by the number of species whose GI could not be verified in this study (**Table 3.6**). This is particularly true for the purpose of providing meaningful dietary recommendations that reflect peoples' actual diets.

The consequences of a narrow and constrained discussion on dietary choices are recognized by healthcare professionals who acknowledge the lack of relevant information and the difficulty around communicating about certain foods like **kwak**. The source of a variety of food products like **kwak** and tapioca, *Manihot esculenta* can arguably be considered a cultural keystone species with strong links to the land through cultural keystone places, namely the swidden-fallow fields (Garibaldi and Turner 2004; Cristancho and Vining 2004; Cuerrier et al. 2015b). Undeniably the principal source of dietary subsistence, *Manihot esculenta* is also an important economic driver

to some, and through the production of basketry both sold and used in cassava transformation, a cultural driver of material life for many more (Davy 2007). Hence, remarks regarding the implications of this food item in diabetes are delicate, striking directly at characteristics that define Parikwene identity and way of life. Unbeknown to participants connected to the healthcare sector, however, one of the most notable practices adopted by the Parikwene of Saint-Georges and Macouria in the management of diabetes is the consumption of acidic **kwak** for better glycemetic control. Indeed, when Boutefeu et al. (2002) documented the varietal diversity of *Manihot esculenta* and the operational sequence of cassava flour, it was that of sweet **kwak** which they recorded.

Changes in the organoleptic properties of acidic **kwak** are likely the result of biochemical changes that occur during the soaking and fermentation of *Manihot esculenta* tubers. Such changes are well documented for a variety of derived cassava products requiring soaking and fermentation where fungi (*i.e.*, *Candida* spp.) and bacteria (*i.e.*, *Bacillus* spp., *Lactobacillus* spp., *Klebsiella* spp., *Leuconostoc* spp., *Corynebacterium* spp.) have been found to break down starches and sugars into organic acids (Okafor et al. 1984; Moorthy and Mathew 1998). This not only results in the acidification of the tubers and the derived foodstuff, but also a decrease in sugar and starch content (Okafor et al. 1984; Dufour et al. 1995; Raimbault 1995; Moorthy and Mathew 1998; Bamidele et al. 2015), key components in lowering the GI of foods (Arasaratnam 2014).

However, soaking and fermentation are just two of a multitude of steps that are used in various combinations to produce a variety of products from cassava tubers (Raimbault 1995; Moorthy and Mathew 1998; Ferraro et al. 2016). One study found that various methods for transforming *Manihot esculenta*, including soaking and fermentation, did not affect the GI of four of its food derivatives (Ogbuji and David-Chukwu 2016). Furthermore, different *Manihot*

esculenta food products were generally found to possess high GI (Arasaratnam 2014; Ogbuji and David-Chukwu 2016). Moorthy and Mathew (1998:73) note that “*glaring inconsistencies [...] in some of the results reflect the differences and variations in the artisanal processes followed in the preparation of these products.*” This is not taking into account that the starch content of *Manihot esculenta*, genetically diverse worldwide (Empeaire et al. 2003), is highly variable from one variety to the next (Mweta et al. 2008). This is all the more true for acidic **kwak** where, to the best of our knowledge, there is a lack of data regarding its GI and whose preparation is conditional on personal preferences in taste and purpose, *i.e.*, personal consumption, variety (*i.e.*, at least 14 varieties have been identified [Boutefeu et al. 2002]), sale, extraction of tapioca. Whether or not acidic **kwak** and its various methods of preparation lead to lower GI should be the focus of further in-depth study. However, anecdotal evidence provided by participants through glucometer readings and the expression of symptoms of hyperglycemia (*i.e.*, dry mouth, weakness, polyuria and diarrhea) lend support to this hypothesis.

In the Parikwene context, these observations place acidity against sweetness. Because most Parikwene participants associated the development of diabetes with an increased consumption of sugar in foods and beverages, such observations strengthen the position of sweetness against acidic and bitter flavours as a central tenet of Parikwene knowledge, attitudes and medicinal practices regarding diabetes. Sour canes (*Costus* spp.), which have already been reported against diabetes by the Parikwene (Grenand et al. [1987] 2004), were some of the most cited species and noted as a refresher due to its acidity. This duality appears to extend to bitter plants. Although a number of plant species have historically been cited by the Parikwene against diabetes (*i.e.*, açai [*Euterpe oleracea*], quassia [*Quassia amara*], **gongo** [*Geissospermum* spp.], caskfruit lianas [*Dolioscarpus* spp.; Dilleniaceae], **tuu kamwi** [*Picrolemma sprucei*; Simaroubaceae], **kwevan** [*Simaba*

orinocensis; Simaroubaceae], coffee senna [*Senna occidentalis*; Fabaceae], guanandi [*Calophyllum brasiliense*; Calophyllaceae], dragonsblood tree [*Pterocarpus officinalis*; Fabaceae], cat's-whiskers [*Orthosiphon aristatus*; Lamiaceae], yellow poui [*Tabebuia serratifolia*; Bignoniaceae] and *Aloe vera* [Asphodelaceae]; Grenand et al. [1987] 2004), the most commonly cited species were noted for their bitterness (e.g., **gongo** [*Geissospermum* spp.] and quassia [*Quassia amara*]).

Not only do acidity and bitterness become the explanation of effective plant remedies used against diabetes, but also a criterion for developing new remedies through use shifting in the pharmacopoeia (Kvist et al. 2006; Odonne et al. 2011). For example, a number of species, such as quassia [*Quassia amara*], **gongo** [*Geissospermum* spp.] and birthworts (*Aristolochia* spp.; Aristolochiaceae), are used by the Parikwene against malaria and dengue, both characterized by fever, and are characterized by their bitterness (Grenand et al. [1987] 2004). As for crabwoods (*Carapa* spp.), the fact that its Parikwene name, **tivigu**, is derived from the word “bitter”, **tiviye** (Grenand et al. [1987] 2004), may simply be enough to try it against diabetes.

It is possible, however, that the popularity of quassia [*Quassia amara*] may have been influenced by a highly mediated biopiracy controversy regarding the patenting of one of its bioactive compounds taking place at the time of the interviews (Bourdy et al. 2017; Thomas 2018; Collomb 2018; Burelli 2019; Odonne et al. 2021b). Such media attention may positively reinforce the perceived medicinal value of quassia (*Quassia amara*) in a similar way that biomedical concepts have been found to reinforce the traditional cardiovascular uses of garlic (*Allium sativum*) in Campania, Italy (Leonti et al. 2010). Furthermore, the fact that Creole populations also use quassia (*Quassia amara*) against diabetes may also add more credence to Parikwene practices (Grenand et al. [1987] 2004), as knowledge sharing between cultures has recently been well

documented. In a study on the circulation and exchanges of plants and phyto-medicinal knowledge on the Franco-Brazilian border, Tareau et al. (2019a) found that exchanges were primarily intra-generational and intra-community as participants here also reported. Nonetheless, a clear inter-community pattern of exchanges existed that involved Parikwene, Karipuna, Brazilian, Saint-Lucian Creole and French Guianese Creole populations. In their own right, these groups also exchanged with Surinamese Creole and Maroon populations, thus creating a network of exchanges linking both border countries of French Guiana, namely Surinam and Brazil (Tareau et al. 2019a, 2020). This appears to be the case for a number of species that have not previously been cited in the literature for treating diabetes by the Parikwene, such as bitter melon (*Momordica charantia*; Cucurbitaceae) and star apple (*Chrysophyllum cainito*), both of which have previously been cited by Creole peoples against diabetes (Grenand et al. [1987] 2004), and corroborated as such by the participants here.

The selection of medicinal plants based on bitterness is not unique to the Parikwene as it appears relatively common throughout Amazonian societies and the Americas at large (Leonti et al. 2002; Shepard 2004; Odonne et al. 2007; van Andel et al. 2012; Charpentier et al. 2016). The Matsigenka, for example, not only considered bitterness as a sensory quality unpleasant to illness, but sourness as well (Shepard 2004). Although there is an evident cultural component to the meaning given to these tastes, taste perception is fundamentally biological. Bitterness is mediated in mammals by several G-protein-coupled taste 2 receptors such as those coded by the TAS2Rs gene family present in humans, chimpanzees and bonobos as well (Parry et al. 2004; Hayakawa et al. 2012; Charpentier et al. 2016). The evolution of this sense of taste is widely thought to be crucial in assessing foods' toxicity as the ability to recognize a wide range of bitter tastes provided better discrimination of edible foods from others containing toxic compounds (Johns 1990; Parry

et al. 2004; Hayakawa et al. 2012; Valente et al. 2018). Indeed, bitterness in plants is caused by several classes of biologically active phytochemicals like flavonoids and alkaloids (Roland et al. 2013; Charpentier et al. 2016). These are known variably for their toxic and medicinal properties, such as the alkaloid galegine, a guanidine derivative from the common goat's-rue (*Galega officinalis* L.; Fabaceae) most notably associated with the discovery of the safer antidiabetic drug metformin (Bailey and Day 2004).

Though the organoleptic characteristics and classifications of plants remain arguably the result of sociocultural and personal interpretations (Simmen and Hladik 1998; Shepard 2004), the sensation of taste can more appropriately be described as a complex biocultural process (Shepard 2004). The behaviour of seeking out and ingesting extraordinarily bitter plants when ill is not one unique to humans, but a cross-species behaviour also observed in chimpanzees in various pathological states (Krief et al. 2005). Hence, the ability to detect a wide and fine-tuned spectrum of bitter taste may also offer the evolutionary advantage of detecting plants rich in bioactive compounds that confer medicinal or health benefits (Johns 1990; Krief et al. 2005; Charpentier et al. 2016).

Indeed, of some of the notably bitter plant species cited against diabetes by the Parikwene a number have demonstrated an antidiabetic potential. A terpene, 7-deacetoxy-7-oxygedunin, isolated from the seeds of crabwood (*Carapa guianensis* Aubl.), was found to suppress adipogenesis and reduce the accumulation of intracellular triglycerides in adipocytes *in vitro* (Matsumoto et al. 2019a). *In vivo*, the same compound was found to lower body weight, improve blood serum triglyceride level and increase insulin sensitivity in rats fed a high-fat diet (Matsumoto et al. 2019b), whereas topical application of the seed oil was found to increase wound healing on diabetic rats (Alves de Souza et al. 2017). Quassia (*Quassia amara*), notably known for its anti-

malarial activity (Ajaiyeoba et al. 1999; Bertani et al. 2006; Cachet et al. 2009), has also shown antidiabetic activity. Most notably, the wood of quassia (*Quassia amara*) was found to elevate fasting blood glucose levels, increase glucose tolerance and normalize dyslipidemia *in vivo* in nicotinamide-streptozotocin-induced diabetic rats (Husain et al. 2011). This antidiabetic activity is corroborated by another study finding hyperglycemic effects similar to metformin *in vivo* in alloxan-induced diabetic rats (Ferreira et al. 2013).

Although bitter melon (*Momordica charantia*) was not a high-ranking species, it is a medicinal plant commonly used by different populations in French Guiana. Growing spontaneously in urban areas, it is the subject of urban picking and harvesting amongst Haitian populations (Tareau et al. 2019a). Furthermore, it has been at the center of a number of pharmacological studies *in vitro* and *in vivo*, thus elucidating its mechanism of action against T2D (Peter et al. 2019; Liu et al. 2021). A systematic review and meta-analysis found 10 clinical trials evaluating the antidiabetic effect of monoherbal formulations of *Momordica charantia*. Though it was found to lower fasting plasma glucose, postprandial plasma glucose and glycated hemoglobin A1c, the authors poorly graded the quality of the evidence due to inadequate sample size and an unclear risk of bias (Peter et al. 2019). Needless to say, one should be reminded by a report from the CHC of possible hypoglycemic comas (Hulin et al. 1988).

Evidently, we describe here an ethnomedicinal framework for the selection of biologically active plants based on bitterness. As compelling as it is to attempt to explain how the development of each new antidiabetic preparation comes to be, it is, in reality, not possible for each case. The emergence of *de novo* uses may simply be invented (Odonne et al. 2011; Tareau et al. 2019b), or even have oneiric origins. This is exemplified here by the use of carambola (*Averrhoa carambola*),

which has incidentally demonstrated *in vitro* and *in vivo* hypoglycemic and antidiabetic effects (Lakmal et al. 2021).

3.6 Conclusion

In the first published reports of diabetes among Parikwene, Vieira-Filho (1978) warned against acculturation and dietary changes on the health status of Brazil's Indigenous people and advocates for greater consumption of traditional foods issued from hunting and fishing, as well as increasing physical activity. Indeed, the lasting impact of diabetes can be compared to that of the introduction of infectious diseases like smallpox, measles and influenza. Certainly not in the number of lives taken, but in the mark it has left and continues to leave on Parikwene history, knowledge system and way of life. Just as these infectious disease have been integrated into Desana myths (Buchillet 1995), diabetes has woven itself into contemporary Parikwene oral history as a key component in explaining the displacement of shamanism and their migration to their current communities. Attitudes around diabetes show us that biomedical knowledge of the disease has not only been integrated into the Parikwene knowledge system, but has merged with authentically Parikwene concepts. This translates into an array of home-grown practices using biomedical tools like glucometers to guide dietary choices and phytotherapies. This points to a strong desire to autonomously manage diabetes. Although at-home visits from nurses are important in this process of self-management of diabetes, the lack of information regarding the nutritive qualities and antidiabetic potential of a number of plants and animals available to Parikwene means that diabetics and their healthcare professionals have to rely strongly on these self-assessment measures. In the absence of proper information, patient education programs, like the one offered

to human immunodeficiency virus (HIV) patients in Saint-Georges (Cebe et al. 2018; Mosnier et al. 2019), may be developed to harness the peoples' will to self-management.

Messages related to diet and the implications of sugar, and fat to a lesser extent, appear to be well understood. However, messages around physical exercise and energy expenditure do not appear to be reinforced as much. This may explain why Parikwene participants did not mention the role of obesity, which is increasingly prevalent in French Guiana (Njuieyon et al. 2018; Sabbah et al. 2021) and a biomedically recognized risk factor in the development of T2D (Chatterjee et al. 2017; Carbone et al. 2019). Linking energy expenditure to culturally relevant activities like fallow-field cultivation, hunting, fishing, as well as the harvesting of natural resources for material and economic purposes (*i.e.*, traditional roundwood construction; Ogeron et al. 2018) may be helpful in making such recommendations accessible. This has the added benefit of acknowledging the value of local customs and practices, while increasing access to a diversity of wild-harvested foods which play into the hand of food security.

In the meantime, research to further understand the implication of cassava root transformation on glycemic control is pertinent. The ethnomedicinal hypothesis that acidic **kwak** has a better impact on glycemic control can be tested by determining their GI following different transformation methods with high-throughput DNA sequencing to assess the microbiome diversity at each fermentation step. Furthermore, an in-depth look into the use of Parikwene *materia medica* in relation to a range of health issues that go hand-in-hand with diabetes, like high blood pressure and cardio-vascular diseases, may provide additional information about their possible properties. For example, the use of the syndromic importance value (SIV), developed by Leduc et al. (2006), which focuses on symptoms and complications, may very well help to distinguish several potentially antidiabetic plant species that have not been prominently identified in this study.

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Chapitre 4 - Defining Indigenous medicine in three First Nations (Mashteuiatsh, Mistissini and Chisasibi) in the Canadian province of Québec: recognising the barrier of representation between healthcare staff and healthcare users

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4.1 Résumé / Abstract

Les Peuples autochtones au Canada sont plus à risque de développer des problèmes de santé chroniques que la population non-autochtone. Des approches culturellement sensibles pour traiter le diabète dans ces communautés sont nécessaires, mais celles-ci restent largement inaccessibles dans de nombreuses communautés autochtones en raison de multiples obstacles. Le but de cette étude était de synthétiser comment le personnel soignant et les usagers des systèmes de santé dans trois communautés autochtones du Québec (Mashteuiatsh, Mistissini et Chisasibi) définissent et décrivent la médecine autochtone locale. Nous avons émis l'hypothèse que les différences dans la représentation de la médecine autochtone locale entre le personnel de santé et les utilisateurs constituent un obstacle majeur à l'accès de la médecine autochtone dans le système de santé, et nous soutenons qu'un tel accès est bénéfique pour améliorer le traitement et la gestion des maladies chroniques, comme le diabète. Nous avons utilisé une approche à méthodes mixtes pour analyser les données. Nous avons d'abord utilisé une approche de synthèse du cadre « le mieux adapté » pour identifier et structurer les thèmes clés utilisés pour décrire la médecine autochtone par les participants. Nous avons ensuite utilisé l'analyse de redondance (RDA) pour analyser et comparer la représentation de la médecine autochtone entre les communautés et les groupes démographiques. Pour les trois communautés, nos résultats indiquent un système de santé holistique local basé sur l'accès et le lien au territoire. Bien que l'utilisation des plantes et des animaux à des fins curatives joue un rôle important dans ces systèmes, ils sont mieux compris comme des éléments du territoire qui peuvent tous être utilisés pour atteindre une santé et un bien-être équilibrés grâce à l'expression des coutumes et des modes de vie locaux. Les approches de guérison basées sur le territoire sont intrinsèquement convenables et avantageuses aux maladies liées au mode de vie comme le diabète en favorisant l'augmentation de l'exercice physique et l'accès à des aliments riches en nutriments. Bien qu'il existe des différences dans la façon dont ces médicaments sont définis par les participants des différentes communautés, les approches de santé communautaire concernant la formation du personnel sur les coutumes locales ou le développement de réseaux avec les services et programmes communautaires peuvent aider à construire des relations de confiance et de compréhension entre les prestataires de soins et les utilisateurs des services de santé.

Mots-clés : médecines Autochtones ; Nation Innu ; Nation Crie ; biomédecine ; diabète.

Indigenous Peoples in Canada are at greater risk of developing chronic health problems compared to their non-Indigenous counterparts. Culturally sensible approaches to treating diabetes in these communities are required, but these remain largely inaccessible in many Indigenous communities due to multiple barriers. The aim of this study was to synthesize how the healthcare staff and healthcare users in three Indigenous communities in Québec (Mashteuiatsh, Mistissini and Chisasibi) define and describe local Indigenous medicine. We hypothesized that there are differences in the representation of local Indigenous medicine between the healthcare staff and users. We argue that such differences act as a major barrier to the access to Indigenous medicine in the healthcare system, and that such access is beneficial to improve the treatment and management of chronic diseases, such as diabetes. We used a mixed-methods approach to analyse the data. We first used a “best-fit” framework synthesis approach to identify and structure the key themes used by participants to describe Indigenous medicine. We then used redundancy analysis (RDA) to analyse and compare the representation of Indigenous medicine between communities and group demographics. For all three communities, our results indicate a local holistic health system based on access and connection to the land and its resources. Although the use of plants and animals for curative purposes plays an important role in these systems, they are best understood as elements of the land, all of which can be used to achieve balanced health and well-being through the expression of local customs and ways of life. Land-based healing approaches are inherently suitable and advantageous for lifestyle diseases like diabetes, in promoting increased physical exercise as well as access to nutrient-dense foods. Though differences exist in the way these medicines are defined by participants from the different communities and whether or not they work in the biomedical healthcare sector, community health approaches in training staff about local customs or developing networks with community services and programs may help in bridging gaps and building trusting relationships and understanding between healthcare providers and users.

Key words: Indigenous medicine; Innu Nation; Cree Nation; biomedicine; diabetes.

4.2 Introduction

In Canada, the prevalence of chronic diseases, such as type 2 diabetes (T2D) and obesity are on the rise (Rosella et al. 2015; Statistique Canada 2020). Although recent evidence suggests that the global incidence of diabetes is slowing down (Sinclair et al. 2020; Fuentes et al. 2020), there are, nonetheless, large health inequities between Indigenous Peoples and the general population (Young et al. 2000; WHO and IDF 2004; Yu and Zinman 2007; Oster et al. 2014; Herman 2017; Crowshoe et al. 2018b; Creatore et al. 2020). In Canada, the age-adjusted prevalence of diabetes is two to three times higher in Indigenous populations (Public Health Agency of Canada 2018; Crowshoe et al. 2018b). Varying from 12.7 % to 19.0 % between the off-reserve and on-reserve population, it can affect up to one out of three people, when adjusted for age, in certain First Nations like the Cree of Eeyou Istchee (Kuzmina et al. 2010; Public Health Agency of Canada 2018; Crowshoe et al. 2018b).

Historical factors associated with colonization have been linked to social determinants that contribute to a disproportionately higher burden of chronic health problems like T2D among First Nations (Roy 1999; Adelson 2005; King et al. 2009; Jacklin et al. 2017; Voaklander et al. 2020). The Truth and Reconciliation Commission of Canada (2015b) exposes in depth the impact of colonization, detailing among other things the effect of the residential school system on these determinants of health and inequities. Overall, assimilation policies, forced relocation and land loss have resulted in rapid lifestyle changes. These are characterized by sedentarization, and dietary changes through the introduction of nutrient-poor, energy-dense market foods (Roy 2003; Compher 2006; Casey et al. 2006; King et al. 2009; Downs et al. 2009; Metallinos-Katsaras et al. 2012; Roy et al. 2013; Voaklander et al. 2020) and decreased food security, which have been linked

to higher risks of developing chronic health problems like T2D (Clement et al. 2018; Tait et al. 2018).

In its clinical practice guidelines, the Canadian Diabetes Association lists multiple recommendations for the management of diabetes in Indigenous communities (Harris et al. 2013a; Crowshoe et al. 2018b). Namely, it recommends that with the support of healthcare systems and other pertinent organisations, Indigenous communities establish primary prevention programs that these take into account cultural dimensions and context, which include approaches, foods, knowledge, medicines, needs, perspectives, practices, traditions and values (Harris et al. 2013a; Crowshoe et al. 2018b). In keeping with, Indigenous communities have developed locally adapted programs and strategies to tackle these health problems, and in some cases, have partnered with research and academia in the process (Paradis et al. 2005; Tremblay et al. 2018). Previous research, for example, has highlighted the relevance and benefits of combining local medicinal practices with biomedical treatments (Cuerrier et al. 2012; Haddad et al. 2012). Multiple Indigenous communities have gone as far as building healthcare centres that offer both biomedical and local medicinal facilities and services, such as the All Nations' Healing Hospital in Saskatchewan (Sanzone et al. 2019; Drost 2019), or the Noojmowin Teg Health Centre on Manitoulin Island (Maar 2004), and the Meno Ya Win Health Centre in Sioux Lookout (Sanderson 2016), two of ten Aboriginal Health Access Centres in Ontario, along with targeted programs for the treatment and management of diabetes.

In keeping with Canada's political system that advocates the division of roles and responsibilities in governance (Jordan 2008; Dubois and Saunders 2013), Canadian provinces manage the structure and delivery of their healthcare systems (Palley 1987; Tiedemann 2008). Although Indigenous populations in Québec are entitled to, and funded by, federal and provincial

support, they too manage and administer the delivery of the healthcare system in their communities (Viger 2011; Pekuakamiulnuatsh Takuhikan 2015a; Morrow 2019). The current healthcare systems available to Cree and Innu First Nations in Québec inevitably increase access to the biomedical system. Though political provisions leave space for the integration of local medicinal systems and practices in First Nation healthcare services across Canada (Lemchuk-Favel and Jock 2004; Premières Nations de Mamuitun et de Nutashkuan et al. 2004; Affaires Autochtones et Développement du Nord Canada 2014), there still exists several barriers to their access ranging from structural and policy barriers to cultural, relational and personal ones (Ouellet et al. 2018).

Here, we report findings from our collaborative work with the First Nations of Mashteuiatsh, Mistissini and Chisasibi who work towards increasing access to their local medicinal practices through their healthcare services. The aim of this study was to synthesize how the healthcare staff and healthcare users in these three Indigenous communities from Québec define and describe local Indigenous medicine. We hypothesize that there are differences between the healthcare staff and users in the representation of local Indigenous medicine between. We argue that such access is beneficial to improve the treatment and management of chronic diseases, such as diabetes, and that these differences act as a major barrier to the access of Indigenous medicine in the healthcare system.

4.3 Materials and Methods

4.3.1 Study Sites

All three First Nation communities involved in this study are located in Québec, Canada (**Figure 4.1**). The Innu Nation of Mashteuiatsh (population 1,957) is located in the Saguenay–Lac-

Saint-Jean region (Statistics Canada 2017a). The Cree Nations of Mistissini (population 3,523) and Chisasibi (population 4,872) are located in Eeyou Istchee, a large territory situated in the Nord-du-Québec (Statistics Canada 2017b, 2017c). This territory is delimited by both the James Bay and Hudson Bay to the west and Nunavik to the north. To the south, it borders the Saguenay–Lac-Saint-Jean region, a region largely overlapping the Nitassinan, the ancestral and traditional territory of the Innu.

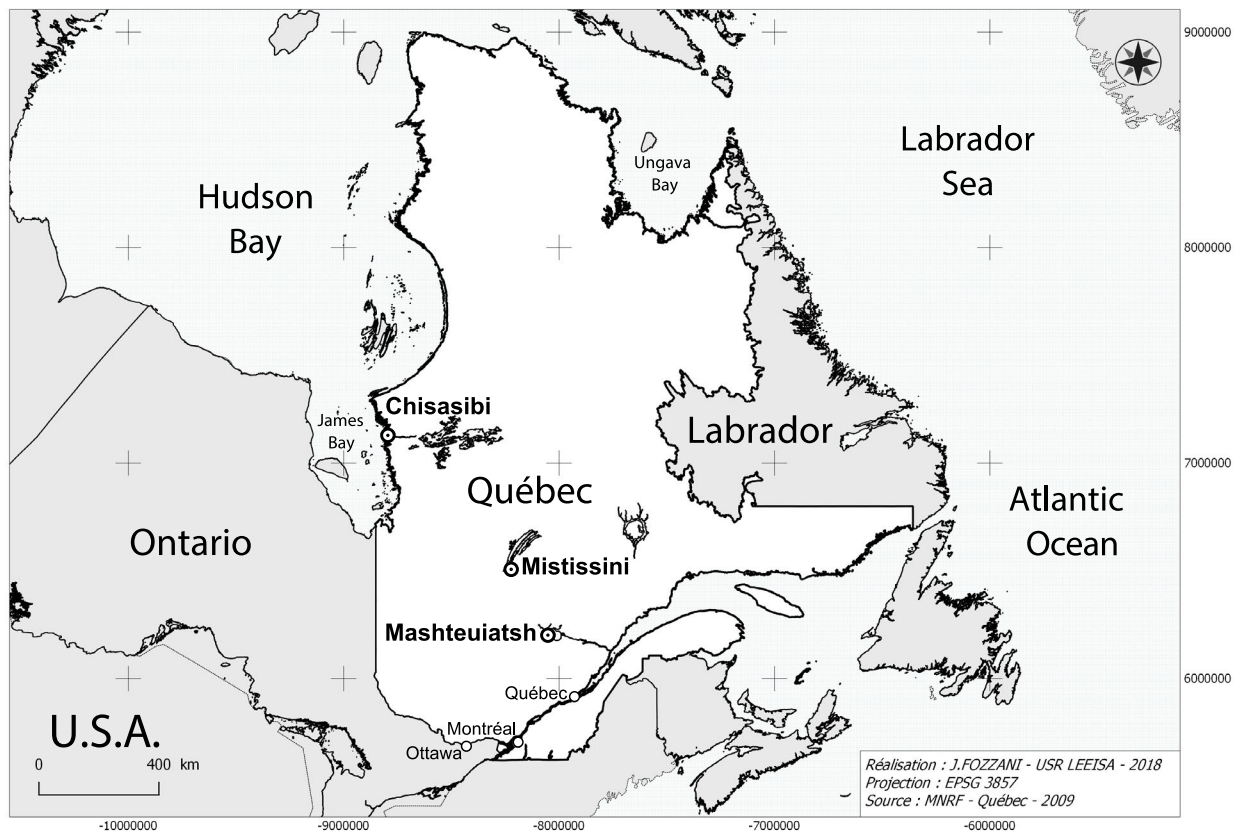


Figure 4.1. Map showing the location of Innu and Cree communities in Québec (Canada), namely Mashteuiatsh (48° 34' N, 72° 13' W), Mistissini (50° 38' N, 73° 48' W), and Chisasibi (53° 46' N, 78° 52' W). Cartography: Jérôme Fozzani – USR LEEISA. Projection in pseudo-Mercateur.

The Cree of Eeyou Istchee are made up of nine communities, namely four inland and five coastal communities speaking two different dialects of the East Cree language **Iiyiyuu Ayimuun** (Junker et al. 2018). The Cree Nation of Mistissini is the largest inland community, speaking the southern dialect, and acts as the seat of the Regional Public Health department for Cree Board of Health and Social Services of James Bay (CBHSSJB), whereas Chisasibi, speaking the northern dialect, is the largest coastal community and hosts the region's only hospital (CBHSSJB 2012b). Although the term “Cree” is frequently used in English, the terms **Iiyiyiu** and **Iinuu**, meaning “person” are more appropriately used in the northern and southern dialects, respectively. Eeyou Istchee, or “The People’s Land”, is therefore referred to as **Iiyiyiu Aschii** or **Iinuu Aschii** (**aschii** “land”) in the northern and southern dialects, respectively (Desbiens 2007; Grand Council of the Crees (Eeyou Istchee) 2020). Alongside **Iiyiyuu Ayimuun**, English and French are spoken by many in these communities.

Mashteuiatsh, on the other hand, is one of five members of the Mamuitun Tribal Council (Premières Nations de Mamuitun et de Nutashkuan et al. 2004; Conseil tribal Mamuitun 2018). Nonetheless, the local dialect of the Innu language (**Ilnu-Aimun**) spoken is called **Nehlueun**, “Our Language” (Laurendeau 2011), although many speak French as a mother tongue (Drapeau and Moar 1996). This merits the distinction that the term “Innu”, which refers to a number of First Nations in Québec, becomes “Innu” in Mashteuiatsh. In **Nehlueun**, members of the First Nation call themselves, more precisely, **Pekuakamiulnuatsh**, “People of the flat lake” (**pekuakami** “flat lake” – the name given to the Lac Saint-Jean; **ilnu** “person”; **-atsh** “plural”) (Kurtness 2014). All dialects and languages, **Iiyiyuu Ayimuun** and **Nehlueun**, are part of a linguistic continuum of the Algonquian language family (Junker and Stewart 2008). The predominance of English or French languages spoken in each community is linked to historical relations with early settlers, provincial

and federal governments and, until more recently, the administration and placement of Indigenous youth in residential schools.

The geographical location of participating communities lie in two ecozones; the Boreal Shield to the south (*i.e.*, Mashteuiatsh), characterized by a continental climate with long cold winters and short warm summers, and the Taiga Shield to the north (*i.e.*, Chisasibi), characterized by a subarctic climate with long cold winters and short cool summers (Wiken 1986; Marshall et al. 1999). Though forest composition, including white pine (*Pinus strobus* L.; Pinaceae), yellow birch (*Betula alleghaniensis* Britton; Betulaceae) and maples (*Acer* spp.; Sapindaceae), around the Lac St-Jean are representative of the Great Lakes-St. Lawrence Forest region, dominant tree species throughout most of the study area, namely paper birch (*Betula papyrifera* Marshall; Betulaceae), trembling aspen (*Populus tremuloides* Michx.; Salicaceae) and several Pinaceae like balsam fir (*Abies balsamea* [L.] Mill.), tamarack (*Larix laricina* [Du Roi] K. Koch), white spruce (*Picea glauca* [Moench] Voss), black spruce (*Picea mariana* [Mill.] Britton, Sterns & Poggenb.) and jack pine (*Pinus banksiana* Lamb.), are typical of the Boreal Forest region (Farrar 2005). Dotted by a patchwork of wetlands, such as bogs and fens, vegetation types vary from mixed forests of shade-tolerant conifers and hardwood trees to closed and opened-canopied forests of conifers with tundra patches (Strong et al. 1989). Characteristic mammals include the woodland caribou (*Rangifer tarandus* subsp. *caribou* [Linnaeus, 1758]; Cervidae), moose (*Alces americanus* (Clinton, 1822); Cervidae), black bear (*Ursus americanus* Pallas, 1780; Ursidae), snowshoe hare (*Lepus americanus* Erxleben, 1777; Leporidae) and beaver (*Castor canadensis* Kuhl, 1820; Castoridae). In-depth characterisations of flora and fauna are described in Strong et al. (1989) and Wiken (1986).

4.3.2 Community Consultations

Fieldwork took place from 2015-2016 (July and October 2015 [Mashteuiatsh]; June to July 2016 [Mistissini]; November 2016 [Chisasibi]). The breakdown of interviews is presented in **Table 4.1**. These were held in French and English, as well as in the local language spoken, **Nehlueun** (Mashteuiatsh) or **Iiyuu Ayimuun** (Mistissini and Chisasibi), with the help of an interpreter. Interviews lasted an average length (\pm SD) of 1h28 (\pm 0h24).

Table 4.1. Interview breakdown by communities and description of participant categories.

Community	# of interviews	# of participants	Mean age (\pm SD)
Mashteuiatsh	38	41	48.1 (\pm 17.4)
Mistissini	28	31	50.6 (\pm 15.5)
Chisasibi	32	35	55.8 (\pm 18.5)
<i>Total</i>	<i>98</i>	<i>107</i>	<i>51.5 (\pm 17.5)</i>

Category	Example
<i>Community members and healthcare users</i>	
Knowledge holders (KH)	Elders, healers.
Healthcare users (HU)	All other community members.
<i>Healthcare network staff</i>	
Healthcare administrators (HA)	Directors, administrators.
Healthcare professionals (HP)	Doctors, nurses, nutritionists.

4.3.3 Data Collection

Data collection is described at length in **Chapter 2**. Briefly, data were collected through semi-structured interviews and participant observation. Potential participants were selected based on their association with one of four group demographics (**Table 4.1**), and were primarily identified by snowball sampling, whereby participants are identified by community members. Names were initially provided through existing relationships between community members and many of the authors (Leduc et al. 2006; Forêt modèle du Lac-Saint-Jean 2015), and by consulting with supporting organisations (*i.e.*, Band Offices, CBHSSJB, Centre de santé et mieux-être collectif de Mashteuiatsh [Nituhkulinitshuap], Musée amérindien de Mashteuiatsh). Search for more participants ceased when researchers judged that saturation had been reached in the data provided through interviews.

Written informed consent was obtained from participants prior to each interview. Consent forms and questionnaires were approved by each community's Ethics Committee along with the Ethics Committee of the Université of Montréal (Certificate #: CERAS-2016-17-081-P; **Annex 1**). Overall, the working approach was conducted with respect to the International Society of Ethnobiology's Code of Ethics (International Society of Ethnobiology 2006).

Questions related to people's knowledge and definition of local medicines, as well as attitudes and practices related to their use in the presence of the biomedical system. More precisely, answers to such questions as: "What do you know of local, or traditional, medicines?", "Have you used local medicines?", "In what context are local medicines used or practiced?", "What do you think of more access to local medicines?" and "How do you see improved access to local medicines?" We recorded words, terms and affiliated concepts in both languages of **Iiyiyuu Ayimuun** and **Nehlueun**. We returned to the communities in the Fall of 2019 and Winter 2020 to

validate and confirm terminology and nomenclature as well as the accuracy of themes, categories and developing theory with as many of the original participants that could be reached for a review.

Participants who preferred to be interviewed together were considered as n=1, reducing participant sample size. Finally, we used verbatim quotes from participants to further elucidate the link between various notions and concepts related to medicine and health.

4.3.4 Data Analyses

Data were analysed using a mixed method approach that has previously been described and discussed at length in **Chapter 2**. Overall, interview transcripts were analysed according to an exploratory sequential design that begins with “best-fit” framework synthesis in a qualitative phase and ends with quantitative transformations and statistical analyses in a quantitative phase.

All transcripts were stored and handled with NVivo qualitative data analysis software (QSR International 2015) to manage, link and retrieve coded data. All data transformations and multivariate statistical analyses were performed with R statistical language (R Core Team 2019) using the built-in “stats” package and the “vegan” package (Oksanen et al. 2019), whereas univariate statistical analyses were performed in IBM SPSS (IBM Corp. 2019).

Qualitative analyses

Interviews were transcribed and analysed using a “best-fit” framework synthesis approach as described by Carroll et al. (2011, 2013) and Houghton et al. (2016) in **Chapter 2**. Briefly, the Medicine Wheel was used as a conceptual framework because it had been mentioned by multiple participants from all communities. Though there exists many representations and interpretations of this model, which also takes the names of “Circle of Wellness”, “Peace Symbol” and “Sacred

Circle”, throughout North-America, the four major dimensions of the human being, namely physical, intellectual (or mental), emotional and spiritual (Reney 2001; Wenger-Nabigon 2010; Bergeron-Martel 2011; Mawhiney and Nabigon 2011; Robertson 2011; King-Paquette 2012; Laberge Gaudin 2012; Young et al. 2015), were used as *a priori* themes upon which to build thematic analysis. Sequential focused coding enabled for the structure of a new model to emerge.

Quantitative data transformation and statistical analyses

The frequency counts of each theme or subtheme identified by “best-fit” frequency analysis were summarized in a data table compatible with statistical analyses. The total count of themes was analysed using parametric analysis of variance (ANOVA) and post-hoc Tukey multiple comparisons to elucidate differences between participant responses from different communities or affiliation with the healthcare sector. The application of diversity indices and ordinations for multivariate analysis are described at length in **Chapter 2**. Briefly, frequency counts of grouped themes were summarized into single measurements calculated from the Shannon-Wiener index (H). Hellinger transformed datasets of response themes were analysed using transformation-based redundancy analysis (tb-RDA). Differences in participant responses from different communities and group demographic were assessed in a multivariate analysis of variance (MANOVA) model using a partial-RDA approach. Testing for significant differences in multivariate analyses was performed in nonparametric models using 100,000 permutations and $\alpha = 0.05$ (Legendre and Legendre 2012).

4.4 Results

4.4.1 A harmonized and general model of Cree and Ilnu medicine

Deriving from “person” (**iyyiyiu** [Northern Coastal Cree], **iinuu** [Southern Inland Cree], **ilnu** [Nehlueun]) and medicine (**nituhkuyin** [Northern Coastal and Southern Inland Cree], **nitukuelin** [Nehlueun]), the words Cree or Ilnu medicine translated literally to the “People’s medicine” (**Iiyiyiunituhkuyin** in Chisasibi, **Iinuunituhkuyin** in Mistissini, **Nitukuelin-ilnu** in Mashteuiatsh). Nonetheless, over 480 terms were employed by participants to define local Indigenous medicines, this includes French words and terms subsequently translated to English. The 100 most frequently cited words used to discuss Indigenous medicines are presented in **Figure 4.2a** and **b**. These terms were linked to the four pillars of the Medicine Wheel established before thematic analysis, but also related to various natural elements, from plants to rocks, and elements relating to Indigenous customs, culture and traditions.

Sequential and focused coding of all these terms, cited by Indigenous participants, revealed a complex hierarchy of themes within a larger global model of medicine and health (**Figure 4.2c**). In the end, a model of Cree and Ilnu medicine emerged, characterized by three major components in interaction (**Figure 4.3, Table 4.2**). Although this diagram cannot accurately reflect every individual’s representation of local Indigenous medicine, it provides a generalized model within which most participants from all three communities expressed their personal vision of Indigenous medicine. For example, LS2014 stated that the four elements, water, fire, earth and wind, could also be represented in each of their own quadrants. Owing to the number of concepts, themes and subthemes included in each major component, both the land and local customs were highlighted by all participants, whereas the third, health and well-being, was cited by nearly all (94.9 %).

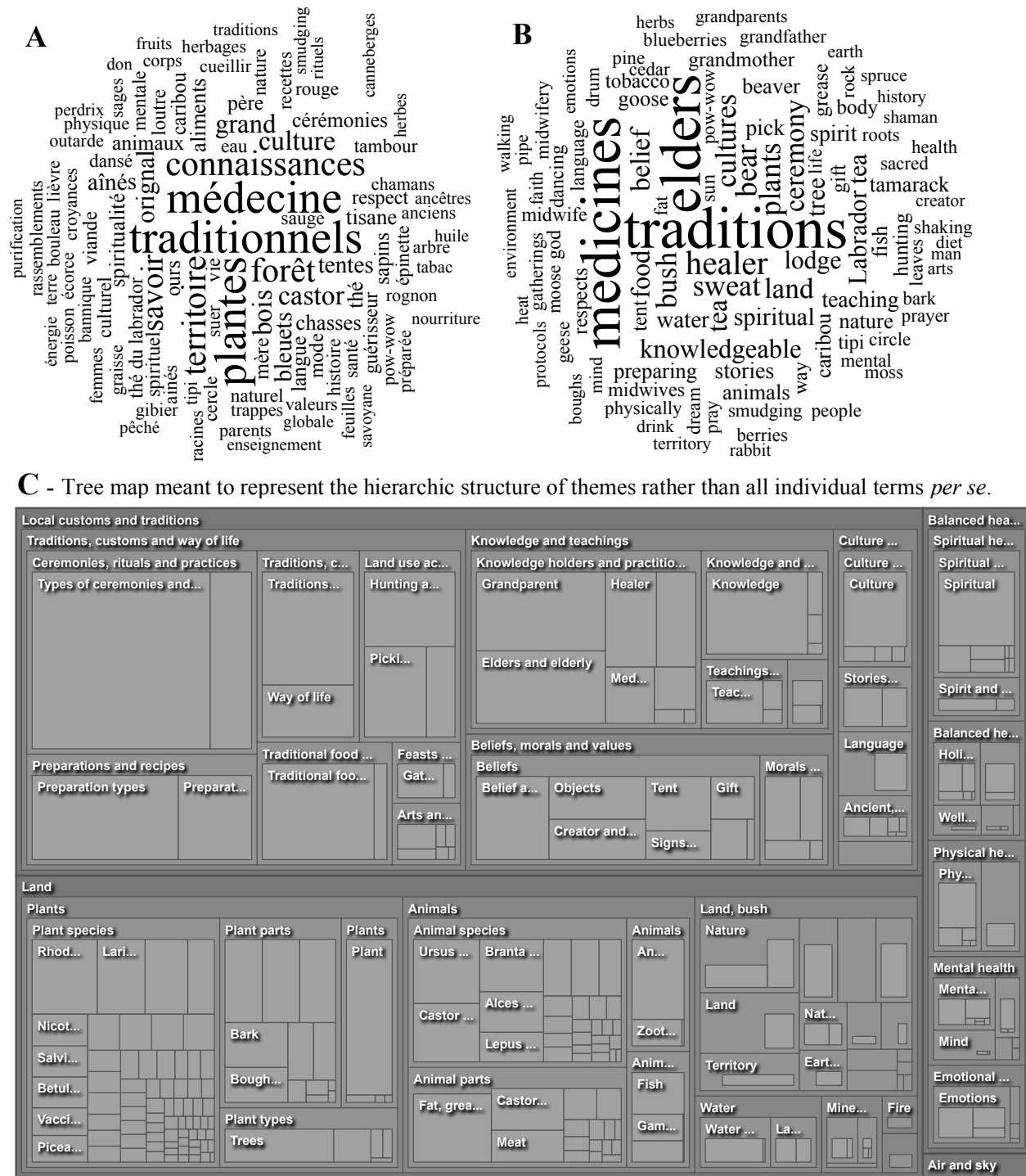


Figure 4.2. Word clouds and hierarchy tree map illustrating the nesting pattern of themes and concepts. (A) 100 most frequent words employed by all participants to describe and define local Indigenous medicine in French and (B) English interviews. (C) Box size reflects the number of participants citing each theme/concept. For ease of visualisation, hierarchic levels beyond the fourth (e.g., 1-Land, 2-Plants, 3-Plant species, 4-*Larix laricina*) are excluded from the diagram. Each level is colour coded from dark grey (higher order theme), to light grey (lower order theme).

Local Indigenous Medicine

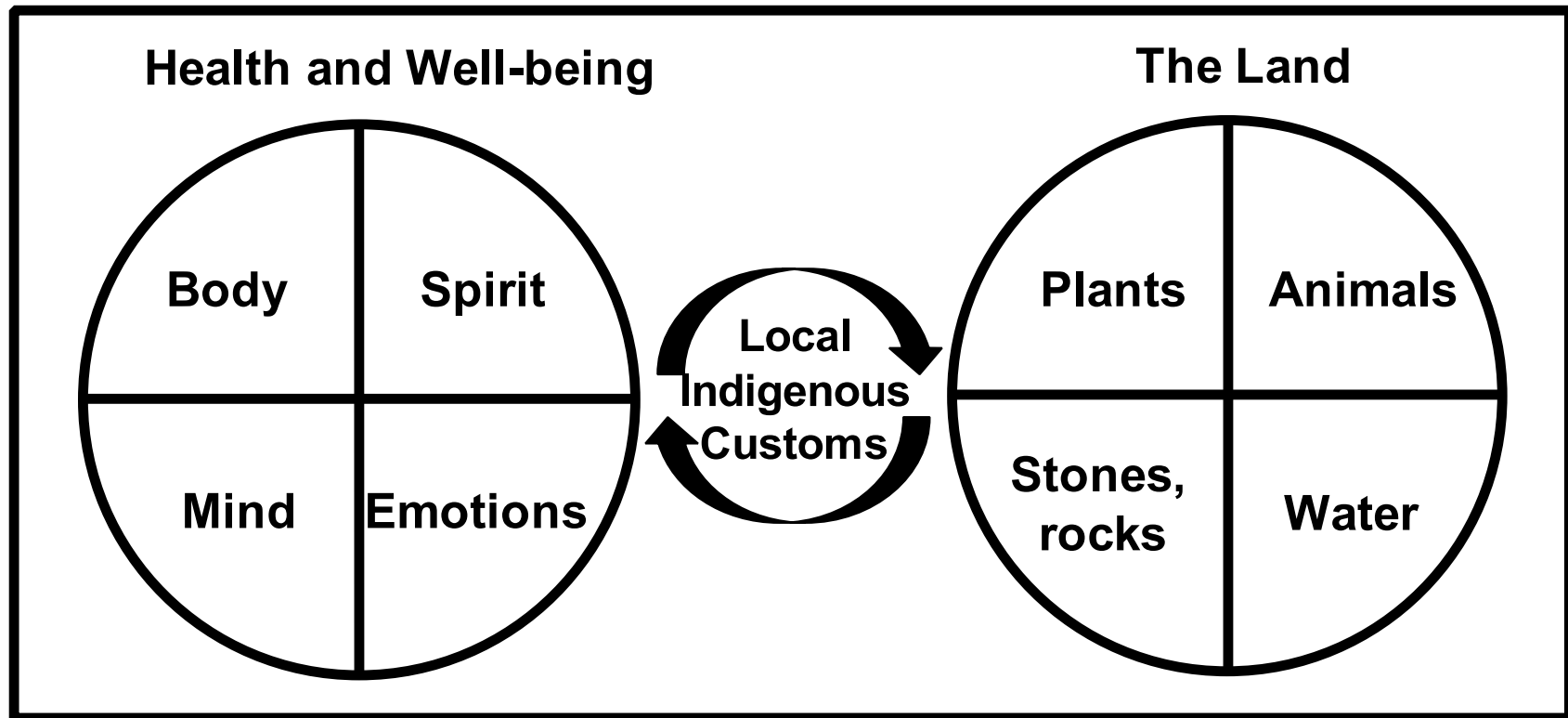


Figure 4.3. Illustration of the general model for local Indigenous medicine. The model is harmonized from descriptions and explanations provided by Indigenous participants from three First Nations: Mashteuiatsh (n = 36), Mistissini (n = 21) and Chisasibi (n = 26).

Illustrating the model using circles is not solely incidental to the conceptual framework of the Medicine Wheel. It is also a descriptive and efficient symbol for representing the other components of the model (*i.e.*, the earth is round, the circular notion of holisticness, the dynamic and cyclical undertone to the way of life, both environmental and personal), as well as the interactive and dynamic aspect of all three components. Above all, it is also a pertinent recurring symbol expressed by participants. One participant (LS1010) from Mashteuiatsh explains that “*les Innu, on fait tout en cercle. On est très circulaire.*” Another from Chisasibi (LS3017) further recounts a discussion with community Elders regarding health:

*“I asked him: ‘What are Cree Helping Methods for you?’ [...] And those Elders said, when they said: ‘Trying to put together a **miyupimaatisiun**, a model: health model, social medical model... Once you begin to do that, they said, you begin to understand the meaning of **miyupimaatisiun**. And everything is under that circle; all what you want to do, your training, your research, your plan or programing, and whatever you do within that health.”*

Component 1: Health and well-being

The first component reprises the four pillars that were chosen as *a priori* themes to the analysis, namely physical, mental, emotional and spiritual health. These were labelled under health and well-being due to most responses referring back to concepts of balance, holisticness and interconnectedness rather than specifically citing the Medicine Wheel. As one participant from Mistissini (LS2025) explains:

“[...] Everything is interconnected, like, in a circle: mental, spiritual, physical, and emotional. So, everything you do is ... everything, when you try to help someone is

medicine. Be it humor, be it traditional... Literal traditional medicines, spiritual healing, or ... you know, storytelling.”

In Chisasibi, one participant (LS3023) summarizes: *“And it is not just, like... Medicine, it is spiritual, it is emotional, it is physical, it is, like... all the aspects of life.”* Another from Mashteuiatsh (LS1035) elaborates: *“C’est sur tous ces axes. C’est pas juste physique. C’est mental, émotionnel, t’sais, ça fait le tour de toute. C’est un tour, là. Pas juste avec les plantes.”*

This was further supported by the words used in Nehlueun and both Cree dialects to translate “health” (Table 4.2). For the Cree, the words **miyupimaatisiun** (northern dialect) and **miyupimaatisiwin** (southern dialect) reprise the concepts of the body, **miyu**, and life, **pimaatisiwin** in an overarching concept which comes to mean being well in your body throughout your life. Both Ilnu words, **miluelimun** and **miluelinium**, reprise the concepts of something that is well, **miluau**, and are best translated as being well and living well.

Component 2: The Land

The second component referred back to the land as a provider of medicine, through all that comes from it, more precisely plants, animals, rocks, water and the air, as one participant from Mistissini explains (LS2028): *“Anything related to land and water, the trees, the animals, anything related to the Cree way of life. That’s traditional to me.”* Whereas another explains (LS2011): *“Traditional means when you are in the bush, you are in nature, it is you seeing nature, to turn it into a medicine, you know. You do something from the trees, from the barks, from flowers.”*

In Mashteuiatsh, some Nehlueun terms did not translate perfectly to their English or French equivalent. The term **nitauchikan**, closely related those used in Chisasibi and Mistissini (Table 4.2), was interpreted as “things that grow on their own” whereas **pishtinaun**, appearing in some

published lexicons, was interpreted as “garden plants”. Furthermore, lichens and mushrooms, taxonomically distinct from plants, are grouped together here, though it is best to interpret elements from the land as interconnected animate and inanimate entities rather than four distinct categories.

The land took on many meanings, varying notably in spatial scale, from forests and traplines on familial hunting territories, to the extent of currently and ancestrally defined lands used by each First Nation and reaching widely, as far as the entire Earth and nature in general. One participant (LS3006) from Chisasibi generalizes how using Indigenous medicine is *“using everything that comes from Mother Earth, your canvas. Everything comes from Her. So that you are actually touching Her.”*

Regardless of the diverse lexicon employed by participants to describe and define the land, the Algonquian words **assi** (Mashteuiatsh) and **aschii** (Mistissini and Chisasibi) manage to capture all these spatial nuances from anything consisting of ground cover like dirt, soil or sand, at a micro level, all the way to the entire planet, namely Mother Earth⁴, at a macro level (Junker and MacKenzie 2016; Junker et al. 2018). The use of these words in referring to specific territorial boundaries is further supported by words like **nitassinan**, **iiyiyiu aschii** or **iinuu aschii**.

Component 3: Local customs and way of life

The third and central component could be summarized as all concepts, practices and beliefs related to local customs and traditions as one participant from Chisasibi details (LS3017): *“Everything in our way of life, our Cree way of life, our culture. Because I’ve learned and believe today that our way of life is our medicine. Everything that is within our culture, that is our medicine.”*

⁴ The term *pukutska* was given by one participant from Chisasibi for Mother Earth.

This component is situated in the middle to act as the interface between the land and health. Arrows represent the dynamic aspect of this interaction, implying that any element of the land can be used to bring balanced health and well-being through any component of a person, as one participant (LS3002) from Chisasibi explains: “*Being out on the land. Being near water, trees, nature, that is medicine for the mind, the soul.*” This is achieved through proper actions and behaviours involved in preparations, uses and manners of conducting oneself. One participant (LS3022) from Chisasibi highlights some of these aspects:

“Being out on the land. For me, that’s the medicine and, like, the traditional, I guess... Like everything that goes with it. The beliefs, the values, the teachings... Because it goes very deep, you have to... Like, if you are taught about traditional medicine, there is a lot of beliefs, traditions, teachings, stories, that they all connect like a puzzle. And for me, it is all that all together, that’s traditional medicine.”

The interaction and interconnectedness of Cree and Innu medicine is an important and central aspect of this system as supported by participants who frequently define and describe this medicine using the multiple components.

4.4.2 A medical system based on access and connection to the Land

The place of the land plays a pivotal functional and structural role in this interconnected model of health. The functional role of the land as a source of provenance for *materia medica* is evidenced by the number of plants and animals spontaneously cited by participants during interviews. Altogether, 113 species, including 78 plants, 30 animals and 5 lichens and mushrooms were mentioned when describing local medicines (**Table 4.3**; **Table 4.4**). Local names are provided

when possible. The suffix **-aahtikw** (Chisasibi and Mistissini) and **-ahtuk^u** (Mashteuiatsh) were frequently added to plant names to refer to the entire plant. In Mashteuiatsh, for example, **pakan** becomes **pakanahtuk^u** (*Corylus cornuta*; Betulaceae); in Mistissini, **piyeuminaanh** becomes **piyeuminaanaahtikw** (*Gaultheria hispidula*; Ericaceae); in Chisasibi, **wiisichipikw** becomes **wiisichipikwaatikw** (*Rhododendron groenlandicum*; Ericaceae). Although taxonomists consider landlocked salmon and the sea-bound Atlantic salmon as the same species (*Salmo salar*; Salmonidae), we distinguished the two as these were considered as two separate units by participants. On the other hand, though white spruce (*Picea glauca*) and white pine (*Pinus strobus*) possessed their own name, when not specified, the generic English and French names given to spruces (*Picea* spp.) and pines (*Pinus* spp.) referred primarily to black spruce (*Picea mariana*) and jack pine (*Pinus banksiana*), respectively (**Table 4.3**). Furthermore, multiple species were determined to genus as participants confounded specific species, like *Sorbus decora* and *Sorbus americana* (*Sorbus* spp.; Rosaceae) or *Vaccinium angustifolium* and *Vaccinium myrtilloides* (*Vaccinium* spp.; Ericaceae; **Table 4.3**).

Plants and animals were cited by participants from all three communities, as well as non-Indigenous participants who are linked to the healthcare sector (**Table 4.4**). Although all species were considered medicines through notions of holistic healing and well-being, over half (55.8 %) were also considered part of the dietary system as a food (**Table 4.4**). Participants also cited plant and animal types, such as trees, herbs, fish and wild game, but also specific parts like leaves, needles and bark, or fat, grease, oil and flesh (**Table 4.5**). Indeed, participants were quick to express that the use of medicinal plants was more than simply knowing what to use, but that their use came with a complex set of knowledge. The knowledge required to make efficient use of the land for healing purposes is evidenced by the central component of our model of Indigenous medicine, local

Table 4.4. Breakdown of plant and animal species mentioned by participants from Mashteuiatsh, Mistissini and Chisasibi as part of their local medicinal practices and systems. Though all species listed are linked to local medicinal systems via notions of holistic healing and well-being, those also belonging to local dietary systems as a food are marked by an X. The origin of species (IND: indigenous species, INT: introduced species), as well as the communities (Ma: Mashteuiatsh, Mi: Mistissini, C: Chisasibi) and participants (I: Indigenous, N-I: non-Indigenous) that cite these species are provided. References to prior knowledge of these species in the medicinal systems of the Cree of Eeyou Istchee (CEI), the Pekuakamiulnuatsh (Ilnu) and linguistically related First Nations from the Algonquian language family (ALF; Cree: Cree in general, Innu: Innu in general, Gen: linguistically related First Nations in general) are also provided.

Latin	Food	Origin	Community	Participant	Literature*		
					CEI	Ilnu	ALF
Animals							
<i>Alces americanus</i>	X	IND	Ma, Mi, C	I, N-I	4		
Anatidae	X	IND	Ma, C	I	6; 10; 14		
<i>Aquila chrysaetos</i>	-	IND	Ma, C	I, N-I			
<i>Branta canadensis</i>	X	IND	Ma, Mi, C	I, N-I	4; 6; 10; 14		
<i>Castor canadensis</i>	X	IND	Ma, Mi, C	I, N-I	1; 4; 6; 8; 10; 14	2-3	
<i>Catostomus</i> spp.	X	IND	Mi	I	1; 10		
<i>Chen caerulescens</i>	X	IND	Ma, C	I	4; 6; 10; 14		
<i>Coregonus clupeaformis</i>	X	IND	Mi, C	I, N-I	(1; 4; 6; 8; 10) [†]		
<i>Erethizon dorsatum</i>	X	IND	Ma	I	1; 6; 10; 14		
<i>Esox lucius</i>	X	IND	Mi, C	I, N-I	(1; 4; 6; 8; 10) [†]		
<i>Falciipennis canadensis</i>	X	IND	C	I	14		
<i>Homo sapiens</i>	-	IND	Ma, C	I	1; 4; 6; 10		
<i>Lagopus lagopus</i>	X	IND	Ma	I	14		
<i>Lepus americanus</i>	X	IND	Ma, Mi, C	I, N-I	1; 6; 10		
<i>Lontra canadensis</i>	?	IND	Ma, Mi, C	I, N-I	1; 6	2-3	
<i>Lota lota</i>	X	IND	M	I	(1; 4; 6; 8; 10) [†]		
<i>Marmota monax</i>	X	IND	Ma	I			

Latin	Food	Origin	Community	Participant	Literature*		
					CEI	Innu	ALF
<i>Mephitis mephitis</i>	-	IND	Ma, C	I	1; 4; 6; 10		
<i>Odocoileus virginianus</i>	X	IND	Ma, Mi	I			
<i>Ondatra zibethicus</i>	X	IND	Ma, C	I	1; 4; 6; 8; 10; 14		
<i>Perisoreus canadensis</i>	-	IND	C	I	6; 10		
Phasianidae	X	IND	Ma, Mi, C	I, N-I	14		
Phocidae	X	IND	Ma, C	I	1; 6; 10		
<i>Rangifer tarandus</i> subsp. <i>caribou</i>	X	IND	Ma, Mi, C	I, N-I	1; 6; 10; 14		
<i>Salmo salar</i> (ouananiche)	X	IND	Ma	I	(1; 4; 6; 8; 10) [†]		
<i>Salmo salar</i> (salmon)	X	IND	Ma, C	I, N-I	(1; 4; 6; 8; 10) [†]		
<i>Salvelinus namaycush</i>	X	IND	Ma, Mi	I	(1; 4; 6; 8; 10) [†]		
<i>Sander vitreus</i>	X	IND	Ma, C	I, N-I	(1; 4; 6; 8; 10) [†]		
<i>Tamiasciurus hudsonicus</i>	X	IND	Ma	I			
<i>Ursus americanus</i>	X	IND	Ma, Mi, C	I, N-I	1; 4; 6; 8; 10; 14	2-3	
Lichens and mushrooms							
<i>Cladonia</i> spp.	X	IND	Ma, C	I		2	
<i>Craterellus tubaeformis</i>	X	IND	Ma	I			
<i>Inonotus obliquus</i>	-	IND	Ma	I			
<i>Morchella</i> spp.	X	IND	Ma	I			
<i>Umbilicaria</i> spp.	X	IND	C	I		3	
Plants							
<i>Abies balsamea</i>	-	IND	Ma, Mi, C	I, N-I	4-6; 8; 10	2-3; 12	Cree: 9; 13. Innu: 9; 11. Gen.: 7; 9
<i>Acer rubrum</i>	X	IND	Ma	I			Gen.: 9
<i>Achillea millefolium</i>	-	INT	Ma, C	I		2-3; 12	Cree: 9; 13. Innu: 9; 11. Gen.: 7; 9

Latin	Food	Origin	Community	Participant	Literature*		
					CEI	Innu	ALF
<i>Allium cepa</i>	X	INT	Ma	I		2	9
<i>Allium tricoccum</i>	X	IND	Ma	I			7; 9
<i>Alnus incana</i> subsp. <i>rugosa</i>	-	IND	Ma, Mi, C	I	4-6; 8; 10	2-3; 12	Cree: 9. Innu: 11. Gen.: 7; 9
<i>Amelanchier</i> spp.	X	IND	Ma	I	8		Cree: 13; 9. Gen.: 9
<i>Anaphalis margaritacea</i>	-	IND	Ma	I			Innu: 9. Gen.: 9
<i>Anthoxanthum</i> spp.	-	IND	Ma, C	I			Cree: 13. Gen.: 9
<i>Aralia nudicaulis</i>	X	IND	Ma	I		12	Cree: 9; 13. Innu: 9; 11. Gen.: 7; 9
<i>Betula papyrifera</i>	-	IND	Ma, Mi, C	I, N-I	4; 6; 10	2-3; 12	Cree: 13. Gen.: 9
<i>Brassica oleracea</i>	X	INT	Ma	I		2	Gen.: 9
Brassicaceae	X	INT	Ma, Mi	I, N-I			Gen.: 9
<i>Cichorium intybus</i>	-	INT	Ma	I			
<i>Comptonia peregrina</i>	-	IND	Ma	I			Gen.: 9
<i>Coptis trifolia</i>	-	IND	Ma	I	8	2-3; 12	Innu: 11. Gen.: 7; 9
<i>Cornus canadensis</i>	-	IND	Ma	I		2-3	Innu: 9. Gen.: 7; 9
<i>Cornus sericea</i>	-	IND	Ma	I		12	Cree: 9; 13. Innu: 11. Gen.: 7; 9
<i>Corylus cornuta</i>	X	IND	Ma	I, N-I		2-3; 12	
<i>Diervilla lonicera</i>	-	IND	Ma	I		12	Cree: 9. Gen.: 9
<i>Digitalis purpurea</i>	-	INT	C	N-I			
<i>Elymus repens</i>	-	INT	Ma	I		2	
<i>Empetrum nigrum</i>	X	IND	C	I	8		Cree: 9. Gen.: 9
<i>Foeniculum vulgare</i>	-	INT	C	N-I			
<i>Fragaria virginiana</i>	X	IND	Ma, Mi, C	I		3	Cree: 13. Gen.: 7; 9
<i>Fraxinus nigra</i>	-	IND	Ma	I			Gen.: 9

Latin	Food	Origin	Community	Participant	Literature*		
					CEI	Innu	ALF
<i>Gaultheria hispidula</i>	X	IND	Ma, Mi	I	4-6; 10	3; 12	Cree: 13. Gen.: 9
<i>Gaultheria procumbens</i>	X	IND	Ma, Mi	I, N-I			Gen.: 7; 9
<i>Helianthus tuberosus</i>	X	INT	Ma	I			
<i>Hypericum</i> spp.	-	IND	Mi	N-I			
<i>Juniperus communis</i>	-	IND	C	I	6; 10		Cree: 9. Innu: 11. Gen.: 9
<i>Kalmia angustifolia</i>	-	IND	Mi, C	I	4-6; 8; 10	2-3; 12	Cree: 9. Innu: 9; 11. Gen.: 7; 9
<i>Larix laricina</i>	-	IND	Ma, Mi, C	I, N-I	4-6; 8; 10	2-3; 12	Cree: 9; 13. Innu: 9; 11. Gen.: 7; 9
<i>Ligusticum porteri</i> (?)	-	INT	C	I			
<i>Matricaria</i> spp.	-	INT	Ma	I			Gen.: 9
<i>Mentha</i> sp.	-	IND	Ma	I			Cree: 9; 13. Innu: 11. Gen.: 7; 9
<i>Nicotiana tabacum</i>	-	INT	Ma, Mi, C	I	4; 6		Gen.: 9
<i>Nuphar</i> sp.	-	IND	Ma	I		3	Cree: 9; 13. Gen.: 9
<i>Olea europaea</i>	X	INT	Ma	I			
<i>Picea</i> spp.	-	IND	Ma, Mi, C	I	1; 4-6; 10	12	Cree: 9; 13. Innu: 9; 11. Gen.: 9
• <i>Picea glauca</i>	-	IND	Ma, Mi	I	4-6; 10	3; 12	Cree: 9; 13. Innu: 9; 11. Gen.: 7; 9
• <i>Picea mariana</i>	-	IND	Ma, Mi, C	I, N-I	4-6; 10	12	Cree: 9; 13. Innu: 9; 11. Gen.: 9
<i>Pinus</i> spp.	-	IND	Ma	I		2	Gen.: 9
• <i>Pinus banksiana</i>	-	IND	Ma, Mi, C	I	4-6; 10	2-3; 12	Cree: 9; 13. Innu: 11. Gen.: 9
• <i>Pinus strobus</i>	-	IND	Ma	I		2	Innu: 9. Gen.: 7; 9
<i>Piper nigrum</i>	X	INT	Ma	I		2	
<i>Plantago major</i>	-	INT	Ma	I		2-3	Gen.: 7; 9

Latin	Food	Origin	Community	Participant	Literature*		
					CEI	Ilnu	ALF
<i>Populus</i> spp.	-	IND	Ma, C	I	4-6; 10	2	Cree: 9; 13. Gen.: 9
• <i>Populus balsamifera</i>	-	IND	Ma	I			Cree: 9; 13. Gen.: 9
• <i>Populus tremuloides</i>	-	IND	Ma, C	I	1; 4; 6; 8; 10	2-3; 12	Cree: 9; 13. Innu: 9. Gen.: 7; 9
<i>Prunus pensylvanica</i>	X	IND	Ma	I		12	Cree: 9; 13. Gen.: 9
<i>Prunus virginiana</i>	X	IND	Ma	I		3	Cree: 9; 13. Gen.: 7; 9
<i>Rhododendron groenlandicum</i>	X	IND	Ma, Mi, C	I, N-I	1; 4-6; 8; 10	3; 12	Cree: 9; 13. Innu: 9; 11. Gen.: 7; 9
<i>Rhododendron tomentosum</i>	-	IND	Mi, C	I, N-I	1; 6; 10		
<i>Rhus typhina</i>	-	IND	Ma	I		2	Gen.: 7; 9
<i>Ribes oxycanthoides</i>	X	IND	Mi	I			Cree: 9; 13. Gen.: 9
<i>Rosa</i> sp.	X	IND	Ma	I		2-3	Cree: 9; 13. Gen.: 7; 9
<i>Rubus chamaemorus</i>	X	IND	C	I			Gen.: 7; 9
<i>Rubus idaeus</i>	X	IND	Ma, Mi, C	I		2-3; 12	Cree: 9; 13. Gen.: 7; 9
<i>Rubus pubescens</i>	X	IND	Ma	I			Gen.: 9
<i>Salicornia depressa</i>	X	IND	Ma	I			
<i>Salix</i> spp.	-	IND	Ma, C	I	4-5; 8; 10	3; 12	Cree: 9; 13. Innu: 9; 11. Gen.: 9
<i>Salvia apiana</i>	-	INT	Ma, Mi, C	I, N-I			
<i>Sarracenia purpurea</i>	-	IND	Mi	I	5		Cree: 9; 13. Innu: 9; 11. Gen.: 9
<i>Solanum tuberosum</i>	X	INT	Ma	I		2-3	
<i>Sorbus</i> spp.	X	IND	Ma, Mi	I	6; 10	2-3	Cree: 13. Gen.: 9
• <i>Sorbus americana</i>	X	IND	Ma, Mi	I	6; 10	2-3; 12	Cree: 13. Innu: 9. Gen.: 9
• <i>Sorbus decora</i>	X	IND	Ma, Mi	I	5-6; 8; 10	2-3	Cree: 9; 13. Gen.: 9
<i>Sphagnum fuscum</i>	-	IND	Ma, Mi, C	I, N-I	1; 4; 6; 10		Cree: 13. Innu: 11

Latin	Food	Origin	Community	Participant	Literature*		
					CEI	Innu	ALF
<i>Spiraea alba</i> var. <i>latifolia</i>	-	IND	Ma	I			Gen.: 9
<i>Taxus canadensis</i>	-	IND	Ma	I		2-3; 12	Innu: 9; 11. Gen.: 7; 9
<i>Thuja occidentalis</i>	-	IND	Ma, Mi, C	I, N-I	4; 6; 10	2-3; 12	Cree: 9. Innu: 9; 11. Gen.: 7; 9
<i>Triticum aestivum</i>	X	INT	Ma, C	I, N-I	1; 6; 10	2	
<i>Typha latifolia</i>	X	IND	Ma	I	4-6; 10		Cree: 13. Gen.: 7; 9
<i>Urtica dioica</i>	-	IND	C	N-I			Cree: 9; 13. Gen.: 9
<i>Vaccinium</i> spp.	X	IND	Ma, Mi, C	I, N-I	10	2-3	Innu: 9. Gen.: 7; 9
• <i>Vaccinium angustifolium</i>	X	IND	Ma, Mi, C	I, N-I	5	2-3; 12	Gen.: 7; 9
• <i>Vaccinium myrtilloides</i>	X	IND	Ma, Mi, C	I, N-I		2-3	Cree: 9. Gen.: 7; 9
<i>Vaccinium oxycoccos</i>	X	IND	Ma, Mi, C	I, N-I		12	Innu: 9. Gen.: 9
<i>Vaccinium vitis-idaea</i>	X	IND	Ma, Mi, C	I, N-I	5-6; 10		
<i>Valeriana</i> sp.	-	IND	Ma	I			Cree: 9; 13. Gen.: 9
<i>Verbascum thapsus</i>	-	INT	Ma	I			Gen.: 9
<i>Zea mays</i>	X	INT	Ma, C	I, N-I			Gen.: 9

* 1) Anonymous 1971; 2) Association des Métis et Indiens hors réserves 1982; 3) Conseil des Montagnais du Lac-Saint-Jean 2003; 4) Marshall et al. 2003; 5) Leduc et al. 2006; 6) Marshall 2006; 7) Durand Nolett 2008; 8) Cosset and Mansion 2009; 9) Moerman 2009; 10) Fireman 2011; 11) Clément 2014; 12) Forêt modèle du Lac-Saint-Jean 2015; 13) Young et al. 2015; 14) Adelson 1998.

† Fish in general

Table 4.5. Plant and animal types and parts mentioned by participants from Mashteuiatsh, Mistissini and Chisasibi. Types and parts were cited by participants describing local medicinal practices and systems and ranked according to the ratio of citing participants (%).

	Animal	(%)	Plant	(%)
Type	1. Fish	32.7	1. Trees	60.2
	2. Wild game (mammals)	19.4	2. Herbs	21.4
	3. Birds and fowl	14.3	3. Conifers and evergreens	6.12
	4. Shellfish	1.02	4. Shrubs	5.10
			5. Grasses	2.04
Part	1. Fat, grease and oil	54.1	1. Leaves and needles	36.7
	2. Flesh	32.7	2. Bark	33.7
	3. Castor and castoreum	26.5	2. Fruits and berries	33.7
	4. Feathers and wings	10.2	3. Sap and gum	28.6
	5. Bone, cartilage and marrow	9.18	4. Boughs and branches	24.5
	6. Intestines	6.12	5. Roots	18.4
	7. Liver	4.08	6. Flowers	15.3
	8. Muzzle and snout	3.06	7. Essential oil	5.10
	9. Blood	2.04	8. Starch and flour	3.06
	9. Breastmilk	2.04	9. Cones	2.04
	9. Faeces	2.04	10. Oils	1.02
	9. Fur	2.04	10. Rotten wood	1.02
	9. Gizzards	2.04	10. Shoots	1.02
	9. Heart	2.04		
	9. Scent gland	2.04		
9. Tongue	2.04			

customs and ways, containing the greatest number of themes and subthemes. By the number of citing participants, some of the most important groups within this component were preparations, practices and land-use activities (**Table 4.6**). Preparations included but were not limited to the transformation of medicinal material in infusions, decoctions, creams and poultices. These were administered externally by washing, rinsing, rubbing or direct application for extended periods. Drinking and eating were the principal mode of internal administration whereas steam baths could act as an internal or external mode of administration. In these preparations, water obtained on the land was generally preferred to tap water. Translating for an Elder from Mistissini (LS2001), the interpreter explained that *“they don’t use that water [from the faucet] to boil any of their medicine, they go in the bush to get it where it is fresh and clean, they make sure of that.”*

Owing to the constant, abundant and fresh supply of medicinal material, the Land, authentic to the relationship between medicine and the environment as opposed to the community, was considered as the best suited place for the practice of Indigenous medicine. LS3017 from Chisasibi explains:

“But some of this medicine has to be used out there. Out on the Land. Because the Elders were saying when you pick up that medicine from the Land, you have to know how to pick it. You have to have that traditional protocol of how to pick it. And they were saying, when you pick some of that medicine and you bring it back, it starts to lose its... some of the properties of medicine. This is what they were saying. And you have to use some of... Use it out there in the ... on the Land. Maybe the doctor can go out there... We can go together and learn...”

Table 4.6. List of preparations, ceremonies, rituals and practices, land-use activities as well as arts and crafts cited by participants from Mashteuiatsh, Mistissini and Chisasibi. Themes were cited when discussing how interactions with the land lead to balanced health and well-being through local customs and ways of life. All elements are ranked according to the ratio of citing participants (%).

Preparation	(%)	Ceremonies, rituals and practices	(%)	Land-use activities	(%)	Arts and crafts	(%)
1. Beverages (<i>i.e.</i> , decoctions, infusions and macerations)	68.4	1. Sweat lodge	68.4	1. Hunting and trapping	60.2	1. Sewing	8.16
2. Steam baths and baths	16.3	2. Feasts and gatherings	39.8	2. Picking and gathering	52.0	2. Beading	4.08
3. Creams and ointments	13.3	3. Pow-wow	33.7	3. Fishing	31.6	2. Carving	4.08
3. Dressing and bandages	13.3	4. Praying and prayers	31.6			3. Embroidering	3.06
4. Broths	11.2	5. Smudges	27.6			4. Quilting	1.02
5. Cataplasms	4.08	6. Shaking tents	23.5				
		7. Songs, chants and incantations	20.4				
		8. Dances	19.4				
		9. Sun Dances	17.3				
		10. Dreams and visions	16.3				
		11. Circles (<i>i.e.</i> , sharing and healing)	14.3				
		12. Walking out	12.2				
		13. Fasts	7.14				
		14. Bloodletting	4.08				
		15. Smoking	3.06				
		15. Yuwipi	3.06				
		16. Full moon	2.04				
		16. Naming	2.04				
		17. Sunrise	1.02				
		17. Midewin tents	1.02				

Owing to the need for increased privacy that individuals may seek, and also in facilitating the personal connection with the environment, many practices intended for spiritual, mental and emotional healing were preferably held on the land (e.g., sweat lodge, sun dance), though others were commonly and more publicly practiced in the community (e.g., walking out ceremony, pow-wow). Through various actions and practices ranging from the more personal and private (i.e., prayers), to more public rites and ceremonies (i.e., pow-wow), plants and animals are employed not only to treat physical ailments, but also matters of the mind, the spirit and the emotions. Similarly, rocks are specifically chosen for sweat lodges, whether they be used for an individual to treat physical pains and aches, like aching muscles, or in a group for residential school survivors, or substance addiction. Moreover, steam produced from water and hot rocks may be used to soften hardened cracked skin in a steam bath, or to carry the vibrations of the drum beat in a sweat lodge performed with a spiritual intent. Furthermore, many other practices cited by participants referred to land use activities such as harvesting, gathering, collecting, fishing, hunting and trapping. These land-use activities were perceived not only as a means to access and eventually transform medicinal elements from the land for healing purposes, but in enabling physical activity and healthy eating, the land plays an important role in promoting healthy lifestyles and habits as evoked by a participant from Mistissini (LS2011): *“It is, being in the bush, it is part of traditional. It is a traditional... I mean medicine. You have fresh air, everything you eat is fresh out there. The fish, you know. And you get to kill game out there. Especially if it is your own hunting territory.”*

Another participant from Chisasibi (LS3022) explains that this contact with the land is just as important to healing than the tangible medicinal material that it provides:

“Healing comes from, like, everything. The sky, the animals, the berries, the plants, the relationship between nature and self. Touching is also another ... when you are... When

you touch the ground, when you touch the water, when you are in contact with the animals, there is the spiritual connection.”

Overall, the medicinal system of all three communities appears considerably dependant on access and connection to the land as it acted as a provider of medicine, a place of practice, a promoter of active lifestyles and habit and above all, a healer in its own right. To be more precise, one participant from Mashteuiatsh (LS1026) summarizes: *“Le territoire, c’est notre maison, c’est notre école, c’est notre église, c’est tout ça. C’est notre marché d’alimentation. C’est notre dispensaire aussi...”*

4.4.3 Land-based healing and diabetes

Spending time on the land was frequently sought out by participants as a means to seek healing for any number of health problems and achieve a sense of well-being (**Figure 4.4**). Whereas taking some distance from the everyday routine and responsibilities of urban community life caters to emotional and mental health, the lifestyle encouraged by being on the land also caters to spiritual and physical health.

In all three communities, participants expressed the general idea that people were historically healthier when they remained and relied on the land. This was particularly true of chronic diseases as one participant from Mistissini explains (LS2015): *“It is only when you came into the community, they would see some diseases. But those diseases that are so rapid today: diabetes, high blood pressure, cancer. They were non-existent.”* One Elder from Mashteuiatsh (LS1026) further specifies how such illnesses appeared in the 50s and 60s:



Figure 4.4. Illustrations of gathering sites on the land. Community gatherings on the land occur regularly for either short periods of time, such as Pekupessekau in Mashteuiatsh (top), or for entire seasons, such as Murray’s Lodge in context of Mistissini’s Chishienuu Chiskutamaachwin program (bottom). Such places and events provide a space for cultural expression that include feasts, characterized by local foods acquired from hunting, trapping, fishing and gathering, cultural transmission activities (*e.g.*, crafts, storytelling, preparing hides) and even for the acquisition and transmission of local medicine and teachings. Generally open to visitors, these places also provide a space for cultural exchanges with guests and relatives from other First Nation communities. Photo credits: M. Rapinski, May 2016 (top) and November 2016 (bottom).

“Je ne pense pas que le diabète était là au début du XXe siècle, là. (...) Tout est arrivé dans les années 50, 60, là. Il y a un changement, là. Et quand il y a eu le boycott du marché de la fourrure par l’Europe, ça, ça a été dévastateur. Ça a été vraiment dévastateur, parce que ça a eu beaucoup d’impact sur notre mode de vie.”

More precisely, these included lifestyle changes like sedenterization and a dietary transition to increased store-bought foods. One participant from Mistissini explains (LS2010): *“There must have been something there, in the plants or in the animals that, you know... Or maybe it was because of activities that they were doing. But still, you know, there was no ... You never heard of people having been diabetic or, like, cancer, you know... Never.”*

In keeping with this, many participants reported better glycemic control, blood pressure levels and a general sense of well-being when coming back from spending time on the land. One participant from Chisasibi (LS3005) further goes on to explain how this is also an approach to combining local medicinal practices with biomedical treatments: *“I take the medicine right now, you know, for my diabetes. Um... With my high blood pressure too. And when I go out on the land, my blood pressure goes down. So that’s how I combine my... And when I am here [in the community], it seems to go high.”*

Whereas another participant from Mistissini drew the benefits through a direct link between people and their contact with the land (LS2014):

“When you are in the wood, your skin absorbs medicine, you breathe medicine, you see medicine. The skin sucks everything, all the medicine from the land, sucks it through the air, through the skin. I noticed that with my parents. They are both sick. Their

diabetes are controlled on the land, because they are so active and their skin absorbs everything.”

Moreover, the benefits of being on the land were generally attributed in part to changes in eating habits, the use of curative plant and animal remedies, and the physical exercise required in daily chores and traditional land use activities. With the help of glucometer readings, participants explained how they use this as a guiding tool to assess the effect traditional foods, medicines or other activities on blood glucose levels. As one participant from Chisasibi puts it (LS3011):

“Like, from us, for plants, like... mainly for berries, and but we can see too, when somebody is diabetic, when their blood sugar level might go up and down, that when they eat traditional food, it stabilizes their blood sugar, but when they eat the store-bought food, it doesn't change at all, like... So, it is good to have traditional medicine... I mean, traditional food, yeah.”

Plants and animals were often discussed by participants as either medicinal products for healing purposes or food items for dietary and culinary purposes, but a fine and ambiguous line separated the two. As one Elder from Chisasibi explained (LS3012):

*“There is a lot of medicines even in caribou, like, when they killed a caribou, there is still the food of the caribou [reindeer lichens; *Cladonia* spp.; Cladoniaceae] inside the stomach, and they still ate that, and it helped them too. We still do that today. But maybe there are some people that throw it out. But it is medicine too.”*

One participant from Mashteuiatsh (LS1018) elaborates on the reasons why some animals like beaver and moose are prized sources of food in the local diet: *“Le castor a beaucoup de médecines. L'orignal a beaucoup de médecines, parce qu'ils mangent des feuilles, ils mangent de*

l'écorce, ça nous amène dans notre corps des vitamines dont on a besoin.” And another specifies (LS1015): *“Quand tu ne veux pas avoir de problèmes avec ton intestin, tu manges du castor. Mais pourquoi ? Le castor mange du tremble, le tremble lui, c'est un remède pour les intestins.”*

Whereas not all plant or animal species intended for a strictly medicinal use were considered a food item, all food items could be considered as medicine. For example, goose and bear grease, collected during the cooking of these animals for dietary ends, is kept to accompanying meals or alternatively applied on rashes and skin infections (**Figure 4.5**). In many cases, there were no differences between these two ideas where the consumption of a food item is directly associated with a medicinal purpose, be it curative or preventive in maintaining general health and well-being. As one participant from Mistissini points out (LS2010): *“It is what they call brain food, eh. Yeah. Blueberries... Traditional medicine.”*

Finally, the self-reported benefits of land-based healing appear to be observed by some participants of the healthcare sector. One retired Indigenous nurse from Mashteuiatsh (LS1001), now considered an Elder, recalls when she used to practice: *“J'avais des clients, qui passaient une partie de leur année dans les bois, puis quand qui revenait du bois, y était toujours avec une glycémie contrôlée.”* These observations were echoed throughout all three participating communities, particularly during the period of Goose Break whereby Cree of Eeyou Istchee communities take a typically month-long spring break for the return of the geese, as one doctor from Chisasibi explains (LS3025):

“They're going to the bush for, let's say, a month and, uh... Goose Break or something like that. And they say: 'When I was... I'm in the bush...' They're eating traditional foods, they're very, very active with all the stuff going on in the camp, and they say:

‘My sugars are amazing!’ And their diabetes is controlled. So, I think that going back to the traditional lifestyle is very, very good.’



Figure 4.5. Illustration of wild game and fowl cooked for a feast during a gathering in Mashteuiatsh to honor Aboriginal Day and the summer solstice. From right to left: Geese, beavers and a piece of moose meat. Here, the grease is left behind to drip on the ground, though people may otherwise place a recipient under each goose to collect the fat when preparing this for more private occasions. Specific parts of the beaver, namely the castoreum, are removed from the beaver before cooking, then dried for later uses in tonics or other medicinal purposes. The consumption of wild animals is generally considered healthier than store-bought meat products, provides a connection with the land and an affirmation of Indigenous identity and belonging. Photo credit: M. Rapinski, June 2019.

One nurse from Mistissini also explains how some diabetics will substitute their prescription medication with that which they make themselves out on the land: *“Because they have different prescriptions in the bush, and when you’re looking at hemoglobin A1c over time, the best*

ones are the ones that cover the goose break period (LS2015).” Finally, another nurse from Mashteuiatsh recalls the case of one diabetic who caused a stir in the healthcare centre for refusing to take his prescription medication. Upon further inquiry regarding his controlled glyceemic results, this person revealed changing his diet, doing exercise, and taking blood glucose readings every day to help replace his prescription medication with blueberry root. LS1028 recounts: “*Puis on va lui poser la question : ‘Qu’est-ce qui vous emmène à prendre votre médication ?’ ‘Parce que je prends de la racine de bleuet, puis je prends ça à tous les jours.’*” But moreover, one doctor from Mistissini (LS2016) further recognizes the empowering affect achieved through greater autonomy in the management of their illnesses: “*Ce n’est pas rien que de voir l’effet sur des prises de sang, c’est de voir l’effet chez les gens qui vont se remobiliser, puis qui vont aller ramasser leurs plantes.*”

4.4.4 Indigenous medicines, unique in their own right

So far, local Indigenous medicinal systems from Mashteuiatsh, Mistissini and Chisasibi have been presented in a general fashion. **Figure 4.3** succinctly generalizes a wide variety of terms into less than a dozen overarching themes common to all communities, though participants note that every community is unique. In questioning how local Indigenous medicines are defined, of interest here are the differences between participant responses from within and outside the healthcare sector along with responses from different communities. A statistically significant ($p = 0.013$) two-way ANOVA on the total count of themes resulted in no significant interactions between participants from different communities and their affiliation with the healthcare sector ($p = 0.255$), suggesting that differences between affiliations with the healthcare sector are expected to be similar between communities. The model remained statistically significant without the interaction term ($p = 0.008$) with both main factors having a statistically significant effect on the

total count of themes ($p_{\text{COMMUNITY}} = 0.021$, $p_{\text{GROUP}} = 0.042$; **Figure 4.6**). Post-hoc pairwise comparison reveal that participants from Mashteuiatsh cited the greatest number of themes as opposed to Mistissini that cited the least (**Figure 4.6a**), whereas participants working in the healthcare network cited fewer themes than participants requiring healthcare services (**Figure 4.6b**).

We used multivariate analysis to obtain a greater understanding of the patterns amongst themes that distinguish communities and group demographics. Because plants and animals were a major theme brought up by participants, we performed a separate tb-RDA to test the difference between communities and groups based on cited species (**Figure 4.7**). A statistically significant ($p < 0.001$, $R^2_{\text{adj}} = 0.0698$) two-way MANOVA by partial tb-RDA reveals no significant interaction between communities and group demographics ($p = 0.746$), suggesting that differences between group demographics are expected to be similar between communities. When removing the interaction, the model remained statistically significant ($p < 0.001$, $R^2_{\text{adj}} = 0.0760$) along with both factors, community ($p < 0.001$, $R^2_{\text{adj}} = 0.0572$) and group demographics ($p = 0.00509$, $R^2_{\text{adj}} = 0.0180$).

A statistically significant difference among communities indicates that each community has a unique representation of Indigenous medicine. Participants group tightly around their centroids with most species responsible for characterising each community being associated with the first and only significant canonical axis ($p_{\text{RDA1}} < 0.001$, $p_{\text{RDA2}} = 0.147$; **Figure 4.7a**). Species that prominently characterized participants from Mashteuiatsh were moose (*Alces americanus*), beaver (*Castor canadensis*), blueberries (*Vaccinium* spp.), sage (*Salvia apiana*; Lamiaceae) and otter (*Lontra canadensis*; Mustelidae). Trends in citing these species were inversely correlated with common Labrador tea (*Rhododendron groenlandicum*), black bear (*Ursus americanus*), Canada

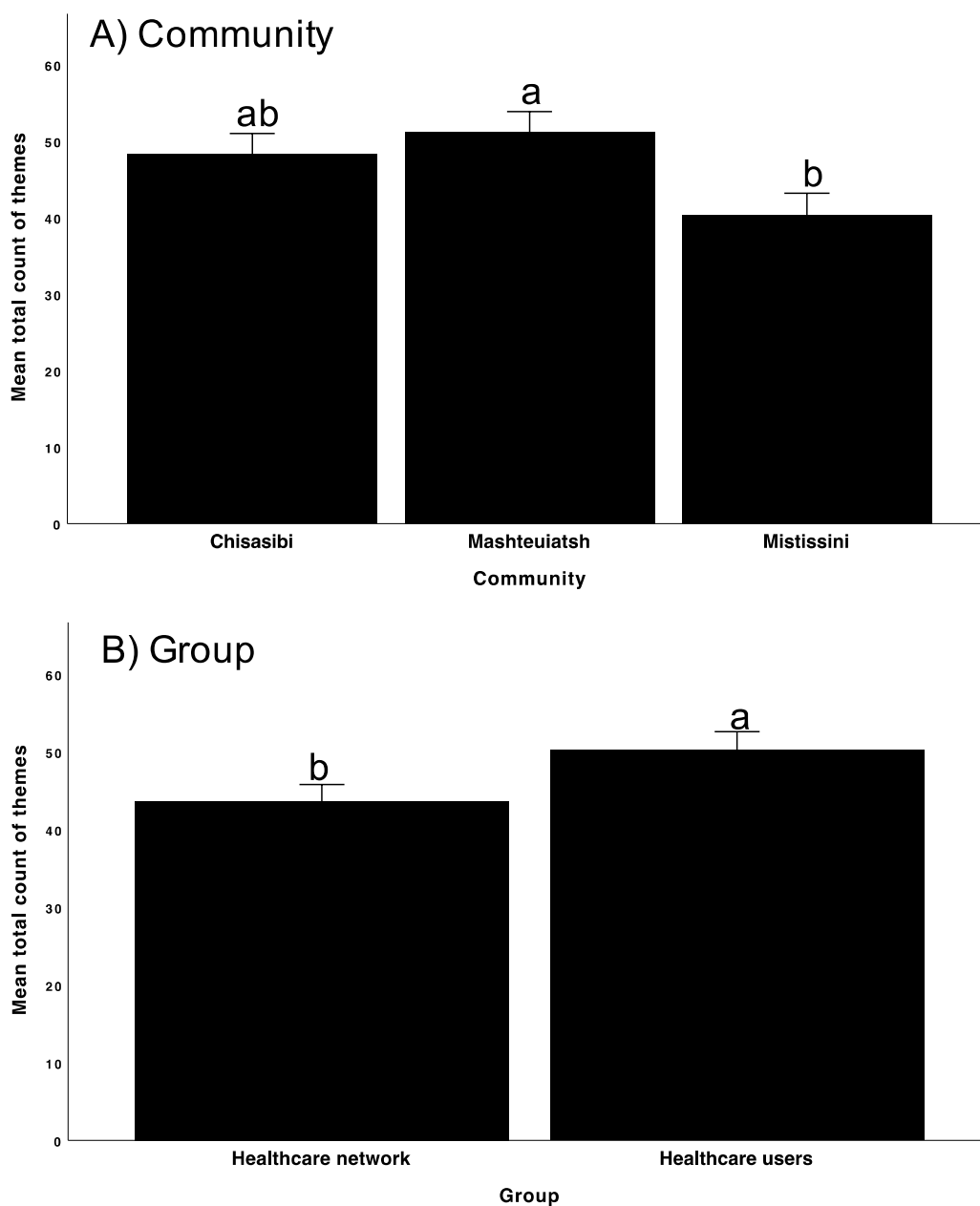


Figure 4.6. Mean total count of themes \pm SE cited by participants when discussing local Indigenous medicine. Statistical differences between A) Communities and B) association to the healthcare network are determined by two-way ANOVA (at $\alpha = 0.05$); letters indicate significant differences according to Tukey post-hoc pairwise comparison.

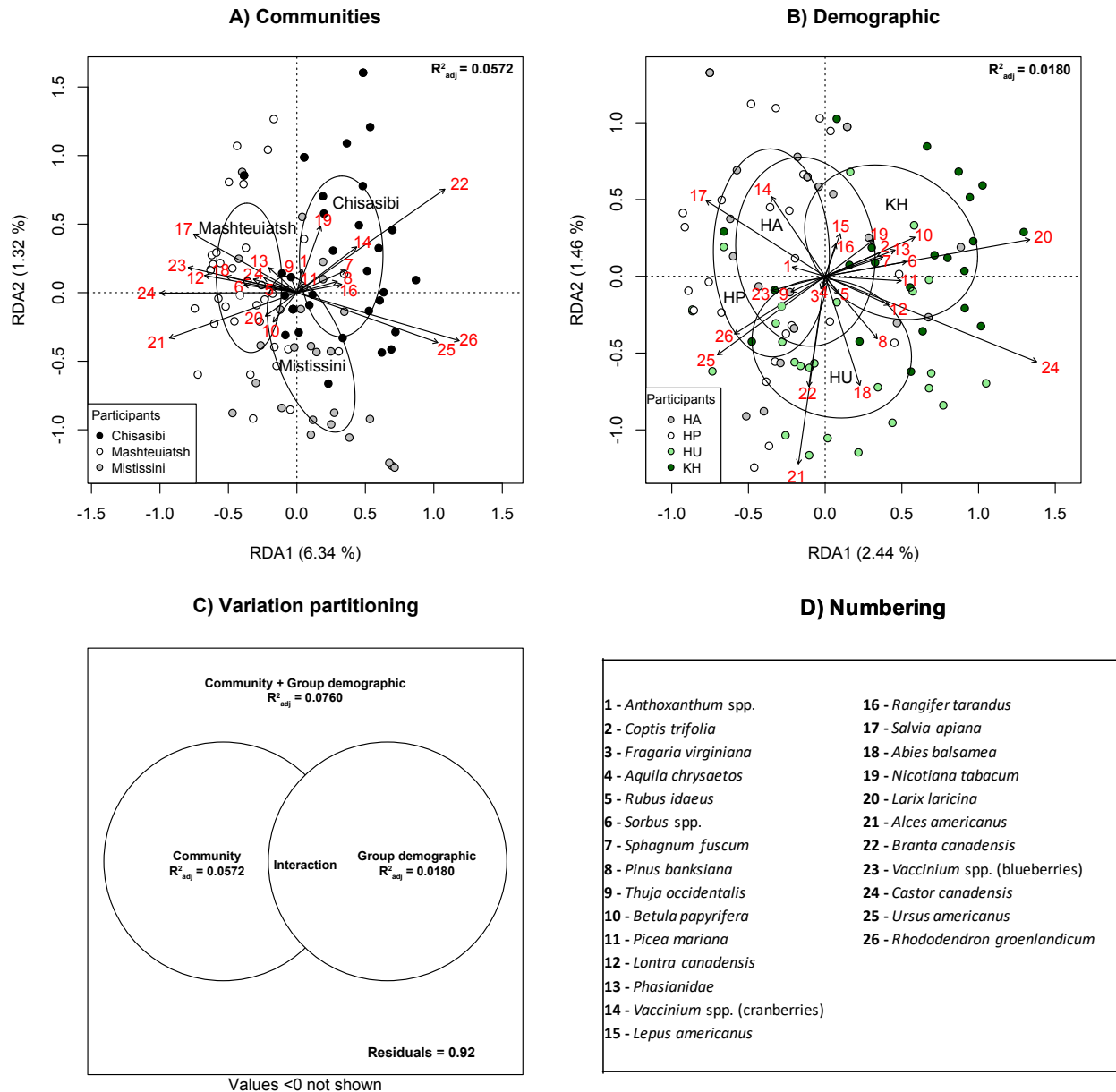


Figure 4.7. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of animal and plant species. Species were cited by participants when describing local Indigenous medicines. A) Variations in the distribution of species cited are tested in relation to the First Nation communities where participants reside and/or work, namely Mashteuiatsh, Mistissini and Chisasibi, as well as B) their relation to the healthcare sector, namely healthcare professionals (HP), healthcare administrators (HA), healthcare users (HU) and more specifically, knowledge holders (KH). Ellipses draw the standard deviations of participants around the centroids of each of their constraining factors. Arrows represent specific animal and plant species for which numbered labels (in red) are defined in D). C) Variation partitioning of the full MANOVA model showing no effect from an interaction between both factors.

goose (*Branta canadensis*; Anatidae) and cranberries (*Vaccinium* spp.), which prominently characterized participants from Chisasibi. None of the species cited tended to characterize participants from Mistissini more than the others. These participants laid primarily near the middle of these gradients.

A statistically significant difference between group demographics indicate that each group has a unique representation of Indigenous medicine. Although participants did not group as tightly around their centroids, the first canonical axis, and the only significant one ($p_{\text{RDA1}} = 0.0289$, $p_{\text{RDA2}} = 0.314$, $p_{\text{RDA3}} = 0.534$; **Figure 4.7b**), primarily distinguished between participants from within and outside the healthcare sector. Along the second canonical axis, knowledge holders were distinguished from the rest of the community, whereas further distinction from participants within the healthcare sector were poorly distinguished. Species that prominently characterized healthcare users were moose (*Alces americanus*), Canada goose (*Branta canadensis*) and balsam fir (*Abies balsamea*). Those that characterized knowledge holders were beaver (*Castor canadensis*), tamarack (*Larix laricina*) and paper birch (*Betula papyrifera*). These were generally inversely correlated with by sage (*Salvia apiana*), cranberries (*Vaccinium* spp.), common Labrador tea (*Rhododendron groenlandicum*), black bear (*Ursus americanus*) and blueberries (*Vaccinium* spp.), which prominently characterized both groups of participants from the healthcare sector.

To take into account the broader picture of Indigenous medicines, major subthemes were summarized using the Shannon-Wiener diversity index. Ordinations performed on the broader thematic dataset produced similar results to those obtained when analysing cited species only (**Figure 4.6**). A statistically significant ($p < 0.001$, $R^2_{\text{adj}} = 0.167$), two-way MANOVA by partial tb-RDA reveals no significant interaction between communities and group demographics ($p = 0.450$), suggesting that differences in group demographics are expected to be similar among

communities. The model remained statistically significant ($p < 0.001$, $R^2_{\text{adj}} = 0.167$) without the interaction factor with both community ($p < 0.001$, $R^2_{\text{adj}} = 0.127$; **Figure 4.8a**) and group demographics ($p < 0.001$, $R^2_{\text{adj}} = 0.0355$; **Figure 4.8b**) being statistically significant. There was also a statistically significant difference between responses from Indigenous versus non-Indigenous participants ($p < 0.001$, $R^2_{\text{adj}} = 0.0245$; **Figure 4.8c**), though its contribution to the overall statistical model was not significant when added to both community and group demographics as explanatory variables ($p = 0.159$).

A statistically significant difference among communities indicates that each community has a unique representation of Indigenous medicine. Both canonical axes were statistically significant ($p_{\text{RDA1}} < 0.001$, $p_{\text{RDA2}} < 0.001$; **Figure 4.8a**). Participants group tightly around their centroids, seemingly separating the coastal community of Chisasibi from the inland communities of Mistissini and Mashteuiatsh along the first canonical axis (RDA1). ‘Beliefs’ along with ‘knowledge holders and practitioners’ were the themes that best varied along RDA1 though most other indicator themes, if they were weakly associated with this axis, seemed to vary along a third axis, not presented here. Nonetheless, characteristic themes for Chisasibi included ‘beliefs’, ‘knowledge holders and practitioners’, ‘teachings and protocols’, ‘morals and values’ and ‘traditional food and diet’, whereas those that characterized Mashteuiatsh included ‘land and bush’, ‘knowledge and wisdom’, ‘balanced health and well-being’, and ‘ancient, ancestral and millennial’. With the exception of ‘traditional customs and way of life’ (20), Mistissini noticeably lacked characteristic themes, instead lying in the middle of an apparent gradient of opposing themes between the northernmost and southernmost communities, Chisasibi and Mashteuiatsh respectively.

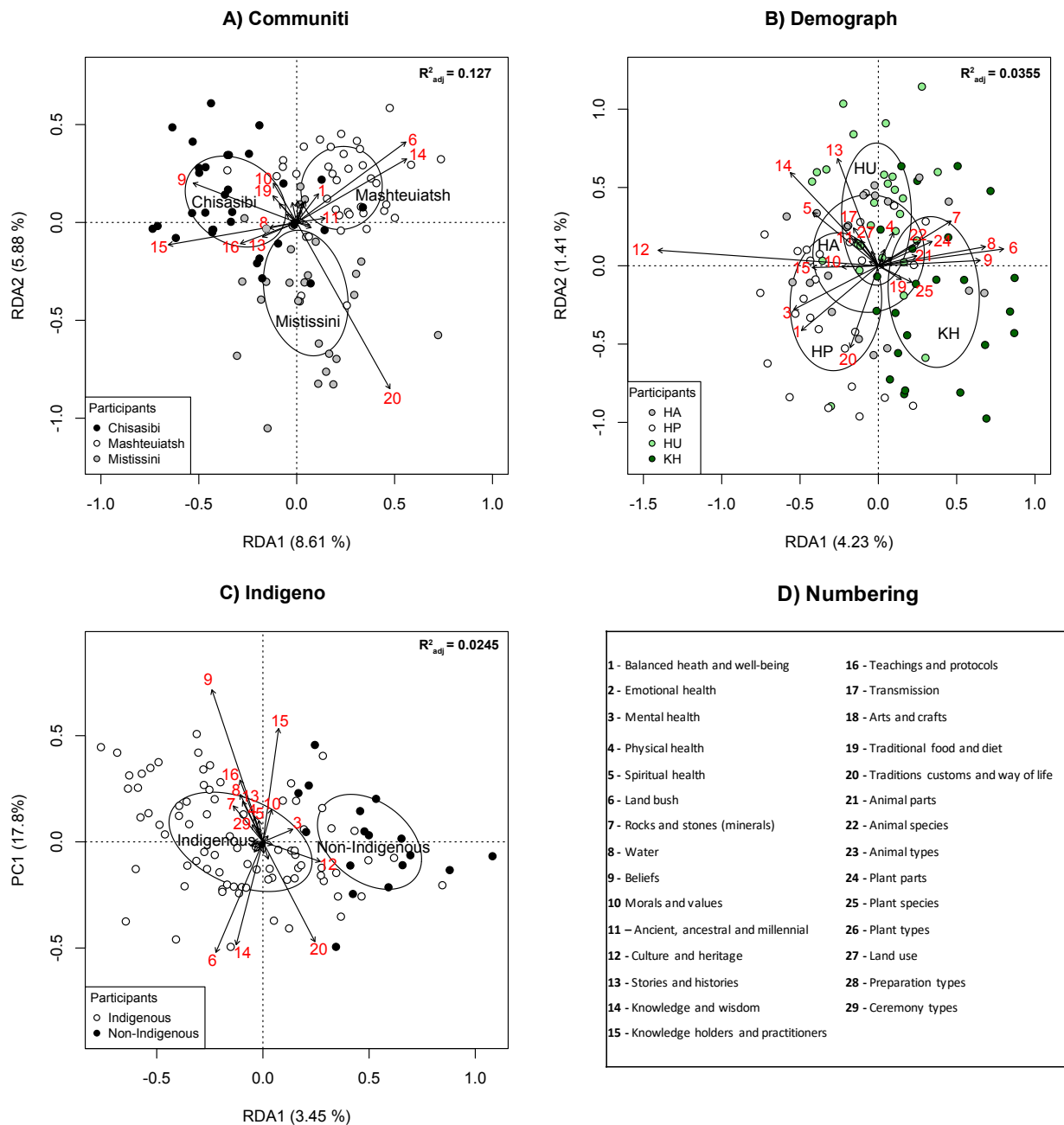


Figure 4.8. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on the frequency count of themes. Themes were cited by participants when describing local Indigenous medicines. A) Variations in the distribution of cited themes are tested in relation to the First Nation communities where participants reside and/or work, namely Mashteuiatsh, Mistissini and Chisasibi, B) their relation to the healthcare sector, namely healthcare professionals (HP), healthcare administrators (HA), healthcare users (HU) and more specifically, knowledge holders (KH), as well as C) identifying as Indigenous or not. Ellipses draw the standard deviations of participants around the centroids of each of their constraining factors. Arrows represent specific themes for which numbered labels (in red) are defined in D).

A statistically significant difference among group demographics also indicates unique representations of Indigenous medicine, though participants did not group as tightly around their centroids as with communities. The first canonical axis, and the only significant one ($p_{RDA1} < 0.001$, $p_{RDA2} = 0.362$, $p_{RDA3} = 0.540$; **Figure 4.8b**), primarily distinguished between participants from within and outside the healthcare sector. Along the second canonical axis, knowledge holders and healthcare professionals appeared to distinguish themselves from healthcare administrators and the rest of the community. Themes that prominently characterized healthcare professionals were ‘balanced health and well-being’, ‘mental health’ and ‘traditional way of life’, ‘culture and heritage’ and ‘knowledge holders and practitioners’. Those that characterized knowledge holders were the ‘land and bush’, ‘water’, ‘rocks and stones’, ‘beliefs’, ‘plant parts’, ‘plant species’, ‘animal parts’, ‘animal species’ and ‘traditional food and diet’. Although other healthcare users and healthcare administrators tend to overlap in the middle of a gradient opposing healthcare professionals from knowledge holders, themes like ‘spiritual health’, ‘knowledge and wisdom’ and ‘stories and histories’ appear to characterize this cluster of participants.

4.5 Discussion

4.5.1 Indigenous medicinal systems adapted for lifestyle diseases

When defining and explaining local Indigenous medicines, the responses of Indigenous participants reflect a diversity of concepts, notions and themes that underline a complex vision of medicine in a highly holistic model involving the interaction of people with nature (**Figure 4.3**, **Table 4.2**). This agrees with the conceptualization of the environment deeply attached to the animist ontologies variously described for Peoples of subarctic Canada (Descola 2005a, 2007;

Tanner 2007; Berkes 2012), and merely corroborates an existing body of knowledge and literature regarding the medicinal and health systems of the Cree of Eeyou Istchee and the Pekuakaminualtsh that underscore these elements (Adelson 1992, 2000; Robertson 2011; Radu et al. 2014; DyckFehderau 2017).

It is important to note that the term “Medicine Wheel” was not employed by most participants, particularly Elders. Its concepts, nonetheless, could be best reprised under the notions of health and well-being, local customs and the land (**Table 4.2, Figure 4.3**), which form a set of teachings unique to each community included here. Indeed, there are a range of representations of the Medicine Wheel interpreted by First Nation Peoples across North-America that promote balance and health as inextricably linked to the environment (Wenger-Nabigon 2010; Young et al. 2015). The Medicine Wheel described by Cree Elders in Alberta, for example, provides teachings through the meaning of colours, seasons, cardinal directions, symbolic animals, stages of life and other elements of nature like the sun, the moon, thunder and spirits (Wenger-Nabigon 2010; Mawhiney and Nabigon 2011; Young et al. 2015). Regardless of the name given to these models, they allow for the interpretation of the human’s place and his interaction with the environment from a physical and social perspective. Herein lies the strength of these holistic representations of health and healing: they are resilient to the unique realities and experiences of individuals and communities.

Hence, our results strengthen the idea that access and connection to the land is a central and important tenet for the Cree and Innu in achieving a sense of good health, wellness and well-being, as amply expressed by people living with diabetes throughout all Eeyou Istchee First Nations (DyckFehderau 2017). In keeping with Walsh et al. (2018:3), if ““break with the land is the single most important factor in health problems among Aboriginal people’ (as cited in Robbins and Dewar

2011, p. 13), then connection to the land may be a crucial part of Indigenous mental health and healing initiatives.”

The place of nature in the medicinal systems of the Cree and the Innu is put at the forefront in a number of ethnobotanical (Association des Métis et Indiens hors réserves 1982; Marshall et al. 2003; Marshall 2006; Leduc et al. 2006; Laurendeau 2011; Rapinski 2012; Forêt modèle du Lac-Saint-Jean 2015) and ethnopharmacological studies (see Haddad et al. 2012) that have focused on the medicinal uses and potential of plants. Although many of these studies have been realized in an effort to preserve knowledge and develop culturally adapted approaches to healthcare treatments and delivery systems in First Nation communities (Cuerrier et al. 2012; Haddad et al. 2012), in trying to achieve this, our results suggest that it is ill-advised to take these elements out of their greater holistic frame.

There are various examples of land-based healing programs and interventions in First Nation communities across Canada (Radu et al. 2014; Dobson and Brazzoni 2016; Walsh et al. 2018). These take place in nature, for short to extended periods of time, and apply the concepts of a connection between people and the land in a holistic approach. The Carrier Sekani Family Services, which serves 11 First Nations in North-Western Canada, has run a land-based addiction recovery program for over 25 years (Dobson and Brazzoni 2016). On the western coast of James and Hudson Bay, grassroot land-based interventions were programmed in the Moose Cree First Nation in response to youth suicides (Walsh et al. 2018). Whereas in Chisasibi, a land-based healing program already exists for participants struggling with addiction and selected based on self-referrals or referrals by the Chisasibi Justice Committee (Radu et al. 2014).

In delivering its program in Chisasibi, Elder Eddie Pash outlines his healing pedagogy by incorporating the same three major components elucidated in this study (Radu et al. 2014), namely

1) land and nature, 2) Cree concepts of wellness (**miyupimaatisiun**) and 3) intergenerational knowledge transfer from a perspective rooted in a Cree way of life (**iiyiyu pimaatisiwin**). These are scheduled into the program using lectures, or storytelling, based on Cree teachings and history, then put into practice with land use activities associated with hunting, trapping, fishing and the upkeep of the camp, for example. Basso (2016) argues the importance of this relation with life on the land in connecting people with stories and memories of the past that are rooted in nature and the environment; thus, the land is contextually significant as a ‘place of healing’ where the practice of local medicines and way of life find their ultimate expression (Radu et al. 2014). Places of particular significance for these practices may be considered cultural keystone places (Cuerrier et al. 2015b). By acting as a place of healing, the land is to local Indigenous healing systems what clinics and hospitals are to the biomedical system.

In promoting personal responsibility and harm-reduction, primarily employed to tackle the behavioral aspect of addiction problems (Wardman and Quantz 2006; Hawk et al. 2017), such programs are generally developed and delivered to address health problems with a mental, emotional and spiritual dimensions of wellness and well-being (Radu et al. 2014; Dobson and Brazzoni 2016; Walsh et al. 2018). But these also take on a physical dimension with land use activities that focus on survival, health and healing as an ongoing process (Radu et al. 2014). In keeping with Cunsolo Willox et al. (2012) and Walsh et al. (2018), who argue that access and connection to the land must be framed as an important determinant of health and well-being, similar land-based approaches may as well be helpful for such chronic health problems as diabetes and could be delivered with the support of the biomedical system.

The case for this suggestion can be made due to the fact that land-based healing approaches innately promote similar lifestyle changes to that advocated in diabetes treatments, such as

increasing physical exercise (Sigal et al. 2018b) and promoting dietary changes through nutrition therapy (Sievenpiper et al. 2018b). This intrinsic interconnection between health and the land is characteristic of the notion of social-ecological health (Berkes et al. 2003; Parlee et al. 2005). In fact, for the Cree of Eeyou Istchee, the closest word for health, **miyupimaatisiun**, loosely translates to being alive and well and more broadly implicates the ability to pursue land use activities, access food that comes from the land, keep warm, enjoy life and be embedded within the community (Adelson 1992, 2000; Radu et al. 2014). “It includes the biomedical concept of health (or absence of disease), but moves beyond it by linking the body to the land and identity” (Radu et al. 2014:95). In a similar fashion, the Ilnu words **milueliniun** and **miluelimun** also move beyond the absence of disease in its concept of health by linking the body to the land through cultural expressions (**Figure 4.9**). If the Ilnu and Cree words for health are different, this may reflect the necessity and pressure of translating widely used terms from the biomedical system into languages that do not have direct equivalents rather than reflecting fundamental differences in concepts.

Indeed, if participating in land-based activities like hunting, fishing, gathering and undertaking various household chores leads to an increase in physical activity, they also lead to the access and increased consumption of nutrient-dense foods, thus contributing to food security (Kuhnlein and Receveur 1996; Kuhnlein et al. 2004, 2006, 2009; Compher 2006; Johnson-Down and Egeland 2013). Moreover, a study on the quality of diet amongst the Cree of Eeyou Istchee identified greater insulin resistance in participants with a dietary pattern characterized by higher junk food consumption (Johnson-Down et al. 2015). Another study found that those consuming higher quantities of fish had reduced risk factors for cardiovascular diseases (Dewailly et al. 2002). Hence, access and connection to the land is more than a central tenet to achieving good health, but a real-life outcome.



Figure 4.9. Illustrations of the concepts of well-being and balanced health represented in Mastheuiatsh’s healthcare center (Nituhkulinitshuap). Left) An interpretation of the Medicine Wheel, focussing on mental (black), spiritual (white), physical (yellow) and emotional health (red). Right) A poster on display, entitled “Miluelinium mahk mamu miluelimun – Collective health and well-being”, expressing the same centre’s approach to health intervention and the connection to the land (outer ring of the bottom circle reads: “In health with the Earth our Mother”). Photo credits: M. Rapinski, October 2019.

The consumption and use of plant and animal remedies can parallel antidiabetic pharmacotherapies (Lipscombe et al. 2018b), though frequent obstacles to their use involve the belief that there is lack of research and evidence (Ouellet et al. 2018). This assumption is largely unsupported for many of the plants listed here (**Table 4.3**), as our team has generated a large body of evidence to the benefit of their antidiabetic potential (see Haddad et al. 2012). The perception that there is a lack of proof may more accurately reflect the reality that healthcare professionals have limited time, due to workload, to give proper attention to the medical situation of each patient, nor to keep up with the most recent and quickly evolving findings in medical, pharmacological and phytochemical research and literature.

Nonetheless, some of the plants with which healthcare professionals and administrators were most familiar with were also some of the most cited species by Indigenous participants (*i.e.*, cranberries and blueberries [*Vaccinium* spp. (cranberries [14] and blueberries [23]) and common Labrador tea [*Rhododendron groenlandicum* (25); **Figure 4.7b**]). These species benefit not only from media attention, but their health benefits are also supported by a number of studies. Indeed, common Labrador tea (*Rhododendron groenlandicum*) was found to attenuate insulin resistance *in vivo* (Ouchfoun et al. 2016) and possessed antioxidant activities due to its content in polyphenols (McCune 1999; McCune and Johns 2002, 2003, 2007; McCune et al. 2006), which contribute to its antidiabetic potential by decreasing adipogenesis *in vitro* (Rapinski et al. 2015; Eid et al. 2016). Similarly, berries like blueberries and cranberries (*Vaccinium* spp.) are generally accepted to possess cardio-protective benefits due to their polyphenolic content (Neto 2007; Basu et al. 2010; Kristo et al. 2010, 2012). Moreover, blueberries (*Vaccinium angustifolium*) have shown antidiabetic properties *in vitro* and *in vivo* (Martineau et al. 2006; Grace et al. 2009), whereas highbush blueberries (*Vaccinium corymbosum*) decreased cardiovascular risk factors in obese

participants with metabolic syndrome in a randomized controlled clinical trial (Basu et al. 2010). In fact, epidemiological evidence, supported by several pre-clinical and clinical trials, suggests that incorporating blueberries in the diet may lower the risk of developing T2D and increase insulin sensitivity (Stull 2016).

4.5.2 Understanding Local Needs

Developing culturally adapted approaches to health treatments requires an in-depth understanding of the local knowledge, attitudes and practices regarding health in the communities that healthcare services serve. Plant and animal use are undoubtedly important components of local health systems and pharmacopoeia. The list provided here is not exhaustive (**Table 4.3**) as a number of other species are known to the Cree of Eeyou Istchee and the Pekuakaminualtsh (Marshall 2006; Leduc et al. 2006; Cosset and Mansion 2009; Laurendeau 2011; Forêt modèle du Lac-Saint-Jean 2015). For example, clubmosses (*Lycopodium* spp.; Lycopodiaceae) have previously been reported in both Mistissini and Chisasibi (Marshall 2006; Leduc et al. 2006; Cosset and Mansion 2009; Fireman 2011), whereas frogs (not specified) and store-bought oatmeal (*Avena sativa* L.; Poaceae) have also been reported in Chisasibi (Marshall 2006), the harlequin blue flag (*Iris versicolor* L.; Iridaceae) in Mistissini (Cosset and Mansion 2009), as well as the rock polypody (*Polypodium virginianum* L.; Polypodiaceae) in Mashteuiatsh (Forêt modèle du Lac-Saint-Jean 2015). Furthermore, a number of species known to these communities, as evidenced by written records, were not cited in this study, these include serviceberries (*Amelanchier* spp.; Rosaceae), goldthread (*Coptis trifolia*; Ranunculaceae), black crowberry (*Empetrum nigrum*; Ericaceae), poplars (*Populus* spp.; Salicaceae), pin cherry (*Prunus pensylvanica*; Rosaceae), willows (*Salix* spp.; Salicaceae) and cattail (*Typha latifolia*; Typhaceae) for Mistissini (Leduc et al. 2006; Cosset

and Mansion 2009), porcupine (*Erethizon dorsatum*; Erethizontidae), snowberry (*Gaultheria hispidula*), American cow parsnip (*Heracleum maximum*; Apiaceae), white spruce (*Picea glauca*) and mountain-ashes (*Sorbus* spp.) for Chisasibi (Marshall 2006; Fireman 2011), as well as northern pitcher plant (*Sarracenia purpurea*; Sarraceniaceae) and sheep laurel (*Kalmia angustifolia*; Ericaceae) for Mashteuiatsh (Forêt modèle du Lac-Saint-Jean 2015). Hence, a number of community-specific species presented here may in fact be common to the communities included in this study as many, namely Canada yew (*Taxus canadensis*; Taxaceae), cattail (*Typha latifolia*), pin cherry (*Prunus pensylvanica*), common plantain (*Plantago major*; Plantaginaceae), northern pitcher plant (*Sarracenia purpurea*), wild sarsaparilla (*Aralia nudicaulis*; Araliaceae), bunchberry (*Cornus canadensis*; Cornaceae), common juniper (*Juniperus communis*; Cupressaceae) and mint (*Mentha* sp.; Lamiaceae) have been reported in the pharmacopoeia of other Cree of Eeyou Istchee and Innu communities (Association des Métis et Indiens hors réserves 1982; Marshall et al. 2003; Rapinski 2012; Clément 2014).

Such differences in species citations from the literature may reflect methodological compromises in discussing overarching themes as opposed to focussing on specific subthemes (e.g., plant species, ceremonies and practices). Hence, species presented here merely reflect a snapshot of a larger system of animal and plant use. However, this should not be a reason to undermine the uniqueness of each community's health and medicinal systems.

The holistic nature of the meaning of health for the Cree of Eeyou Istchee has already been described and discussed at length (Adelson 1992, 2000; Radu et al. 2014) and the holistic aspect of health is generally accepted as a characteristic of the medicinal systems of many First Nations across North America (Berkes et al. 2003; Parlee et al. 2005; Truth and Reconciliation Commission of Canada 2015a). This appears to be true for all three First Nations implicated in this study, where

health and healing are highly interconnected with the land (**Figure 4.3, Table 4.2**). However, differences in response patterns distinguishing participants from Chisasibi, Mistissini and Mashteuiatsh underscore remarks from some participants that each First Nation community is different, even those within the Grand Council of the Cree (*i.e.*, Chisasibi and Mistissini). This is highly relevant to the CBHSSJB that administers and delivers the health services of nine different communities through both Indigenous and non-Indigenous personnel.

Differences amongst participant responses suggest that the southernmost community, Mashteuiatsh, and the northernmost community, Chisasibi, are the most different. Undeniably, the presence or absence of species within a specific territory may certainly explain why some are not cited in a given community's pharmacopoeia. Though species diversity tends to decrease with latitude in Québec (Weiser et al. 2018), this does not appear to be the sole factor in explaining the apparent geographical gradient from Chisasibi to Mistissini as indicator species of these communities are common throughout the entire region (*e.g.*, moose [*Alces americanus*], beaver [*Castor canadensis*], blueberries and cranberries [*Vaccinium* spp.], common Labrador tea [*Rhododendron groenlandicum*]; **Figure 4.7a**). These differences may better be explained by a multitude of historical, political, geographical and cultural factors as the broader analysis of themes suggest in providing similar grouping results (**Figure 4.7 and 4.8**).

Of historical origin, the prolonged influence of missions from different Christian denominations (*e.g.*, Anglican, Catholic, Evangelical, Pentecostal), in combination with residential schools administered by the Anglican or Catholic Church with the support of provincial and federal governments (Tanner 2007; Blacksmith 2011; Bousquet 2012; Kim 2019), have had a profound negative impact on the transmission of Indigenous knowledge and practices (Truth and Reconciliation Commission of Canada 2015b). Indeed, after extended fieldwork in Mistissini,

Tanner (2007) observed and discussed the loss of a number of practices through time and changing lifestyles, though also noting the adoption of the pow-wow and other pan-Indigenous practices more recently. Incidentally, the last performance of the shaking tent documented by researchers in Mistissini is traced back to the community's 1972 pow-wow, considered "a newly-instituted summer event" (Tanner 1979:112). Furthermore, the political climate surrounding the James Bay and Northern Québec Agreement for the Cree—initiated to protect the Land from large-scale hydroelectric development (Saganash 2011)—and the current land claim negotiations between Mashteuiatsh and the Governments of Québec and Canada, which are still not resolved since the statement of claim has been filed in 1979 (Premières Nations de Mamuitun et de Nutashkuan et al. 2004; Tipi and Boivin 2020), details different relationships between First Nations and governments regarding land claims, self-determination and self-government with respect Indigenous rights and title. That these medicinal systems evolve over time appears as an undeniable outcome that has been observed elsewhere, such as the Wayãpi pharmacopoeia in South America (Odonne et al. 2011).

The grouping pattern of participants based on their community of origin also appears to underscore processes of culture and knowledge transfers based on geographical proximity between neighbouring communities. Whereas Chisasibi is also home to a small Inuit community, Kiggaluk, Mashteuiatsh is historically considered a place of meeting and exchanges between Nations. The Nitassinan bordering a number of First Nations, corn and tobacco would have been acquired through trade with Iroquoian Peoples further south (Rousseau 1957a; Conseil des Montagnais du Lac-Saint-Jean 2003). Indeed, early records of sacraments delivered by the Jesuit François de Crespieu around the Lac-Saint-Jean indicate a number of First Nations, notably Cree from Mistissini, but also Algonquin and Atikamekw as early as the mid 17th century (Gill 1989; Hébert

1994). Written and oral history testifies further to these relationships, particularly between Mashteuiatsh and Mistissini (Burgesse 1944; Rousseau 1945b; Kurtness and Girard 1997).

When communities are in close geographical contact, knowledge transfers that cross cultural boundaries are bound to occur, as demonstrated by Tareau et al. (2019) on the use of medicinal plants in French Guiana. Of notable example here, although northern Labrador tea (*Rhododendron tomentosum*; Ericaceae), widely used amongst Inuit populations in Québec's Arctic and Subarctic (Cuerrier and Elders of Kangiqsualujjuaq 2011; Cuerrier and Elders of Kangiqsujuaq 2011; Cuerrier et al. 2011; Black et al. 2011), does not grow near Mistissini, it was obtained through exchanges with Eeyou Istchee communities from the coast, namely Chisasibi and Whapmagoostui. Whereas species like potatoes (*Solanum tuberosum*; Solanaceae), onions (*Allium cepa*; Amaryllidaceae), cabbage (*Brassica oleracea*; Brassicaceae), and black pepper (*Piper nigrum*; Piperaceae) may very well have been introduced to the Innu pharmacopeia (Mashteuiatsh) from French-Canadian herbalism due to close contact and mixing with neighbouring non-Indigenous communities. By the beginning of the 1980s, the use of such introduced species as potatoes (*Solanum tuberosum*), onions (*Allium cepa*) and turnips (*Brassica rapa* var. *rapa* L.; Brassicaceae) was already documented in that First Nation (Association des Métis et Indiens hors réserves 1982).

The presence of non-Indigenous species in these pharmacopoeias provides compelling evidence of the constantly evolving nature of Indigenous medical systems through such processes as inter-community shifting (Odonne et al. 2011). Although it is outside the scope of this study to establish whether the predominant or unique use of indigenous species or practices is the result of truly community-specific knowledge, a resulting patchwork of a more common and widespread body of knowledge whose transmission was corroded by aggressive governmental assimilation

policies, or a mix of the two, these are evidently prone to processes of inter-community shifting (Tanner 2007). But in a similar process to the speciation of organisms within their environments, pharmacopoeias and practices may also evolve through processes of intra-community shifting (Odonne et al. 2011). Indeed, Tanner (2007) posits that elements of the ‘Eat All’ feast, though no longer practiced in Mistissini, now appear in contemporary Cree practices like community feasts.

Considering all these factors, it is not surprising that the discussion regarding the authenticity of local knowledge and practices pertaining to one community often came up when defining Indigenous medicine. This was particularly true of certain species (*e.g.*, sage [*Salvia apiana*], sweetgrass [*Anthoxanthum* spp.; Poaceae] and tobacco [*Nicotiana tabacum*; Solanaceae]), their symbolic meaning and purpose (*e.g.*, spiritual, emotional, mental and physical) and various associated practices acquired through exchanges with other First Nations, as noted by Tanner (2007) following fieldwork in Mistissini. What is clear, however, is that in principle, the medicinal systems of all three communities are innately dynamic and therefore prone to evolving. Roy et al. (2013) notes how bannock bread was adopted by Innus from Pessamit as trading first began with Europeans; despite major transformations propelled by colonialism in Innu foodways and identity relations by the second half of the 20th century, it had nonetheless become a distinctive Indigenous food. In a similar fashion, identity is also revealed and strengthened through the therapeutic act, both of which are dependent of personal and collective experiences. Multiple community-oriented events like the pow-wows, held annually in Chisasibi and Mashteuiatsh, and feasts (**makusham**) facilitate intercultural exchanges in an environment that fosters cultural affirmation (**Figure 4.10**). In constantly evolving and adapting itself to peoples’ individual needs and realities, whether they be physical, emotional, mental or spiritual, these systems are contemporary and unique to everyone who adheres to its concepts. But more importantly, due to their dynamic nature, these systems are



Figure 4.10. Cross cultural exchanges in action. A nurse for the Cree Health Board, of Cree and Inuit origin from Chisasibi dancing at Mashteuiatsh’s annual Pow-Wow. Each object adorned on the regalia holds healing meaning specific to each dancer. Photo credit: M. Rapinski, July 2016.

inherently resilient in their capacity to evolve and adapt to treating contemporary lifestyle diseases like diabetes.

4.5.3 What does greater representation of Indigenous medicine look like?

Our results indicate significant differences in the definition and representation of Indigenous medicine between participants within and outside the healthcare sector, regardless of the community. Although participants from the healthcare sector generally described Indigenous medicine with a more restricted diversity of terms and concepts (**Figure 4.6**), some of the key themes that characterized this group reflect an understanding of the cultural, holistic and interconnected nature of Indigenous medicine (*i.e.*, ‘balanced health and well-being’, ‘traditional way of life’, ‘culture and heritage’; **Figure 4.8b**). Moreover, that ‘knowledge holders and practitioners’ are another characteristic theme for this group is also suggestive of the recognition that healthcare professionals have of the role of these members of the community as references for local medicinal practices. Indeed, this appears to be well supported as knowledge holders were characterized by increased knowledge of plant and animal species, amongst other key elements of Indigenous medicines (*i.e.*, water, rocks and stones; **Figure 4.8b**).

Bridging the knowledge and cultural gap regarding the representation of local Indigenous medicines between healthcare professionals and community knowledge holders is certainly beneficial to the development and delivery of culturally adapted treatments and healthcare systems. However, considering the complexities and uniqueness of local medicinal systems of each individual community is sure to add layers of difficulty in achieving this. For chronic health problems like diabetes, where healthcare treatments are increasingly personalized and patients are followed by larger teams of healthcare professionals (Crowshoe et al. 2018b; Ivers et al. 2019), the

benefits of including local knowledge holders and practitioners may very well outweigh perceived risks to using local medicines like interactions with biomedical drugs or a lack of research on effectiveness and safety, for example (Tam et al. 2014; Ouellet et al. 2018). Nonetheless, our results suggest that the presence of local Indigenous staff in the healthcare sector reduces the knowledge gap between healthcare users and providers (**Figure 4.8b** and **c**) in understanding local medicines within a holistic frame of wellness and well-being. In overcoming more restricted perceptions of Indigenous medicines based on plants for physical healing or ceremonies for spiritual healing, this may help prevail over concerns regarding efficacy and safety that some healthcare professionals may have.

Increasing access to local Indigenous medicines therefore begins by recognizing the fact that holistic approaches to wellness are fundamental to Cree and Innu medicines. Land-based activities like berry picking, for example, not only increase physical activity, but also access to nutrient-dense foods that inherently blur the line between nutrition and medicine, all the while connecting personal health to the Land from a mental, emotional and spiritual perspective. Such activities may be more culturally relevant and meaningful to diabetics than conventional approaches to lifestyle interventions that fall within the scope of the market economy (*i.e.*, purchasing healthy foods at the supermarket) and a more sedentary way of life (*i.e.*, walking around town vs. occupying the Land). Hence, increased access to local medicines and practices can appear very well through indirect, as well as direct implication of local healthcare services.

In direct implication from the healthcare sector, this study provides the following considerations:

- Develop and deliver land-based healing programs for major health problems, including but not limited to chronic health diseases like diabetes.

- Build and administer a healing centre and/or facilitate retreats on the land.

While delivering on these objectives may be susceptible to such barriers as funding capacity or political will from higher levels of government (Ouellet et al. 2018), these considerations are supported by the Truth and Reconciliation Commission of Canada (2015b:3), which calls for “the federal government to provide sustainable funding for existing and new Aboriginal healing centres to address the physical, mental, emotional, and spiritual harms caused by residential schools.”

In indirect implication from the healthcare sector, this study provides the following considerations:

- Create, and continue cultural safety training opportunities for healthcare workers, namely non-Indigenous staff, to familiarize themselves with the community, its history, its customs and its people (*e.g.*, language and culture training, short to long retreats on the land with community Elders).
- Create and develop functional networks with existing services that provide a cultural space for local medicines, including Band Offices and their programs (*i.e.*, Chisheinu Chiskutamaachewin in Mistissini), museums, grassroot organisations (*e.g.*, Parc Sacré, Plume Blanche), and more importantly, community Elders and knowledge holders that are regarded as pillars of the community.
- Encourage lifestyle changes that reflect local customs (*e.g.*, berry picking, harvesting, eating wild game and fish).
- Continue to monitor, as expected during doctor’s appointment and nurse’s visit, and support patients that are using local medicines in their healthcare choices by focusing on common targets (*e.g.*, glycemic control) instead of diverging means of

treatment (*e.g.*, the constraints of regimented pharmacotherapies on the realities of extended periods of time on the land).

Delivering on these considerations requires further development of the technocratic and participation pole of community health (Conill and O’Neill 1984), principles that are in keeping with the Truth and Reconciliation Commission of Canada (2015b:3) that call not only for cultural competency training to be provided to all healthcare professionals, but also for all “those who can effect change within the Canadian health-care system to recognize the value of Aboriginal healing practices and use them in the treatment of Aboriginal patients in collaboration with Aboriginal healers and Elders where requested by Aboriginal patients.” For Mashteuiatsh, Mistissini and Chisasibi, this certainly calls for governing authorities on medical ethics like the Collège des médecins du Québec and the Ordre des infirmières et infirmiers du Québec to review what place the healthcare community gives to Indigenous practices and what role they play in dispensing or facilitating access to Indigenous medicines with respect of Article 24 of the United Nations (2007) Declaration on the Rights of Indigenous Peoples and the calls for action on health by the Truth and Reconciliation Commission of Canada (2015b).

4.6 Conclusions

Local Indigenous medicinal practices in the First Nation communities of Mashteuiatsh, Mistissini and Chisasibi extend far beyond the use of medical plants and animals for curative purposes. Though these practices have an important place in these medicinal systems, they are best understood in a highly interactive model between health and medicine. This system involves three major components that include: 1) the use of all components of the land (*i.e.*, plants, animals, rocks

and water), 2) to reach a balanced sense of wellness and well-being (*i.e.*, physical, mental, emotional and spiritual) through 3) the expression of local customs and ways of life. Key to the workings of this system is access and connection to the land as a ‘place of practice’, a ‘provider of foods and medicines’ and as a ‘healer and teacher’. Land-based healing programs have adapted these concepts of Indigenous medicinal systems to mental health problems. And these appear to be well adapted to complex life-style diseases like diabetes by focusing on land use activities that promote an increase in physical exercise and access to nutrient-dense and culturally relevant foods. Although the use of plants has the pharmacological potential to help diabetic patients, influence from healthcare orders (*i.e.*, for nurses) in Québec may provide a major obstacle for the direct involvement of healthcare service providers in this aspect. Increasing the representation and the access to local Indigenous medicines may be achieved, in the broader sense, through the development and delivery of treatments that focus on land use activities. Building and developing on relationships with other community services and programs may benefit in tailoring these services based on the specificities and needs of each First Nation in community health approaches. Furthermore, creating opportunities for healthcare professionals, both Indigenous and non-Indigenous, to connect with people and local customs may help bridge the gap in the representation of Indigenous medicines and overall well-being in an effort to create more trust and confidence between healthcare service providers and users. Faced with a holistic ethos regarding diseases in a society, it is crucial for healthcare providers to understand this vision.

Access and connection to the land is a central component of the medicinal and health systems of the Pekuakamiulnuatsh from Mashteuiatsh and the Cree of Eeyou Istchee from Mistissini and Chisasibi. If alienation from the land is one of the major contributing factors at the root of health problems among Indigenous Peoples in Canada (Robbins and Dewar 2011; Walsh et

al. 2018), then re-establishing its link is the remedy. Achieving this, however, is not just a healthcare issue, but a political one as well, as this relation with the land is in ontological opposition with extractive and economic policies of governing bodies. Indeed, access and connection to the land is a central question at the heart of Indigenous claims across all the Americas (Palisse and Davy 2018; Turner 2020). In current land-claim and treaty negotiations with both federal and provincial governments, Mashteuiatsh highlights the land as a central notion to Innu affirmation of culture and practices, territorial occupation and autonomy (economic, dietary, health, education, subsistence) (Premières Nations de Mamuitun et de Nutashkuan et al. 2004). Furthermore, the Truth and Reconciliation Commission of Canada (2015b:5) calls upon all levels of governments to acknowledge the direct effects of their policies on the current state of Indigenous Peoples' health, "to repudiate concepts used to justify European sovereignty over Indigenous peoples and lands, such as the Doctrine of Discovery and *terra nullius*, and to reform those laws, government policies, and litigation strategies that continue to rely on such concepts." This requires the recognition, and more importantly, the implementation of Indigenous Peoples' rights to self-government and self-determination as identified internationally by the United Nations Declaration on the Rights of Indigenous Peoples.

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Chapitre 5 - Treating Diabetes and the representation of the People's Medicine in the healthcare sector: a cross-cultural comparison of Indigenous medicines in the Americas.

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5.1 Résumé / Abstract

Les peuples autochtones du monde entier sont touchés de manière disproportionnée par le diabète. Parmi eux, les Cris d'Eeyou Istchee et les Innu (Québec, Canada), ainsi que les Parikwene (Guyane française, France), recourent à leurs médecines locales pour traiter cette maladie. Bien que certaines communautés autochtones du Canada bénéficient d'un plus grand contrôle sur leurs services de santé, ce n'est pas le cas pour de nombreux Peuples dans les Amériques. Afin d'évaluer comment cela affecte la représentation de ces médecines dans le secteur de la santé, des descriptions interculturelles des médecines locales concernant le diabète ont été analysées dans une approche de recherche à méthodes mixtes. Au total, 173 entretiens semi-dirigés ont été menés auprès de 208 participants travaillant en lien avec le secteur de la santé ou utilisant ses services de santé dans des communautés autochtones sur les deux continents américains. Les participants cris, innu et parikwene ont décrit les médecines liées au diabète à travers différents éléments du monde naturel, des pratiques et des coutumes locales, ainsi que des concepts distincts les liant à la Terre. Avec plus de 350 espèces citées, les pharmacopées animales et végétales ont été parmi les sujets les plus discutés. Celles-ci étaient liées entre elles aux systèmes alimentaires locaux via des notions associées au bien-être (Cris et Innu) ou à leurs propriétés organoleptiques (Parikwene). Dans les communautés où la population autochtone est plus impliquée dans leurs services de santé, la représentation des médecines locales était beaucoup plus proche entre les prestataires des services de santé et de leurs utilisateurs en capturant, entre autres, la pertinence du territoire pour le bien-être des diabétiques. Les résultats montrent non seulement que ces médecines sont indissociables du territoire, mais ils soulèvent des questions importantes sur la santé et les droits des peuples autochtones.

Mots-clés : diabète ; médecines Autochtones ; services de santé ; Cri ; Innu ; Palikur.

Indigenous Peoples around the world are disproportionately affected by diabetes. Amongst them, the Cree of Eeyou Istchee and the Innu (Québec, Canada), as well as the Parikwene (French Guiana, France), resort to their local medicines to treat this disease. Though some Indigenous communities in Canada benefit from a greater control of their healthcare services, many others throughout the Americas do not. In order to assess how this affects the representation of these medicines in the healthcare sector, cross-cultural descriptions of local medicines regarding diabetes were analyzed in a mixed-methods research approach. Overall, 173 semi-structured interviews were conducted with 208 participants working in connexion with the healthcare sector or using healthcare services in Indigenous communities across both American continents. Cree, Innu and Parikwene participants described medicines related to diabetes through different elements of the natural world, local practices, and customs, as well as distinct concepts linking them to the Land. With over 350 species cited, animal and plant-based pharmacopoeias were among the most discussed topics. These were linked to the local dietary systems together via notions associated with well-being (Cree and Innu) or their organoleptic properties (Parikwene). In communities where the Indigenous population is more involved in their healthcare services, the representation of local medicines was much closer between healthcare workers and users in capturing the relevance of the Land for the well-being of diabetics. Results not only show these medicines are inseparable from the Land, but they bring up important questions about the health and the rights of Indigenous Peoples.

Key words: diabetes; Indigenous medicines; healthcare services; Cree; Innu; Palikur.

5.2 Introduction

Globally, the number of adults with diabetes has more than quadrupled since 1980 when there were an estimated 108 million diabetics (NCD Risk Factor Collaboration 2016). The International Diabetes Federation (IDF) estimated that the diabetic population between the ages of 20-79 years reached 463 million people in 2019, affecting 9.3% of the global population in this age group, and that this prevalence is likely to increase to 700 million by 2045 (Saeedi et al. 2019). In 2017, there were approximately 5 million deaths attributed to diabetes in adults aged 20-99 years, accounting for 9.9% of the global cause of death worldwide for people in this age group (Cho et al. 2018), even surpassing the combined figure of annual deaths attributed to the human immunodeficiency virus (HIV), tuberculosis and malaria in 2015 (Ogurtsova et al. 2017). Furthermore, there are regional disparities in the prevalence of diabetes. While its rate is estimated in the western Pacific regions as well as North America and the West Indies at more than 10% of the population, it is estimated on the other hand that it is nearly 6% in Europe (Saeedi et al. 2019).

In addition to these regional disparities, there are also marked distinctions among Indigenous Peoples who are among the populations most at risk (WHO and IDF 2004; Yu and Zinman 2007; Herman 2017; Crowshoe et al. 2018b; Creatore et al. 2020). This is particularly true in Canada where the age-adjusted prevalence of diabetes is two to three times higher in the Indigenous population (Kuzmina et al. 2010; Public Health Agency of Canada 2018; Crowshoe et al. 2018b). Although it represents a particular geopolitical body, French Guiana, the only South American department of France, is not exempt from these geographical and populational health disparities (Richard et al. 2015; Fosse-Edorh et al. 2016; Mandereau-Bruno and Fosse-Edorh 2017; Fuentes et al. 2020; Sabbah et al. 2021). For the same age structure, the prevalence of diabetes, estimated at 8.08% in 2015, was 1.6 times higher than the national rate (Mandereau-Bruno and

Fosse-Edorh 2017). The demographic makeup of the people of French Guiana is characterized by large numbers of diverse Creole, Businenge, and Indigenous cultural groups (Renault-Lescure and Goury 2009), and data suggests that some populations are more affected than others. Delocalized Centers for Prevention and Care, called *Centres Délocalisés de Prévention et de Soins* (CDPS) operated by Cayenne's hospital, *Centre Hospitalier de Cayenne Andrée Rosemon* (CHC), report that the largest numbers of diabetic patients are found in Saint-Georges de l'Oyapock and Maripasoula (Guarmit et al. 2017), municipalities characterized by strong Indigenous and Businenge populations, namely Parikwene and Aluku respectively (Renault-Lescure and Goury 2009). Moreover, this reality is expressed through the discourse of the residents of Saint-Georges who identify diabetes as one of the main health problems (Van Gastel et al. 2021).

Indigenous Peoples in Canada and French Guiana are linked by a common history of colonialism that has been associated with social determinants of health and inequities, particularly regarding diabetes (Roy 1999; Adelson 2005; Bellier 2008; King et al. 2009; Elfort 2010; Chicot 2011; Filoche 2011; Jacklin et al. 2017; Voaklander et al. 2020). Over both North and South America, lifestyle changes associated with colonization have been rapid and are characterized by evangelization, monetization, forced schooling, sedentarization and dietary changes through the introduction of nutrient-poor, energy-dense market foods (Vieira-Filho 1978; Grenand 1981; Ouhoud-Renoux 2000a; Roy 2003; Compher 2006; Casey et al. 2006; Capiberibe et al. 2009; King et al. 2009; Downs et al. 2009; Metallinos-Katsaras et al. 2012; Roy et al. 2013; Voaklander et al. 2020). Moreover, sedenterization and dietary changes are tied to decreased food security, which the latter has been linked to higher risks of developing chronic health problems that included hypertension, coronary heart disease, obesity and T2D (Clement et al. 2018; Tait et al. 2018).

Despite health inequities and disparities in the incidence of diabetes, Indigenous Peoples across the Americas possess distinct health and medicinal systems rich in *materia medica* (Arnason et al. 1981; Grenand et al. [1987] 2004; Moerman 2009; Uprety et al. 2012). Indeed, self-medication is not unheard of amongst the various ethnic populations of French Guiana (Mosnier et al. 2020), whereas Diabetes Canada recognizes that diabetics may resort to several complementary means of treatment when they do not achieve the results expected from biomedical treatments (Grossman et al. 2018). Amongst its clinical practice guidelines, Diabetes Canada recommends that with the support of the biomedical healthcare system and other pertinent organizations, Indigenous Peoples establish programs to tackle diabetes that take into account their cultural dimensions and context, which include approaches, foods, knowledge, medicines, needs, perspectives, practices, traditions and values (Harris et al. 2013a; Crowshoe et al. 2018b). Though similar recommendations are provided to address the regional health inequities in French Guiana (Mandereau-Bruno and Fosse-Edorh 2017; Sabbah et al. 2021), the absence of legal recognition of the Indigenous title provides little place and opportunity for locally and indigenously run healthcare systems and services as opposed to Canada where a number of such systems exist (Lemchuk-Favel and Jock 2004; Saganash 2011; Collomb 2011; Guyon and Trépiéd 2013; Dubois and Saunders 2013).

Here, we report findings from our collaborative work with Indigenous Peoples and First Nations from French Guiana (France) and Québec (Canada), namely Parikwene from Macouria and Saint-Georges de l'Oyapock, Cree of Eeyou Istchee from Mistissini and Chisasibi, as well as Pekuakamiulnuatsh from Mashteuiatsh. The aim of this study was to synthesize how the healthcare staff and healthcare users define and describe local Indigenous medicine. We hypothesized that participants that work in the healthcare sector describe local Indigenous medicine differently from

healthcare users and that such differences decrease with a higher presence of Indigenous workers in the healthcare system. We argue that these differences act as a major barrier to the access of Indigenous medicine in the healthcare system, and that such access is beneficial to improve the treatment and management of chronic diseases, such as diabetes.

5.3 Materials and Methods

5.3.1 Study Sites

Indigenous Peoples involved in this study were located in the province of Québec, Canada, and the overseas department of French Guiana, France (**Figure 5.1**). The Ilnu Nation of Mashteuiatsh (population 1,957) is located in the Saguenay–Lac-Saint-Jean region (Statistics Canada 2017a). The Eeyou Istchee Nations of Mistissini (population 3,523) and Chisasibi (population 4,872) are located in Eeyou Istchee, a large territory situated in the Nord-du-Québec (Statistics Canada 2017b, 2017c). This territory is delimited by both the James Bay and Hudson Bay to the west and Nunavik to the north. To the south, it borders the Saguenay–Lac-Saint-Jean region, a region largely overlapping the Nitassinan, the ancestral and traditional territory of the Ilnu. Both Pekuakaminualtsh and Cree of Eeyou Istchee are linguistically related, their languages belonging to the Algonquian family (Junker and Stewart 2008).

The Parikwene, on the other hand, are grouped in several villages in the commune of Macouria (Kamuyene and Norino) along the French Guianese coast, and the commune of Saint-Georges de l’Oyapock (Espérance 1 and Espérance 2), on the Franco-Brazilian border (estimated population abroad of 1800). Having migrated to their current settlements in French Guiana throughout the 20th century, the Parikwene are a cross-border people with strong family ties to the

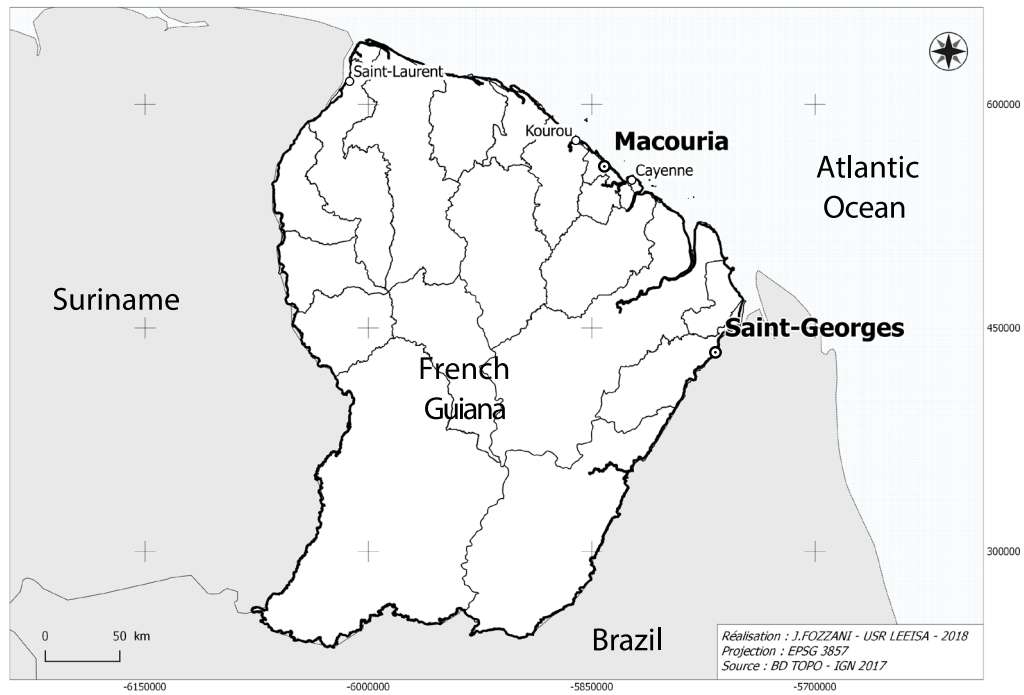
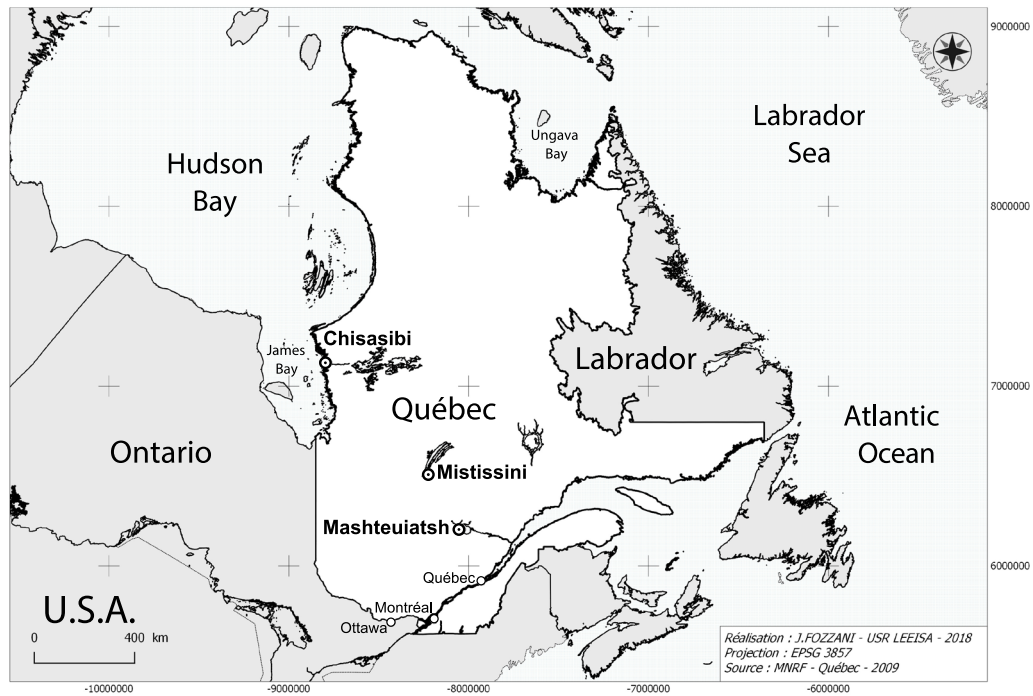


Figure 5.1. Map showing the location of all Indigenous communities from Québec (Canada) and French Guiana (France), namely Mashteuiatsh (48° 34' N, 72° 13' W), Mistissini (50° 38' N, 73° 48' W), Chisasibi (53° 46' N, 78° 52' W), Macouria (5° 00' N, 52° 28' W) and Saint-Georges de l'Oyapock (3° 53' N, 51° 48' W). Cartography: Jérôme Fozzani – USR LEEISA. Projection in pseudo-Mercateur.

Parikwene residing in the Brazilian state of Amapá (Dreyfus 1981; Grenand et al. [1987] 2004; Pereira and Martins 2019).

5.3.2 Community consultations

Fieldwork took place from 2015-2018 (July 2015 to November 2016 [Québec, Canada]; June 2017 to July 2018 [French Guiana, France]). The breakdown of interviews is presented in **Table 5.1**. These were held in English, French and French Guianese Creole as well as the local languages spoken with the help of an interpreter, namely **Nehlueun** (Mashteuiatsh), **Iiyiyuu Ayimuun** (Mistissini and Chisasibi), which are part of a linguistic continuum of the Algonquian language family (Junker and Stewart 2008), and **Parikwaki** (Macouria and Saint-Georges), a language from the Arawak language family (Capiberibe et al. 2009).

Table 5.1. Interview breakdown by communities and description of participant categories.

Community	# of interviews	# of participants	Mean age (\pm SD)
<i>Pekuakamiulnuatsh</i>			
Mashteuiatsh	38	41	48.1 (\pm 17.4)
<i>Cree of Eeyou Istchee</i>			
Mistissini	28	31	50.6 (\pm 15.5)
Chisasibi	32	35	55.8 (\pm 18.5)
<i>Parikwene</i>			
Saint-Georges	32	43	53.4 (\pm 15.8)
Macouria	28	42	51.1 (\pm 15.4)

Community	# of interviews	# of participants	Mean age (\pm SD)
Cayenne*	15	16	42.3 (\pm 10.6)
<i>Total</i>	<i>173</i>	<i>208</i>	<i>51.1 (\pm 16.5)</i>

Category	Example
<i>Community members and healthcare users</i>	
Knowledge holders (KH)	Elders, healers.
Healthcare users (HU)	All other community members.
<i>Healthcare network staff</i>	
Healthcare administrators (HA)	Directors, administrators.
Healthcare professionals (HP)	Doctors, nurses, nutritionists.

5.3.3 Data Collection

Locally practiced Indigenous medicines were discussed around the topic of diabetes in semi-structured interviews. Participants were selected based on their association with one of four group demographics (**Table 5.1**), and were identified through non-probabilistic approaches like snowball sampling as described in **Chapters 2, 3** and **4**.

Open-ended questions related to people’s knowledge and definition of local medicines, as well as attitudes and practices related to their use in the presence of the biomedical system. More precisely, answers to such questions as: “What do you know of local, or traditional, medicines?”, “Have you used local medicines?”, “In what context are local medicines used or practiced?”, “What do you think of more access to local medicines?” and “How do you see improved access to local medicines?”

Informed consent was obtained from participants prior to each interview. Consent forms and questionnaires were approved by each community's Ethics Committee (Cree and Innu) or leadership (Parikwene) along with the Ethics Committee of the Université of Montréal (Certificate #: CERAS-2016-17-081-P; **Annex 1**). Overall, the working approach was conducted with respect to the International Society of Ethnobiology's Code of Ethics (International Society of Ethnobiology 2006).

5.3.4 Data analyses

Interviews transcribed verbatim were analyzed using the mixed-method approach detailed in **Chapter 2** and adapted for the analyses performed in **Chapter 4**. Briefly, important themes describing locally practiced Indigenous medicines were identified using thematic analysis and summarized in a data table compatible with statistical analyses. Themes were transformed into presence-absence counts and overarching themes characterized by lists of sub-themes, such as animal and plant species were summarized into single measurements calculated from the Shannon-Wiener index (H).

Multivariate statistical analyses, such as transformation-based redundancy analysis (tbr-RDA), using Hellinger's transformation, and distance-based RDA (db-RDA), using Gower's (1971) distance as described by Podani (1999), were used to analyse datasets. These analyses made it possible to test the null hypothesis that there are no differences in the description of local medicines between participants based on the themes, concepts and notions that were cited. Differences in participant responses from different demographic groups and characteristics, like Indigenous affiliation and relation to the healthcare sector, were assessed in a multivariate analysis of variance (MANOVA) model using a partial-RDA approach. Testing for significant differences

in multivariate analyses was performed in nonparametric models using 100,000 permutations and $\alpha = 0.05$ (Legendre and Legendre 2012).

All transcripts were stored and handled with NVivo qualitative data analysis software (QSR International 2015) to manage coded data. All data transformations and multivariate statistical analyses were performed with R statistical language (R Core Team 2019) using the built-in “stats” package and the “vegan”, “labdsv” and “FD” package (Laliberté et al. 2014; Oksanen et al. 2019; Roberts 2019), whereas univariate statistical analyses were performed in IBM SPSS (IBM Corp. 2019).

5.4 Results

For all Indigenous Peoples included in this study, the nomenclature for local, or traditional medicines, reveals knowledge systems tightly tied with identity. For the Cree, local medicines are called **Iiyiyunituhkuyin** (Chisasibi) or **Inuunituhkuyin** (Mistissini). For the Pekuakamilnuatsh, they are called **Nitukuelin-ilnu**. For the Parikwene, they are **Parikwene giveykis**. In all cases, these translate to the “People’s medicine”. Naturally, a considerable number of species, both animal and plant, were cited for their medicinal use. With over 350 species cited across the board (**Annex 3**), these represent a substantial part of local medicines. However, in discussing these, participants cited a considerable number of themes, providing the unique cultural context which frames their use. This not only involves a deep knowledge of species, their types and parts used (**Table 5.2**), but translates into the mastery of preparations and practices for which the Elders are the primary keepers of knowledge (**Table 5.3**).

Table 5.2. Animal and plant types and parts mentioned by all Indigenous participants as part of their local medicinal practices and systems. Types and parts are ranked according to the ratio of citing participants (%). Cree and Innu participants from Chisasibi, Mistissini and Mashteuiatsh are grouped together, due to their affinity with the Algonquian language family (Al) and compared to Parikwene participants from Macouria and Saint-Georges (Pa).

	Animal	(%)			Plant	(%)		
		All	Al	Pa		All	Al	Pa
Type	Wild game	27.2	19.4	37.3	Trees	59.5	60.2	58.7
	Fish	19.1	32.7	1.33	Herbs and grasses	19.7	22.4	16.0
	Birds and fowl	8.09	14.3	-	Lianas	11.0	-	25.3
	Shell	0.58	1.02	-	Palm trees	8.67	-	2-
					Shrubs	3.47	5.10	1.33
				Conifers and evergreens	3.47	6.12	-	
Part	Fat grease and oil	41.0	54.1	24.0	Leaves and needles	48.0	36.7	62.7
	Flesh	19.1	32.7	1.33	Bark	43.4	33.7	56.0
	Scent glands and sacs	16.8	27.6	2.67	Fruits and berries	31.8	33.7	29.3
	Bones, cartilage and marrow	9.25	9.18	9.33	Latex, sap, resin and gum	28.9	28.6	29.3
	Feathers and wings	6.36	10.2	1.33	Roots	18.5	18.4	18.7
	Intestines	3.47	6.12	-	Boughs and branches	17.9	24.5	9.33
	Fur	2.31	2.04	2.67	Flowers	10.4	15.3	4.00
	Liver	2.31	4.08	-	Oils	9.83	1.02	21.3
	Blood	1.73	2.04	1.33	Seeds	9.83	-	22.7
	Tongue	1.73	2.04	1.33	Leaf buds	2.89	-	6.67
	Muzzle and snout	1.73	3.06	-	Essential oil	2.89	5.10	-
	Gallbladder	1.16	-	2.67	Leaf fibre	2.31	-	5.33
	Shell	1.16	-	2.67	Starch and flour	1.73	3.06	-
	Breastmilk	1.16	2.04	-	Liquid album (palm water)	1.16	-	2.67
	Faeces	1.16	2.04	-	Wood	1.16	-	2.67
	Gizzard	1.16	2.04	-	Cone	1.16	2.04	-
	Heart	1.16	2.04	-	Rotten wood	0.58	1.02	-
	Beak	0.58	-	1.33	Shoot	0.58	1.02	-

Table 5.3. List of preparations, land-use activities, ceremonies, rituals, and practices cited by all Indigenous participants. These were cited when describing their medicinal practices and systems. All elements are ranked according to the ratio of citing participants (%). Cree and Innu participants from Chisasibi, Mistissini and Mashteuiatsh are grouped together, due to their affinity with the Algonquian language family (Al) and compared to Parikwene participants from Macouria and Saint-Georges (Pa).

Preparations	(%)			Land-use activities	(%)			Ceremonies, rituals and practices	(%)		
	All	Al	Pa		All	Al	Pa		All	Al	Pa
Beverages	72.8	68.4	78.7	Hunting and trapping	37.6	60.2	8.00	Sweat lodge	38.7	68.4	-
Steam and baths	31.2	16.3	50.7	Picking and gathering	30.1	52.0	1.33	Feasts and gatherings	23.1	39.8	1.33
Creams and ointments	11.0	13.3	8.00	Fishing	19.1	31.6	2.67	Praying and prayers	21.4	31.6	8.00
Dressings and bandages	10.4	13.3	6.67					Pow wow	19.1	33.7	-
Cataplasm	8.67	4.08	14.7					Songs, chants, and incantations	19.1	20.4	17.3
Massages	8.09	-	18.7					Smudges and purifications	16.2	27.6	1.33
Broth	7.51	11.2	2.67					Spells	13.9	-	32.0
								Shaking tent	13.3	23.5	-
								Dreams and visions	12.7	16.3	8.00
								Dance	12.1	19.4	2.67
								Sun Dance	9.83	17.3	-
								Cleanses and purges	9.83	-	22.7
								Circles	8.09	14.3	-
								Walking out	6.94	12.2	-
								Blowing	5.78	-	13.3
								Fast	4.05	7.14	-
								Smoke	2.89	3.06	2.67
								Bloodletting	2.31	4.08	-
								Cachiri	2.31	-	5.33
								Yuwipi	1.73	3.06	-

Preparations	(%)			Land-use activities	(%)			Ceremonies, rituals and practices	(%)		
	All	Al	Pa		All	Al	Pa		All	Al	Pa
								Full moon ceremony	1.16	2.04	-
								Naming ceremony	1.16	2.04	-
								Sun ceremony	0.578	1.02	-
								Tente midewin	0.578	1.02	-
								Charms	0.578	-	1.33

A tb-RDA of species cited by participants significantly distinguishes North American participants from their South American counterparts along the first canonical axis ($p < 0.001$, $R^2_{\text{adj}} = 0.133$; **Figure 5.2**). This axis appears to capture the most evident gradient in the dataset, one that sees species composition changing latitudinally, and their richness decreases from equatorial rainforests to subarctic boreal forest (*i.e.* species used by the Cree and Ilnu account for just under a third of all species cited; **Annex 3**). The second canonical axis separates mainly North American participants along a longitudinal gradient capturing distinctions between North American First Nations of the same linguistic family. The distinct lack of variation along this axis between South American participants suggests that there are important underlying gradients influencing the citation of species that can be attributed to North American participants.

In a similar fashion to **Figure 5.2**, db-RDAs of general themes cited by participants further distinguishes participants from Québec to those from French Guiana (**Figure 5.3**). Concepts surrounding the organoleptic properties of medicines, distinguishing bitter and acidic tastes from sweet ones, are characteristic of French Guianese participants. On the other hand, notions relating to general health and well-being, including emotional, mental, and spiritual health were characteristic of Québec participants. Whereas the organoleptic properties of medicines pertain primarily to curative medicines for physical health, the array of notions associated with well-being may very well be a contributing factor to creating gradients in the Algonquian discourse relating to their medicinal systems. Indeed, some participants may be more inclined to discuss medicines from the perspective of emotional healing as opposed to physical healing, and so forth.

Evidence for this hypothesis is supported in **Figure 5.2**. A closer look at species that characterized Parikwene participants reveals that amongst the most important ones that vary along RDA1 are notoriously bitter plants (*i.e.*, crabwoods [*Carapa* spp.; Meliaceae], quassia [*Quassia*

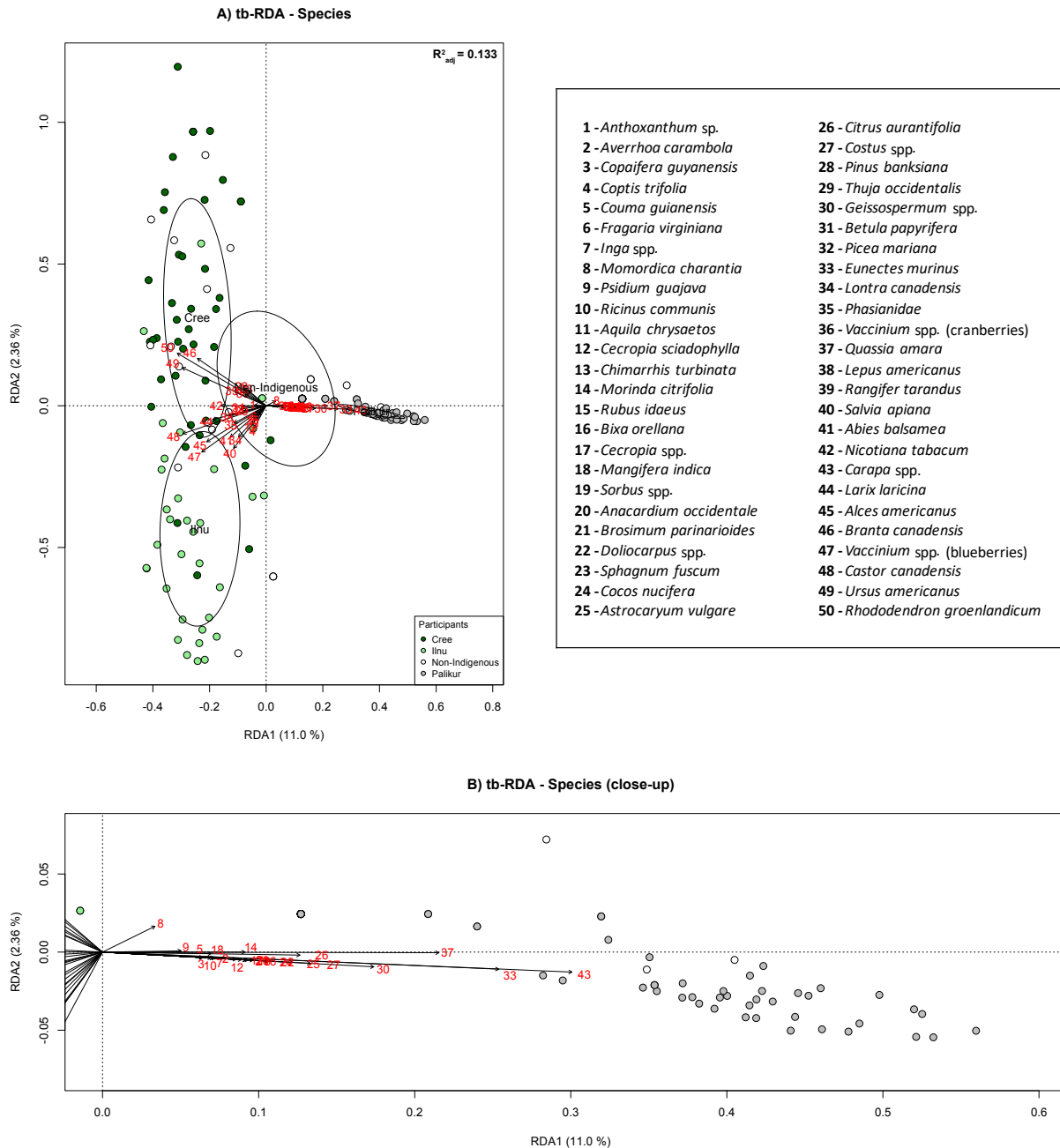


Figure 5.2. Ordination triplots in type 2 scaling of tb-RDA using Hellinger’s transformation on animal and plant species. Species were cited by participants when describing local Indigenous medicines and include those cited by more than five participants. A) Variations in the distribution of species cited are tested in relation to participants’ association with an Indigenous group, namely Cree, Ilnu, Parikwene or Non-Indigenous. B) Close-up on the cluster of points corresponding to Parikwene participants. Ellipses draw the standard deviations of participants around the centroids of their corresponding group. Arrows represent specific animal and plant species for which numbered labels (in red) are defined in the table.

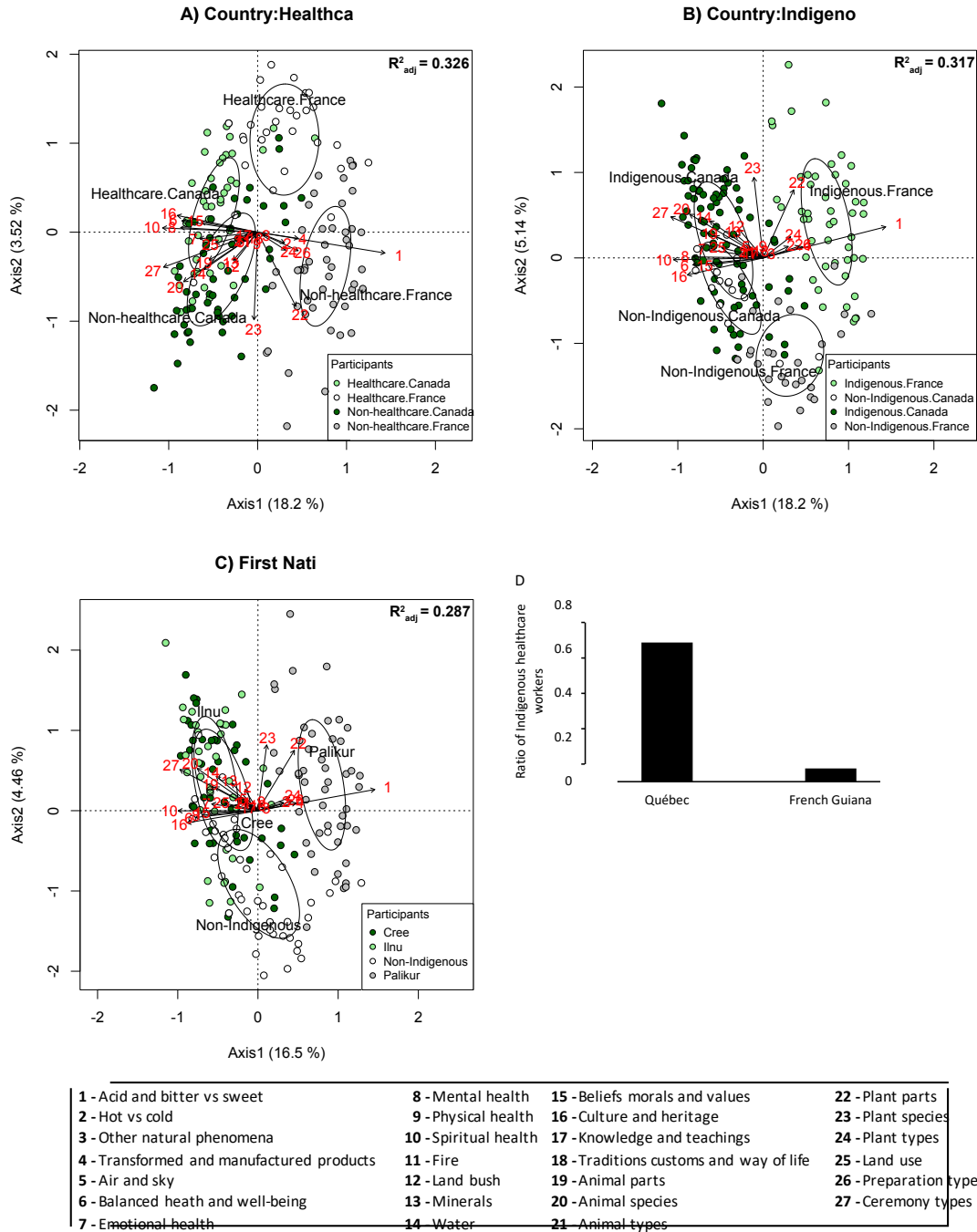


Figure 5.3. Ordination triplots in type 2 scaling of db-RDA using Gower’s distance on themes. Themes were cited by participants when describing local Indigenous medicines. Themes were selected based on the “best-fit” framework synthesis analysis of transcribed interviews. Variations in the distribution of cited themes are tested in affiliation with the healthcare network (A), to an Indigenous group (B), or their specific Indigenous affiliation (C). Ellipses draw the standard deviations of participants around the centroids of each of their constraining factors. Arrows represent specific themes for which numbered labels (in red) are defined in the bottom table. D) Ratio of Indigenous healthcare workers comparing the participants from Québec and French Guiana.

amara; Simaroubaceae] and **gongo** [*Geissospermum* spp.; Apocynaceae]; **Figure 5.2a**) that are used against diabetes, a disease which the Parikwene characterized by sweetness (**Chapter 3**). Although the distinction between Cree and Innu participants reflects their relative geographical placements (**Figure 5.1**), characteristic species for each First Nation group do not support a secondary geographical gradient based on species composition as they are present and abundant throughout both their territories (*i.e.*, common Labrador tea [*Rhododendron groenlandicum*; Ericaceae], Canada goose [*Branta canadensis*; Anatidae], black bear [*Ursus americanus*; Ursidae], blueberries [*Vaccinium* spp.; Ericaceae], moose [*Alces americanus*; Cervidae] and beaver [*Castor canadensis*; Castoridae]). Indeed, sage [*Salvia apiana*; Lamiaceae], which does not grow in northeastern subarctic and boreal forest, was a distinguishing species for Mashteuiatsh residents and was cited by participants primarily for spiritual healing. On the other hand, common Labrador tea (*Rhododendron groenlandicum*) was cited primarily for physical health and glycemic control, amongst mainly Cree participants. Though blueberries (*Vaccinium* spp.) were predominantly cited for treating diabetes amongst Innu participants, their consumption as food could also contribute to emotional healing as well. Indeed, most species were cited by Innu and Cree participants as medicines for more than one aspect of general health and well-being. For example, black bear (*Ursus americanus*) most notably touched all aspects.

A two-way factor analysis of cited themes describing local medicines using db-RDA found a significant interaction between participants' association with the healthcare sector and country of residency ($p < 0.001$, $R^2_{\text{adj}} = 0.326$) indicating that differences between healthcare users and healthcare practitioners were not the same between regions (**Figure 5.3a**). Whereas descriptions of local medicines were considerably different between healthcare users and workers in French Guiana, they were more congruent in Québec. A similar analysis also found a significant

interaction between participants of indigenous identity and country of residency ($p < 0.001$, $R^2_{\text{adj}} = 0.317$; **Figure 5.3b**). When indicating the particular social group to which participants belong in a one-way factor analysis, the model remained significant ($p < 0.001$, $R^2_{\text{adj}} = 0.287$; **Figure 5.3c**). Similar patterns between groups to those observed from the previous analysis reveal a link between participants' participation in the biomedical system and Indigenous identity, whereby all non-Indigenous participants were healthcare workers. The convergence in the description of local medicines between Indigenous and non-Indigenous participants, as well as healthcare users and workers in Québec in relation to French Guiana is likely two-fold: 1) there are a greater number of Indigenous healthcare workers in Québec (**Figure 5.3d**) and 2) the Cree and Ilnu healthcare services are locally run and administered by Indigenous organisations (**Chapter 1**).

The results from all three db-RDAs capture a gradient along the first axis defined by fundamental differences between the Parikwene medicinal system in French Guiana and the Algonquian medicinal systems of the Cree and the Ilnu in Québec (**Figure 5.3a-c**). For the former, these are defined throughout by organoleptic dualities between sweetness and bitterness, or acidity, as well as physico-chemical dualities between hot and cold (see **Chapter 4**), captured here to a lesser extent. For the latter two, these are holistic concepts of well-being through balanced emotional, mental, physical, and spiritual health as discussed in **Chapter 4**.

The Land and its resources are characteristic themes that tend to distinguish healthcare workers, who are primarily non-Indigenous, from healthcare users, who tend to cite several elements pertaining to the natural world, such as water, rocks and minerals, and a greater number of animal and plant species, types, and parts (**Figure 5.3a-c**). However, the significance of the Land, for one, did not hold the same meaning between South American and North American participants. For Indigenous participants from both regions, the land was held in high regard and

was considered essential for accessing medicinal and dietary resources and enabling culturally relevant practices to the maintenance of health. For the Cree and Pekuakamilnuatsh the Land, in the Algonquian context of holistic medicines, could also be considered a medicine in its own right (**Chapter 4**). Furthermore, animal species were predominantly characteristic of these medicinal systems. Though various animal parts, such as grease and fat or scent glands and sacs, are commonly used in all medicinal systems, animals held symbolic meanings expressed via a number of ceremonies and practices that also characterized Ilnu and Cree medicines. Finally, the Ilnu and Cree use of animal medicines could also be framed in the context of local foods and dietary practices that attribute the consumption of most animal and plant-based foods to a range of health benefits, either emotionally, mentally, physically, or spiritually (*e.g.*, blueberries and cranberries [*Vaccinium* spp.], black bear [*Ursus americanus*], beaver [*Castor canadensis*]; **Figure 5.4**).

Although a number of plant and animal species used medicinally by Parikwene were also important contributors to the Parikwene dietary system (*e.g.*, the cashew tree [*Anacardium occidentale*; Anacardiaceae], the mango tree [*Mangifera indica*; Anacardiaceae], the awara palm [*Astrocaryum vulgare*; Arecaceae], terrestrial tortoises [*Chelonoidis* spp.; Testudinidae], and chicken [*Gallus gallus domesticus*; Phasianidae]), a marked distinction was made between the two, whereby parts consumed as food were different from those used as medicine. Despite major differences in some of the fundamental concepts behind Parikwene and Algonquian medicinal systems, it is possible that holistic notions of well-being and health were once more present in Parikwene medicines. Many participants recall the loss of several healing practices pertaining to the land. While certain Parikwene participants ascertain the health benefits of the land and various land-use activities in a holistic context like the Cree and Ilnu, like fishing and hunting in the forest, or cultivating cassava (*Manihot esculenta*; Euphorbiaceae) in the fields, this association is largely

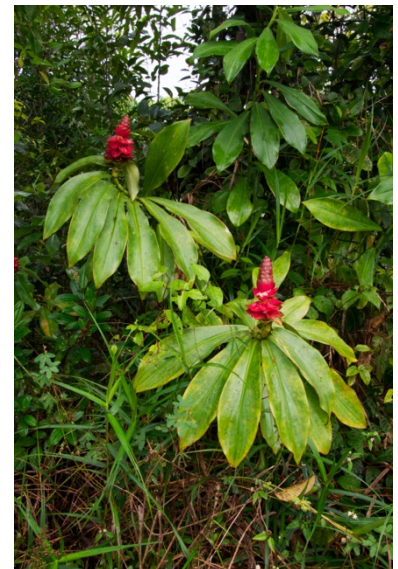


Figure 5.4. Examples of species perceived as dietary and medicinal at once. Top left: beaver (*Castor canadensis*), in the forefront, and geese (*Branta canadensis* and/or *Chen caerulescens*), in the background, cooking at a community feast in Mashteuiatsh. For the Cree of Eeyou Istchee and the Pekuakamilnuatsh, these species are medicinal through their consumption as a food or through the use of various parts. Top right: The wild harvested bagasse fruits (*Ambelania acida*) are considered both a food and medicine for some Parikwene. Bottom left: The fruits of *Vaccinium myrtilloides*, or blueberries, the quintessential antidiabetic food and medicine for the Cree of Eeyou Istchee and Pekuakamilnuatsh. Bottom right: A sour cane (*Costus* sp.), consumed as a trailside nibble, but also makes one of the more important antidiabetic medicines for the Parikwene. Photo credits: M. Rapinski.

relinquished to the practices of long-gone Elders and influenced by a reportedly fading interest by younger generations in traditions and customs. Similar observations are made of dietary practices whereby two participants cited the consumption of specific wildfowl (*i.e.*, Gray-fronted Dove [*Leptotila rufaxilla*; Columbidae] and Great Tinamou [*Tinamus major*; Tinamidae]) as a food for curative purposes and the treatment of diabetes and, similarly, a few more cited the consumption of specific fruits, like bagasse (*Ambelania acida*; Apocynaceae; **Figure 5.4**) and soursop (*Annona muricata*; Annonaceae).

Despite the apparent exclusion of foods from the Parikwene medicinal system, organoleptic and physico-chemical concepts of Parikwene medicines do find their way into the Parikwene dietary system thus dictating the consumption habits of **kwak**, or cassava flour (*Manihot esculenta*), in the management of diabetes (**Chapter 3**). This suggests that regardless of an apparent separation of the dietary system from the medicinal system, these cannot be taken in strict exclusion from one another, especially in the context of chronic illnesses with a dietary origin.

5.5 Discussion

5.5.1 Indigenous medicines in the wake of colonial legacies

The species listed here are surely non-exhaustive. Given the local plant diversity and the number of species used against diabetes and its complications, the knowledge shared, or not, during interviews and fieldtrips depends highly on personal experience, transmitted knowledge as well as proximity to and abundance of available species. Although participants possess a great deal of knowledge, some may only share positive personal experiences, refraining from sharing stories

and anecdotes that they've either witnessed or heard about (*e.g.*, when presented with species use that they had not listed, participants would affirm knowing of its use, but never trying it). Furthermore, for the Parikwene, a considerable number of plant species were cultivated near the household or the *carbet* (**Figure 5.5**), however, several species were harvested opportunistically, *i.e.*, while hunting, fishing, seed gathering and harvesting plant materials for basketry. Lifestyle, thus, has an important implication for personal experience and knowledge.

The way of life of the Cree and Ilnu, in contrast with the Parikwene, are considerably different. Though hunting, fishing, and harvesting activities from the wild are common to all three Peoples, the Cree and Ilnu are traditionally described as semi-nomadic with a noticeable absence of agriculture in comparison to the Parikwene. This marked distinction in the way of life is reflected downhill in the dietary system. In the absence of the cultivation of starchy foods and their consumption in large quantities, Cree and Ilnu traditional dietary systems were likened to low-carbohydrate and high protein diets (*i.e.*, ketogenic diets), in opposition to low-fat and high-carbohydrate diets classically attributed to agrarian societies elsewhere on the American continents (Ravussin et al. 1994; Phinney 2004; Milburn 2004; Batch et al. 2020). Despite these differences, changes in lifestyles that are largely attributed to mechanisms of colonialism have steered Cree, Ilnu and Parikwene diets to ones higher in carbohydrates and fats altogether.

It is important to note, however, the cultural importance attributed to fat, not only for its dietary value — after all, fats are one of the best sources of dietary energy after carbohydrates (Galgani and Ravussin 2008) — but for their medicinal value as well. This is particularly true of the Cree of Eeyou Istchee and Pekuakaminualtsh. Though it appears evident that both **Figure 5.2** and **3** reveal gradients that are both geographical in nature and peculiar to two very distinct medicinal systems, one attributed to Algonquian Peoples and one attributed to Parikwene, there



Figure 5.5. Illustrations of camps and *carbet* providing access to the land. A Parikwene *carbet* where cassava tubers (*Manihot esculenta*) are harvested along with several other medicinal and dietary plants (top left). A Cree camp (top right) and an Ilnu camp (bottom) where several land-use activities take place. All three provide access and connection to the land and forest, thus enabling many dietary and medical practices to take place. Photo credits: M. Cardozo (top left), M. Rapinski (top right and bottom).

may also be other gradients at play. These are presumably captured along the second axis of **Figure 5.2** where Indigenous participants from Québec (*i.e.*, Cree and Innu) are visibly more spread out based on their responses than those from French Guiana (*i.e.*; Parikwene). The history of colonization may be a driving factor in creating gradients based on:

- linguistic assimilation and loss of language, whereby Cree and Innu children were separated from their families and knowledge holders, and sent to English and French residential schools, respectively;
- evangelisation efforts by different Christian denominations that influence traditional cosmologies and belief systems;
- sedenterization policies from governments that led to alienation from the land and the introduction of new foods and eating habits.

Inherent cultural and historical distinction amongst Algonquian Peoples, owing to their occupation of large territories and evidenced by well-established local dialects, may also play an important role. This does not mean that the Parikwene are not susceptible to these same gradients. Over the course of this study, some Parikwene participants have noted the development of dialectal and cultural distinctions between their villages since their migrations out of Brazil, beginning at the turn of the 20th century, and the establishment of their villages in French Guiana, beginning in the 1960s (see **Chapter 3** for a description of current Parikwene migration and settlement in French Guiana). However, this may also be influenced by the existence of past dialects before their unification under one language (Grenand and Grenand 1987). Though strong familial ties still exist amongst Parikwene villages on both sides of the Franco-Brazilian border, time will undoubtedly lead to further distinctions among Parikwene populations. Furthermore, it is possible to suggest that the inclusion of responses from Parikwene participants from Brazil might introduce

sufficiently strong gradients to tease out nuances and unravel the flattening observed in **Figure 5.2**. This can be taken one step further by including other groups of Peoples that are linguistically and culturally related to the Parikwene, and to a greater extent by including cultural groups throughout the Americas, from North to Central to South, in order to create a truly representative and balanced gradient for these types of cross-cultural analyses.

When it comes to the description of local medicines between healthcare users and workers (**Figure 5.3**), it is likely that legal recognition of Indigenous Peoples in Canada and the rights to self-management and self-determination granted to such title, especially in terms of health and social services, plays an important role in bridging their representation closer together. Although such forms of recognition do not exist for French Guiana's Indigenous Peoples, France has nonetheless demonstrated the capacity to concede such rights to the Kanak Peoples of New Caledonia (Hermitte 2007; Bellier 2008; Chicot 2011; Guyon and Trépiéd 2013). It is therefore not impossible to conceive that such legal provisions may one day be granted to Indigenous Peoples, increasingly claiming the recognition of their lands and rights (Filoche 2011; Guyon and Trépiéd 2013; Davy et al. 2016), throughout the French territory.

Our results support a number of calls to action put forth by the Truth and Reconciliation Commission of Canada (2015), such as providing sustainable funding for existing and new Indigenous healing centers, increasing the number of Indigenous professionals working in the healthcare sector and providing cultural competency training for all healthcare workers. Though these recommendations are provided specifically in the context of Canada, this, by no means, excludes their validity for other Indigenous Peoples living with the power dynamics of colonization, like the Parikwene. Indeed, the experience of healthcare users plays an important role in the success of healthcare services, as negative experiences and encounters were associated

with the renunciation of care amongst migrants in French Guiana (Valmy et al. 2015). Along with culturally inadequate services, such barriers to healthcare access were associated with an increased risk of diabetes among urban First Nations Peoples in Canada (Beckett et al. 2018). Overall, several authors have summarized the Indigenous experience with healthcare services under several themes, like colonial heritage, the perpetuation of inequities and structural barriers (Geddes 2017; Jacklin et al. 2017), which Jacklin et al. (2017) have found to contribute in creating a collective experience of mistrust amongst diabetics in Indigenous communities.

This can be mitigated through a greater understanding of the population healthcare services respond to and supports the improvement of the relationship between the two through processes of autochtonization, in the sense of representing local populations in general (Viger 2011; Jacklin et al. 2017). This is in keeping with recommendations from Diabetes Canada, which advocate for the personalization of care that facilitate self-management through the support of interprofessional healthcare teams operating in healthcare systems supported by local community partners that intervene, for example, on a number of environmental factors like food security (Clement et al. 2018). For the Truth and Reconciliation Commission of Canada (2015), this calls for healthcare systems to recognize the value of Indigenous healing practices and to use them in the treatment of Indigenous patients. In contrast to France, this is certainly easier said and done in Canada where the legal recognition of Indigenous title exists. The fundamental principles of a unified People under one French republic means that France establishes healthcare center in Saint-Georges de l'Oyapock for the people, who are French citizens, and not for the Parikwene, the Galibi, the Karipuna or the Creole, who make up the people of Saint-Georges.

5.5.2 Indigenous medicinal systems: unique in their own right

Just as we illustrate the holistic characteristic of Algonquian medicinal systems, such concepts relating to well-being and the inclusion of spiritual health have been highlighted amongst those of several Peoples across South-East Asia (*i.e.* Burma, Cambodia, Laos), Central America (*i.e.* Guatemala) and Africa (*i.e.* Namibia) (Nettleton et al. 2007). For the Parikwene, the Cree and the Pekuakamilnuatsh, their medicinal practices have been linked in the past to their cosmology and characterized similarly based on animist ontologies (Rousseau 1953; Descola 2005a; Green and Green 2009). Our results, however, advise against characterizing too quickly all Indigenous medicines as holistic in general as some medicinal systems may function on different fundamental premises.

Although it may be true to surmise that for the Parikwene in the past, several studies remind us that these systems are not static, but just as prone to change and evolve as much as the Peoples who make and keep these systems alive (see **Chapters 3 and 4**). For that reason, it is not surprising that participants evoke the ancestral nature of Indigenous medicines, reflecting on certain practices that have arguably gone out of use for most, such as bloodletting, shaking tents and the consultation of healers more colloquially referred to as “shamans”, as well as the knowledge of long past Elders. Naturally, concerns over “modernization” on the authenticity and preservation of local knowledge arise amongst participants and researchers alike. However, Quinlan and Quinlan (2007) argue that this does not forcibly have to lead to loss of knowledge, finding that commercial occupation and consumerism were positively associated with herbal knowledge amongst individuals from Dominica. Moreover, Indigenous run healthcare systems may unwittingly preserve and solidify current notions of Indigenous health and medicine by acting as a vector for oblique transmission of knowledge. Such transmission patterns have explained how contemporary medicinal plant use

in Europe still reflects the knowledge from texts of Renaissance and Classical writers and physicians (Leonti et al. 2009, 2010).

The organoleptic properties of plants, on the other hand, are common notions of the medicinal systems of a number of Amazonian Peoples, but also of African Peoples (Shepard 2004; van Andel et al. 2012; Charpentier et al. 2016). Though Descola (2005b) remarks how the concept of a cold and hot polarity is not present amongst the Peoples of Siberia, subarctic North America or the Amazonian basin, we found it to be associated sweetness and bitterness, or acidity, in opposition (see **Chapter 3**). The relevance of the organoleptic properties certainly plays an important functional role as taste is a useful identifier of plant species in diversity rich equatorial rainforests, which render the identification of trees through their leaves difficult due to canopy height. Furthermore, bitterness may further act as a means of drug discovery through use-shifting (Shepard 2004; Charpentier et al. 2016). This does not diminish the biological implication of bitterness in targeting species rich in bioactive compounds, as discussed in **Chapter 3**, in medicinal systems for which the organoleptic properties of medicines are not presented as central tenets. Certain Cree and Ilnu medicines do present characteristically bitter flavors, such as some preparations made from common Labrador tea (*Rhododendron groenlandicum*) and the castoreum of beaver (*Castor canadensis*), a source of salicylic acid (Müller-Schwarze and Houlihan 1991). Furthermore, the local name for the small bog cranberry (*Vaccinium vitis-idaea*; **uishetshimin** [Ilnu], **wiisichiminh** or **wiisichiminaanh** [Cree]) refers to its characteristically sour taste. Perhaps the organoleptic properties of medicines are relevant concepts of Cree and Ilnu medicine, though the question has yet to be asked.

The Cree and Ilnu relation to the Land support the notion of “land” in the context of social-ecological health that centers on the integrated concept of humans-in-nature (Berkes et al. 2003;

Parlee et al. 2005; **Figure 5.5**). This interconnected relation between well-being and the Land echoes similar concepts expressed by Peoples across Canada's subarctic and boreal regions (Parlee et al. 2005; King et al. 2009). Though most values associated with the Land by the Gwich'in, such as well-being and spirituality, for example, resonate amongst the Cree and Innu, the values of land and resource use, as well as cultural continuity transcended to all three Indigenous Peoples included in this study. The fact that the Parikwene resort to the agriculture of cassava (*Manihot esculenta*) as the basis of their subsistence, in comparison to the Cree and Pekuakamilnuatsh who have relied more heavily on wild harvesting, may be an important factor in explaining different relationships with the land. Furthermore, the Cree and Innu can be considered well centered on the land, which they have continuously occupied for generations. The Parikwene migration to French Guiana, on the other hand, leads many to refer to their homeland in Brazil, where the Parikwene consider themselves well centered (Dreyfus 1981). Passes (2002:173) further describes this relation to the land along a pole whereby Aukwa is the omphalos (*i.e.*, the navel) at one end and the antiomphalos, at the other, is evidenced by a feeling of marginalization within two nation-states (Brazil and France).

Nonetheless, links to notions of social-ecological health amongst the Parikwene are rendered through the lens of cultural keystone places, defined as "places of high cultural salience for a particular group of people at a particular time and critical to their identity and well-being" (Cuerrier et al. 2015:427). In assessing the role that food and medicine play in the management of diabetes amongst the Parikwene, **Chapter 3** suggest swidden-fallow fields as cultural keystone places for its role in the cultivation *Manihot esculenta* and the production of cassava flour, a staple food tightly tied into Parikwene identity. Swidden-fallow fields are furthermore linked to the land as not only a place where medicinal plants are cultivated and harvested, but in many cases, act as

a gateway to secondary and primary forests where resources to feed and treat oneself, in order to remain healthy, are wild harvested.

Berry patches may be considered in a similar fashion in the Algonquian context, whereby berry picking activities, in ensuring cultural continuity and well-being, enhance physical health as well as emotional, mental, and spiritual health. In assessing the harvesting efforts of the Gwich'in, who view berry patches similarly (Parlee et al. 2005), harvesting efforts average 3-4h per visit along with 3-4 litres of cloudberry (*Rubus chamaemorus*, Rosaceae), 2 litres of blueberries (*Vaccinium* spp.) and 6 litres of cranberries (*Vaccinium* spp.), which, by no stretch of the imagination provides a non-negligible contribution to physical exercise and diet. Though some estimates of berry consumption suggest that this represents 5% of the overall traditional diet (Kuhnlein and Turner 1991), this likely does not account for several other berries that may more conveniently be consumed as trailside nibbles. Such places can be protected, as suggested by the Gwich'in, not only to ensure cultural continuity (Parlee et al. 2005), but to be considered in land-use plans that increase access to Indigenous medicines. Like the Gwich'in and numerous Indigenous Peoples across the world (Parlee et al. 2005; Kuhnlein et al. 2009), the Cree and Innu express a strong belief that foods from the land are necessary to be healthy and well. Such a relationship to food is similar amongst the Parikwene where activities around the cultivation and consumption of cassava (*Manihot esculenta*) defines much of Parikwene identity. In keeping with social-ecological notions of health, this implies that the Land must be healthy if the Peoples want to be healthy. This rings particularly true considering more recent concerns over mercury and lead contamination linked with such industrial activities like mining and forestry (Régine et al. 2006; Donaldson et al. 2010; Ayotte et al. 2011; Laird et al. 2013; Rimbaud et al. 2017; Maurice et al. 2021). Considering this, is it no surprise that the land is indissociable from health and medicine?

5.6 Conclusions

In assessing the medicinal systems of three distinct Indigenous Peoples, two characteristically different systems were distinguished: one characterized by notions of holistic well-being (Cree and Innu) and another characterized by notions of organoleptic properties (Parikwene). Despite two different approaches to conceiving the Land and its role in these medicinal systems, the Land is nonetheless inseparable from medicines and health. Although these medicinal systems are rich in *materia medica* of natural origin, their use cannot be taken or understood in isolation. This is particularly true when considering the overlap between foods, medicines, and their role in maintaining health, especially in Algonquian medicinal systems. This is significant for diabetes treatments as these parallel conventional biomedical treatments, which do not rely solely on pharmacotherapy, but are heavily supported by dietary interventions and physical exercise (Lipscombe et al. 2018b; Sievenpiper et al. 2018b; Sigal et al. 2018b). Indeed, in Indigenous run healthcare systems in Québec (Canada), the representation of local medicines is much closer between healthcare workers and users than in French Guiana where there is less Indigenous participation in the healthcare network. Though this likely is an important contributor in enabling healthcare workers to capture the nuances of local medicines, the level of autochtonization permitted in the Canadian and French healthcare system is very different. This, however, does not prevent both systems from addressing, in the long-term, social-economic and education inequities that prevent the local population from becoming stakeholders and participating in the biomedical system. Furthermore, this does not prevent healthcare systems, in the short-term, from increasing their cultural awareness of the people they treat. In France, the most evident space for such cultural integration is in the development of therapeutic education

programs that aim to consider the environmental and cultural setting of patients with chronic illnesses. Finally, the Truth and Reconciliation Commission of Canada stipulates that the recognition of Indigenous rights, as stated by the United Nations (2007) Declaration on the Rights of Indigenous Peoples, is an important step in the reconciliation of Peoples facing a colonial legacy. Roy et al. (2013) state how this legacy inadvertently plays a role in transforming, shaping, and solidifying Indigenous identity in Innu foodways in response to imposing culture. This may very be true for the Cree of Eeyou Istchee and Pekuakamilnuatsh who have a shared experience, but also for the Parikwene, through the consumption of cassava root, for example. But moreover, this seems to apply to Indigenous therapeutic acts, whereby local medicines are contrasted with biomedicine by being rightfully theirs, and access and connection to the Land is the gateway.

5.7 Acknowledgments

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Considérations finales

Rousseau (1961) précise que l'ethnobotaniste s'intéresse à la raison d'être des plantes vis-à-vis des populations humaines. Par extension, l'ethnobiologiste s'intéresse donc plus largement à la raison d'être du vivant. C'est ainsi que cette thèse ne se limite pas qu'aux usages des plantes dans le parcours des soins des diabétiques, mais également des animaux. Mais en posant la question ouvertement, « qu'est-ce que la médecine locale, ou soi-disant traditionnelle ? », l'on ouvre la porte à une représentation émiqwe de ce que représente le vivant et le monde naturel vis-à-vis de la santé humaine. Tenant compte de la diversité considérable derrière l'expression de ce que représente les médecines locales auprès des participants inclus dans cette thèse, l'objectif de définir ces médecines ne représente pas une tâche facile.

La solution proposée ici, soit d'employer des méthodes mixtes, revient à l'essence même de l'interdisciplinarité qui définit l'ethnobiologie. Afin d'analyser des discours, la relation entre les thèmes qui en sont issus est abordée de la même manière que les écologistes abordent la relation entre les espèces au sein des écosystèmes. C'est donc en répondant au premier objectif de cette thèse, soit d'adapter au discours des méthodes statistiques communes en écologie, que l'on parvient ici à répondre aux objectifs subséquents, soit définir le système médicinal des Cris d'Eeyou Istchee, des Pekuakamilnuatsh et des Parikwene, et de les comparer. De surcroît, c'est en se concentrant sur la relation entre le rôle médicinal et alimentaire des espèces animales et végétales que l'on lie ensuite ces systèmes médicaux aux soins accordés aux diabétiques. Mais avant d'aborder la signification des résultats issus de ces analyses, il importe d'établir ce que nous apporte cette méthode.

Les limites et les avantages des méthodes mixtes

L'utilisation des méthodes statistiques multivariées, dites quantitatives, sur des thèmes issus du discours ne remplace en aucun cas les analyses dites qualitatives. Au contraire, ces analyses, telles les analyses thématiques employées ici, sont indispensables afin de produire des tables de données pertinentes et significatives. C'est ici que demeure l'une des premières limites de cette méthode : la capacité de tirer des interprétations évocatrices des analyses statistiques dépend entièrement de la qualité des analyses qualitatives. Mais cette caractéristique des analyses statistiques est indépendante de l'origine des données, qu'elles soient issues d'une analyse qualitative ou quantitative car, afin d'employer des méthodes statistiques à un jeu de données, le design expérimental doit être réfléchi d'avance afin de tester l'effet des facteurs d'intérêt.

La puissance des tests statistiques, par exemple, augmente avec la taille d'échantillonnage. Bien que ces méthodes s'avèrent pertinentes pour analyser un grand nombre de discours, cela implique la multiplication des participants et des entrevues, ce qui peut poser un obstacle temporel à la recherche. Des méthodes d'entrevue plus structurées, sous le format du « *free listing* » par exemple, offrent des solutions à la contrainte du temps, mais au dépend de la richesse des thèmes que l'on peut chercher et de l'interprétation des relations qui les lient. En revanche, les entrevues semi-structurées ou à questions ouvertes, bien qu'elles permettent de les élucider, entraînent aussi le risque d'introduire bon nombre de bruit dans les jeux de données en donnant, notamment, un sens ou un lien à des thèmes alors qu'il n'en existe réellement pas avec le sujet en question.

Face à ces impasses, il s'avère néanmoins que les méthodes statistiques employées ici parviennent à souligner efficacement, dans un premier temps, les thématiques principales qui caractérisent des groupes de personnes et de détecter les nuances dans le discours qui les

distinguent. L'une des forces de ces analyses est de schématiser visuellement les multiples relations qui existent entre les thèmes, les participants et les facteurs d'intérêt qui les influenceraient. Cela offre la possibilité non seulement d'explorer le jeu de données pour émettre des questions et des hypothèses, mais même de les poser et de les tester statistiquement.

Finalement, la capacité qu'ont démontré ces analyses de détecter des patrons dans les jeux de données malgré le bruit que peut induire la méthode de collecte, soit des entrevues à questions ouvertes, s'avère un avantage de la méthode en soit. Cela n'implique pas que les chercheurs seront récompensés de résultats parlants pour un moindre effort dans l'analyse thématique, mais la méthode pardonnera plutôt les incongruences méthodologiques qui peuvent avoir lieu en combinant les discours issus d'entrevues réalisées dans des milieux différents, voire menées par des personnes différentes (notons plus précisément la manière dont l'absence des thèmes est abordée au **Chapitre 2**). Cela s'avère particulièrement pertinent dans le contexte d'études réalisées au sein d'équipes de chercheurs pluridisciplinaires et internationales, telle que celle qui encadre cette thèse, ou des réseaux de centre de recherche internationaux, tel que celui des Observatoires Hommes-Milieu (OHM) du Centre National de la Recherche Scientifique (CNRS) (Chenorkian 2020), qui chercheront peut-être à faire des études transversales à partir du discours.

C'est sur ce même ordre d'idée que l'on peut aussi souligner la contribution de cette thèse. Certes, il existe plusieurs études horizontales en ethnobiologie comparant la relation entre les humains et leur environnement, soit entre des peuples linguistiquement rapprochés ou provenant de milieu semblable (par exemple : Leonti et al. 2003; Shepard 2004; Odonne et al. 2011; Tareau 2019). Cependant, il existe peu d'études verticales adressant des questionnements comparatifs entre peuples de milieux environnementaux et culturels entièrement différentes, tels ceux du Québec et de la Guyane française. Bien que la différence marquée de la flore et la faune ne pose

aucun doute des différences marquées qui existent entre l'ethnobotanique boréale et amazonienne, ce sont les relations à l'environnement et de sa catégorisation dans le contexte ethnomédicinal qui donne une saveur solide à la comparaison entre ces peuples. Les méthodes statistiques présentées parviennent non-seulement à capter les patrons influencés par des facteurs évidents, mais aussi en ce qui concerne les plus cryptiques.

La médecine et la santé, une question foncière

Les résultats de cette thèse démontrent l'importance de la biodiversité en lien avec la santé et le bien-être. La liste complète des espèces citées à l'**Annexe 3** ne témoigne pas que de la richesse des pharmacopées crie, ilnu et parikwene, mais aussi de leur place dans un système alimentaire lié au diabète. C'est ainsi que la pertinence des médecines locales ne relève pas seulement que de l'histoire, mais elles illustrent toujours son actualité pour tous les Peuples inclus dans cette thèse. Tenant compte de la caractéristique chronique du diabète, la maladie s'installant généralement pour le reste de la vie, sans compter ses diverses complications, quelles sont alors les stratégies adoptées par les diabétiques pour accommoder leurs médecines dans leurs parcours de soins ?

Des études montrent que les familles de plantes les mieux représentées dans les pharmacopées végétales à travers le monde sont les Asteraceae, les Apiaceae, les Lamiaceae et les Solanaceae (Leonti 2011). La plante médicinale « parfaite » serait donc non-seulement abondante, mais facilement accessible, prône à pousser en milieu anthropogénique, et dotée de propriétés organoleptiques prononcé (Stepp and Moerman 2001; Leonti 2011). Bien qu'une partie de la pharmacopée parikwene corresponde à cette description, la majorité des plantes citées dans cette thèse sont pourtant récoltées en nature. Cela s'inscrit bien dans le mode de vie traditionnelle

algonquien qui dépend d'un large territoire pour la collecte des ressources de subsistance. Mais chez les Parikwene, où la culture des plantes médicinales près du domicile ou à proximité des carbeta est pratique courante, les plantes les plus citées contre le diabète sont accessibles tant en forêt secondarisée qu'ancienne.

Selon le Conseil des Montagnais du Lac-Saint-Jean (2003:227), le « *Nitassinan et l'Ilnu ne font qu'un, l'un ne va pas sans l'autre, ils sont indissociables. [...] Les Ilnuatsh font partie du territoire et ils doivent y vivre dans le plus grand respect de ses ressources.* » Cet énoncé, provenant des Pekuakamilnuatsh même, répond bien à la première hypothèse de cette thèse : l'accès et le lien aux territoires et à la nature est un principe central des médecines décrites et qu'il est lié à la santé des diabétiques. Le discours des participants Ilnu interviewés dans cette thèse réaffirme cette relation : ce ne sont pas que les ressources du territoire qui permettent de maintenir les Ilnu en santé, mais le territoire lui-même. Le rapprochement du discours entre les Pekuakamilnuatsh et les Cris d'Eeyou Istchee nous permet d'en venir à la même conclusion pour ces derniers. Quant au Parikwene, bien que cette relation avec le territoire soit différente, les relations sociales y sont tout de même étroitement liées, les activités de récoltes favorisant tant l'échange, que la transmission des savoirs et des connaissances (Iaparrá and Ramos 2018). Les animaux, les plantes et autres éléments de la nature figurent eux-mêmes dans la classification des clans parikwene (Grenand and Grenand 1987; Batista 2018). L'accès à la nature permet non-seulement l'accès aux ressources alimentaires et médicinales, mais ces activités renforcent les relations sociales assurant la continuité culturelle, et encouragent les saines habitudes de vies.

En effet, tant chez les Cris d'Eeyou Istchee, les Pekuakamilnuatsh que les Parikwene, un discours similaire fait écho quant à l'origine de diabète : cette maladie était inconnue de leur peuple avant qu'ils ne se sédentarisent, changent leur mode de vie et leur alimentation. Le même discours

existe chez plusieurs autres peuples autochtones dans les Amériques. Chez les Yanomami du Brésil, entre autres, l'on rappelle que les gens étaient en bonne santé et vivaient longtemps avant l'orpailage, une activité associée aux « Blancs » (Kopenawa and Albert 2010). Sa description de « fumée de métaux nocive pour les hommes » rappelle les inquiétudes de contamination aux métaux lourds en santé publique présente au Québec et en Guyane ; citons le mercure dans le poisson et rajoutons maintenant le plomb dans le **kwak** qui touchent tous les deux à la subsistance même des Peuples impliqués dans cette étude (Régine et al. 2006; Donaldson et al. 2010; Lemire et al. 2015; Rimbaud et al. 2017; Maurice et al. 2021). Il n'est donc pas surprenant que la santé s'entremêle à l'accès et le lien au territoire et qu'ils prennent tous les deux une dimension identitaire dans la revendication des droits de ces peuples et du droit foncier. Rappelons ici que le droit à la terre est une condition *sine qua non* de toutes les luttes autochtones (Palisse and Davy 2018).

L'utilisation des médecines locales démontre une volonté d'autogestion du diabète chez les participants interviewés. Discutant du rôle de ces médecines dans cette quête d'autonomie, il devient clair que cela participe aussi à la reconnaissance des droits autochtones. « Comment devons-nous nous nourrir et nous soigner si nous coupons la forêt et polluons l'eau ? » font remarquer les participants de cette étude. La réponse à cette question conviendrait maladroitement aux conseils de plusieurs nutritionnistes et diététiciens qui prônent une alimentation saine à partir de ce qu'ils connaissent, les aliments du marché, ou de plusieurs médecins qui traitent selon leurs moyens, la biomédecine. Le lien avec les changements de modes de vie, notamment l'alimentation, que font les participants à cette étude, avec le diabète est bel et bien perçu comme une maladie importée dans le même sens des grandes épidémies de la variole, la rougeole et la grippe associées à l'arrivée des Européens (Buchillet 1995). Face à la relation étroite existante entre

la colonisation et ces changements, nous sommes alors confrontés à la question suivante : le diabète n'est-il qu'une séquelle du legs colonial, et est-il toujours dans les mains de ce jeu de pouvoir ?

En ce qui concerne la reconnaissance des droits autochtones et de leur réconciliation avec ces Peuples, le Canada et la France ne sont pas aux mêmes endroits dans leur démarche. Bien que la France ait signé la Déclaration des droits autochtones des Nations Unies et qu'elle ait légiféré le Protocole de Nagoya sur l'Accès et le Partage des Avantages (APA), le Canada reconnaît le titre « autochtone » dans sa constitution et accorde des droits d'autogestion aux Premières Nations en fonction des accords tenus sous formes de traités ou de conventions. Cela se traduit chez les Cris d'Eeyou Istchee et les Pekuakamilnuatsh par une plus grande participation autochtone dans le système de santé géré localement par les Premières Nations elles-mêmes. Le rapprochement du discours des participants travaillant dans le système de santé à celui des participants utilisant les services de ce système vient alors supporter la deuxième hypothèse postulée dans cette thèse que le lien au territoire et à la nature dans les systèmes biomédicaux varie en fonction de l'implication de la population locale dans ces systèmes de santé : plus les services de santé sont dominés par des travailleurs non-autochtones, plus cette rupture avec le territoire est grande.

Cela montre bel et bien un rapprochement théorique entre les notions des médecines locales chez les participants travaillant dans les services de santé algonquiens et ilnu. Bien qu'il soit difficile d'évaluer réellement l'impact de ce rapprochement sur le bien-être et la santé des diabétiques, plusieurs participants parikwene relativisent les conseils des professionnels de la santé, spécialement à l'égard de l'alimentation et du **kwak** : « Comment les Parikwene peuvent se nourrir s'ils n'ont pas les terres pour faire pousser le manioc ? » Le diabète ne veut rien dire s'y l'on meurt de faim. Les Cris d'Eeyou Istchee et les Pekuakamilnuatsh n'auraient donc pas tort de

recentrer la santé physique dans un contexte équilibré avec la santé émotionnelle, mentale, et spirituelle, ainsi qu'à un accès au territoire.

Ce qui est certain, c'est que les Cris d'Eeyou Istchee, les Pekuakamilnuatsh et les Parikwene naviguent entre leurs médecines locales et les traitements biomédicaux. Bien entendu, le mélange des connaissances et des pratiques peut mener à l'abandon de certaines coutumes en échange de l'adoption de nouvelles pratiques ; ces systèmes de connaissances et leurs pratiques associées sont dynamiques. McClatchey (2005) souligne que les changements engendrés par ce processus ne devraient pas être considéré comme une tragédie, tant que la santé de la population ne souffre pas de ces développements, voire s'améliorer. Étant donné la caractéristique chronique du diabète, la maladie étant généralement inscrite pour la vie avec la possibilité de ses diverses complications, cette maladie offre un contexte propice au pluralisme médical où les diabétiques naviguent entre les systèmes de soins qui leur sont à portée de la main, ayant parfois recourt à la mixité des itinéraires thérapeutiques. La coexistence, voire même le syncrétisme, des systèmes biomédicaux aux systèmes de médecines locaux s'observe à travers le monde (Cosminsky and Scrimshaw 1980; Etkin et al. 1990; Hausmann Muela et al. 2002; Calvet-Mir et al. 2008; Byg et al. 2010; Giovannini et al. 2011), et l'exemple des Cris d'Eeyou Istchee et des Pekuakamilnuatsh nous démontrent comment ce syncrétisme peut avoir lieu et se conjuguer dans le secteur de la santé.

Quelques pistes de réflexion...

Le constat étant fait sur l'importance des médecines locales dans les soins des diabétiques, quelques recommandations et pistes de réflexions nous viennent à l'esprit. Afin d'améliorer le

traitement du diabète et de ses complications chez les Cris d'Eeyou Istchee, Hayward et al. (2012) suggèrent qu'une emphase devrait être placée sur 1) la formation des employés du secteur de la santé, sur 2) une plus grande utilisation des outils de gestion du diabète et sur 3) une meilleure communication entre les utilisateurs des soins et des professionnels de la santé. À ce premier point, les résultats présentés dans cette thèse peuvent contribuer à donner un meilleur aperçu du parcours thérapeutique des diabétiques, dont le rôle de l'utilisation combinée du glucomètre et d'une écoute attentive du corps et des symptômes dans la sélection des remèdes et des choix alimentaires.

Au deuxième point, cette démarche d'autogestion demande donc un support approfondi de i) l'utilisation du glucomètre et de l'interprétation de ses résultats de glycémies, ainsi que de ii) la distinction des symptômes d'hyperglycémie et d'hypoglycémie. La non-perception de l'hypoglycémie est un réel problème (Schopman et al. 2010), et plusieurs signes et symptômes rapportés par les Parikwene peuvent correspondre à ceux d'hypoglycémie, soit le tremblement, la transpiration, la nausée, la faiblesse, l'altération temporaire de la vue, les maux de têtes et l'étourdissements (Yale et al. 2018). Distinguer les complications à long-terme de l'hyperglycémie des signes d'un événement aigu d'hypoglycémie ou d'hyperglycémie peut donc avoir un impact important sur les choix des aliments et des remèdes. Tel support peut se présenter sous divers formats passant par des ateliers réalisés avec le support d'organismes à vocation communautaire jusqu'à des programmes mieux orientés à la culture et intégrés aux services de santé, telles l'éducation thérapeutique du patient en Guyane française ou les guérisons axées sur le territoire au Québec.

Au troisième point, ces approches peuvent contribuer à une meilleure communication entre les utilisateurs des services de santé et des professionnels de la santé. Mais il est important de se rappeler que les systèmes de médecine cries, ilnu et parikwene, tout comme la biomédecine, sont

complexes. Ces médecines ne se limitent pas qu'à des pharmacopées d'origine végétale et animale. Dans le contexte du diabète, ces médecines sont indissociables de l'alimentation et de l'accès au territoire. Bien se soigner, bien manger, bien bouger... Il y aurait en fait bien plus de points communs entre la biomédecine et les médecines locales qu'on y croit !

Chez les trois Peuples impliqués dans cette thèse, le rapport entre la santé et l'accès au territoire, que Berkes et al. (2003) et Parlee et al. (2005) appellent la santé socio-écologique, nous rappelle les notions de services écosystémiques. Ces services représentent les bénéfices, au bien commun et au bien public, que procurent les écosystèmes aux sociétés humaines (Millennium Ecosystem Assessment 2005). Ils peuvent être généralement regroupés en quatre catégories, principalement :

1) les services d'approvisionnement, ou les produits tangibles obtenus des écosystèmes, comme la nourriture et les médicaments ;

2) les services de régulation, soit les bénéfices immatériels maintenus par le fonctionnement des écosystèmes, comme la pollinisation ainsi que la régulation du climat, de la qualité de l'air et de l'eau ;

3) les services socioculturels, ou les contributions intangibles de la biodiversité tirées de la relation qu'entretient l'humain avec la nature revenant entre autres aux valeurs spirituelles et éducatives, ainsi qu'au sentiment d'appartenance qu'apporte l'environnement ;

4) les services de soutien et de support, nécessaires à la réalisation de tous les autres services, comme les grands cycles biogéochimiques de l'eau, du carbone, de l'azote et du phosphore.

La dépendance des sociétés humaines à travers le monde à ces services est mise en évidence par le nombre de ressources extraites de l'environnement. Mais avant tout, les services écosystémiques soulignent que le bien-être humain est inhérent à celui des écosystèmes et de l'environnement (Mainka et al. 2005; PNUE and ILRI 2020; WHO 2020). En mentionnant la perte des connaissances des aliments issus de la forêt auprès des jeunes Parikwene, le Chef coutumier d'Espérance 1 précise que « ces plantes disparaissent maintenant. » Disparaissent-ils vraiment de l'environnement ? Certes, s'ils disparaissent du savoir collectif, quelle raison d'être pouvons-nous donner à des ressources que nous ne connaissons plus ? Quelle valeur pouvons-nous donner à ce que nous ne voyons pas ? Invisibles, il est donc plus facile de donner raison d'être aux grandes opérations d'exploitation des ressources. La disparition de ces ressources ne serait donc pas que symbolique, mais manifestement réelle.

Cette leçon évoque l'indissociabilité des Ilnu et des Cris au territoire, mais un message commun et plus important est à tirer. Le diabète, bien qu'il touche disproportionnellement les peuples autochtones, est un problème de santé mondial. L'expérience du diabète vécu par les participants de cette étude met en garde contre un phénomène bien commun, mais vécu sur des échelles temporelles différentes par les sociétés humaines à travers le monde. Les dimensions socio-économiques de la santé issue du legs colonial perdurent aussi de nos jours à travers les processus de globalisation qui influencent directement et indirectement les rapports alimentaires et territoriaux de la population mondiale. Le diabète et les autres maladies attribuées au mode de vie relèveraient donc d'une relation dysfonctionnelle avec l'environnement et la nature.

Nous sommes vraisemblablement témoin d'un conflit de paradigme ontologique à l'échelle globale. Alors que l'Organisation des Nations Unies (ONU) et l'OMS se positionnent sur des concepts écologiques qui accordent une similarité biologique aux humains, aux animaux et aux

plantes dans l'environnement, le marché économique mondial se repose en grande partie sur l'exploitation de ces ressources. Selon Descola (2005), l'on pourrait attribuer le rapport écologique des humains vis-à-vis la nature à une ontologie naturaliste, alors que l'on pourrait attribuer son rapport économique à un héritage judéo-chrétien qui correspondrait plus à une ontologie analogique. Mais ces catégorisations sont basées sur une sélection bidimensionnelle distinguant l'intériorité, soit l'âme, de l'extériorité, soit le corps. S'il y a une dernière leçon que les Cris et les Ilnu ont encore à nous enseigner, c'est que l'humain ne se limite pas qu'à ces deux dimensions, car son intériorité peut être décrit par sa faculté spirituelle, émotionnelle et mentale. Qu'arrive-t-il donc si nous rajoutons une troisième dimension à la classification des ontologies de Descola, distinguant ainsi la faculté émotionnelle de la faculté spirituelle ? Les caractéristiques dites « animistes » se distingueraient sûrement plus finement. Peut-être que nous pourrions mieux consolider l'expérience humaine et son rapport avec le Terre d'un point de vue mondial. De toute évidence, les Cris d'Eeyou Istchee, les Pekuakamilnuatsh, les Parikwene et les autres Peuples autochtones à travers le monde n'ont certainement pas fini de contribuer à la progression du savoir collectif et mondial.

Perspectives de recherche

L'on ne peut pas conclure cette thèse sans présenter quelques perspectives de recherche. Dans un premier temps, le discours des Parikwene autour du **kwak** acide et sucré sur le contrôle de la glycémie nous pousse naturellement à vouloir vérifier l'impact des différences observées dans la chaîne opératoire de la transformation du **kwak**. La pertinence d'une étude sur la variation du potentiel glycémique du **kwak** est mise en évidence par l'absence marquée de ces informations

dans les tables internationales des indices de glycémie (Atkinson et al. 2008). Une telle étude pourrait se réaliser sous plusieurs angles, soit en se penchant sur la constitution de la flore microbienne impliquée dans la transformation du **kwak** acide, soit en se penchant sur l'index glycémique mêmes des divers produits dérivés.

Dans un deuxième temps, l'importance des propriétés organoleptiques dans les médecines Parikwene nous mène à se poser la question concernant la pertinence biologique et culturelle de ce concept. Malgré l'absence de ces concepts rapportés ici dans les médecines cris et ilnu, un questionnement plus ciblé sur l'écologie sensorielle pourrait les faire remonter à la lumière du jour. La présence de remèdes amers chez les Cris d'Eeyou Istchee et les Pekuakamilnuatsh viendrait supporter ce concept plutôt caractéristique des Parikwene. Ainsi, pour tester l'hypothèse que l'amertume des plantes est une caractéristique prédictive de leur activité antidiabétique, il s'agirait donc de les classer selon une échelle telle l'unité internationale d'amertume, ou l'*international bitterness unit* (IBU), utilisée pour mesurer l'amertume des bières, et d'évaluer leur potentiel hypoglycémique pharmacologiquement.

Troisièmement, il est important de constater que pour les Parikwene, en particulier, cette étude n'effleure que la surface des pratiques médicinales en lien avec le diabète. Des études employant la valeur d'importance syndromique (*syndromic importance value* ; Leduc et al. 2006; Rapinski 2012) ont démontré qu'une panoplie de plantes utilisées par les Cris d'Eeyou Istchee pour soigner de multiples symptômes associés au diabète possédaient un potentiel antidiabétique même si elles n'étaient pas forcément utilisées pour cette raison (Haddad et al. 2012). Une étude similaire sur la pharmacopée parikwene s'avère donc utile pour cerner davantage les plantes antidiabétiques utilisées par les Parikwene. Quant aux Pekuakamiluatsh, qui utilisent plusieurs des

mêmes plantes que les Cris, une telle étude fournirait une valeur ajoutée aux connaissances déjà documentées chez les Cris.

Engagé prochainement à assurer le retour approprié des résultats de cette thèse auprès des participants de cette étude, et de leurs communautés, toutes ces perspectives de projets s'inscrivent dans des démarches interdisciplinaires visant à trouver des solutions culturellement adaptées pour réduire les iniquités sanitaires.

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Annexe 1. Certificat d'éthique

Comité d'éthique de la recherche en arts et en sciences

CERTIFICAT D'APPROBATION ÉTHIQUE

Le Comité d'éthique de la recherche en arts et en sciences (CÉRAS), selon les procédures en vigueur, en vertu des documents qui lui ont été fournis, a examiné le projet de recherche suivant et conclu qu'il respecte les règles d'éthique énoncées dans la Politique sur la recherche avec des êtres humains de l'Université de Montréal.

Projet	
Titre du projet	Ethnobotanique des peuples premiers d'Amérique: l'impact de l'alimentation et de la médecine traditionnelle dans le maintien de la santé et du bien-être chez les diabétiques
Étudiant requérant	Michael Rapinski (B3983), Étudiant au doctorat, FAS - Département de sciences biologiques
Sous la direction de	Alain Cuerrier, Professeur associé, FAS - Département de sciences biologiques, Université de Montréal & Damien Davy, Centre national de la recherche scientifique, Université de Guyane.

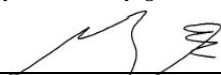
Financement	
Organisme	IRSC
Programme	
Titre de l'octroi si différent	Équipe de recherche sur la mise en œuvre des voies de l'équité - composante 2
Numéro d'octroi	355270
Chercheur principal	Pierre Haddad (Université de Montréal)
No de compte	

MODALITÉS D'APPLICATION

Tout changement anticipé au protocole de recherche doit être communiqué au CÉRAS qui en évaluera l'impact au chapitre de l'éthique.

Toute interruption prématurée du projet ou tout incident grave doit être immédiatement signalé au CÉRAS.

Selon les règles universitaires en vigueur, un suivi annuel est minimalement exigé pour maintenir la validité de la présente approbation éthique, et ce, jusqu'à la fin du projet. Le questionnaire de suivi est disponible sur la page web du CÉRAS.


Martin Arguin, Président
Comité d'éthique de la recherche en arts
et en sciences
Université de Montréal

7 juin 2017
Date de délivrance

1er juillet 2022
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Annexe 2. Exemple de script dans R

Step 1 - Read tables

```
participants=read.table("participants.txt",header=T,row.names=1) # Opening a dataset containing participant information (eg. age, profession, gender, city, country, etc.) for a .txt file; named "participants.txt" for the sake of argument
themes=read.table("themes.txt",header=T,row.names=1) # Dataset containing themes cited by participants; named "themes.txt" for the sake of argument
```

Step 2 - Open libraries

```
library(vegan)
```

Step 3 - Transformation

```
## Hellinger ##
```

```
hel=decostand(themes, "hellinger") # Perform Hellinger transformation on the themes dataset. If applying transformations on a subset of data, apply Hellinger last
```

```
## Species Richness/Total Themes ##
```

```
subset.1=rowSums(themes[,1:10]>0) # Calculate total themes, or species richness, on a subset of the 10 first column of the themes matrix
```

```
## Shannon ##
```

```
subset.2=diversity(themes[,11:20]) # Calculate the Shannon Index on a subset of the second set of 10 column of the themes matrix
```

```
## Creating a new dataset ##
```

```
new.matrix=cbind(subset.1, subset.2) # Combines specified subset into a new dataset
```

Step 4 - Ordinations

```
## For tb-PCA, see Step 4.1 ##
```

```
## For tb-RDA, see Step 4.2 ##
```

Step 4.1 - tb-PCA

```
tbPCA=rda(hel) # rda() function performs a PCA when datasets containing explanatory variables are excluded
```

Step 5 - Retrieve the proportion of variation explained by axes

```
summary(tbPCA)
```

Step 6 - Plot the ordination

```
plot(tbPCA, scaling=2) # Basic plotting function in type 2 scaling
```


Step 4.2 - tb-RDA

Full model with interaction

```
tbRDA.full.int=rda(hel~participants[,1]+participants[,2]+participants[,1]:participants[,2])
```

Step 5 - Tests of significance

Full model with interaction

```
anova(tbRDA.full.int,step=1000,perm.max=1000) # p-value for general model
```

```
anova(tbRDA.full.int,step=1000, perm.max=1000, by="terms") # Partial p-values for each terms
```

Step 6 - R-squared (R2)

Full model with interaction

```
RsquareAdj(tbRDA.full.int) # Provides both R2 and adjusted-R2
```

Step 7 - Repeat steps 4.2-6 for specific factors

Factor 1

```
tbRDA.1=rda(hel~participants[,1])
```

```
anova(tbRDA.1,step=1000,perm.max=1000)
```

```
anova(tbRDA.1,step=1000, perm.max=1000, by="axis") # Partial p-values for each axis
```

```
RsquareAdj(tbRDA.1)
```

Factor 2

```
tbRDA.2=rda(hel~participants[,2])
```

```
anova(tbRDA.2,step=1000,perm.max=1000)
```

```
anova(tbRDA.2,step=1000, perm.max=1000, by="axis")
```

```
RsquareAdj(tbRDA.2)
```

Step 8 - Retrieve the proportion of variation explained by axes

```
summary(tbRDA.1)
```

```
summary(tbRDA.2)
```

Step 9 - Plot the figures

```
par(mfrow=c(1,2))
```

```
plot(tbRDA.1) # Basic plotting function in type 2 scaling
```

```
plot(tbRDA.2)
```

Step 10 - Variation partitioning

```
out=varpart(hel,participants[,1],participants[,2]) # Variation partitioning for main factors, if non-significant interaction
```

```
plot(out)
```

Step 11 - Other helpful plotting functions

```
scores.tbRDA.1=scores(tbRDA.1) # Retrieve plotting coordinates for points and arrows
plot(tbRDA.1, type="none", main="A) tb-RDA", xlab="RDA1", ylab="RDA2") # Make empty plot to add custom
points and arrows
points(scores.tbRDA.1$sites[1:10,1:2],type="p",pch=21,bg="white",col="black") # Add empty points for the
first ten participants (rows)
arrows(0,0, scores.tbRDA.1$species[,1]*2,scores.tbRDA.1$species[,2]*2, length = 0.05, col="red") # Add
arrows for themes with specification to increase their length 2-fold
ordiellipse(tbRDA.1, participants[,1],label=T, kind="sd") # Add ellipses to delimit the standard deviation of
points around the centroids of each factor's level
```


Annexe 3. Liste complète des espèces citées

Liste complète des espèces citées par tous les participants en fonction de leur usage médicinal (M) et alimentaire (F). Bien que ces espèces soient listées pour des usages spécifiquement cités par les participants (c'est-à-dire, médicinal et alimentaire), seules les espèces citées uniquement comme alimentaire par les Cris d'Eeyou Istchee et les Pekuakamilnuatsh peuvent aussi être traitées de médicinales selon les notions holistiques du bien-être. Pour plus d'information sur les noms communs, ou vernaculaires, voir la **Table 3.5** pour les espèces mentionnées par les Parikwene et la **Table 4.3** pour les espèces mentionnées par les Cris d'Eeyou Istchee et les Pekuakamilnuatsh. Les groupes de participants : Parikwene (Pa), Cris d'Eeyou Istchee (Cri), Pekuakamilnuatsh (Il) et participants non-autochtones (N-I). L'origine des plantes : Amérique générale (AM), Amérique du Nord (NA), Amérique du Sud (SA), Europe (EU), Asie (AS), Afrique (AF) and Océanie (OC). Le statut des espèces : sauvage (W), domestiquée (D), cultivée (C), importée ou achetée (I), rudérale (R).

Famille	Nom latin	Usage	Groupe	Origine	Statut
Animaux					
<i>Poissons</i>					
Acestrorhynchidae	<i>Acestrorhynchus</i> spp.	F	Pa	SA	W
Arapaimidae	<i>Arapaima gigas</i> (Schinz, 1822)	F	Pa	SA	W
Ariidae	<i>Sciades passany</i> (Valenciennes, 1840)	F	Pa	SA	W
Callichthyidae	Voir la famille (kariwu)	F	Pa	SA	W
Catostomidae	<i>Catostomus</i> spp.	M, F	Cri	NA	W
Centropomidae	<i>Centropomus</i> spp.	F	Pa	SA	W
Characidae	<i>Tetragonopterus</i> spp.	F	Pa	SA	W
Cichlidae	<i>Astronotus ocellatus</i> (Agassiz, 1831)	F	Pa	SA	W
Cichlidae	<i>Chaetobranchus flavescens</i> Heckel, 1840	F	Pa	SA	W
Cichlidae	<i>Cichla monoculus</i> Spix, 1831	F	Pa	SA	W
Cichlidae	<i>Heros efasciatus</i> Heckel, 1840	F	Pa	SA	W
Cichlidae	Voir la famille (be)	F	Pa	SA	W
Clupeidae/Pristigasteridae	Voir la famille (karaht)	F	Pa	SA	W
Erythrinidae	<i>Hoplerythrinus unitaeniatus</i> (Spix, 1829)	F	Pa	SA	W

Famille	Nom latin	Usage	Groupe	Origine	Statut
Erythrinidae	<i>Hoplias aimara</i> (Valenciennes, 1846)	F	Pa	SA	W
Erythrinidae	<i>Hoplias malabaricus</i> (Bloch, 1794)	F	Pa	SA	W
Esocidae	<i>Esox lucius</i> Linnaeus, 1758	M, F	Cri	NA	W
Gymnotidae	<i>Electrophorus electricus</i> (Linnaeus, 1766)	F, M	Pa	SA	W
Lotidae	<i>Lota lota</i> (Linnaeus, 1758)	M, F	Cri	NA	W
Megalopidae	<i>Megalops atlanticus</i> Valenciennes, 1847	F	Pa	SA	W
Mugilidae	<i>Mugil incilis</i> Hancock, 1830	F	Pa	SA	W
Paralichthyidae	<i>Syacium</i> spp.	F	Pa	SA	W
Percidae	<i>Sander vitreus</i> (Mitchill, 1818)	M, F	Il, Cri, N-I	NA	W
Pimelodidae	<i>Brachyplatystoma filamentosum</i> (Lichtenstein, 1819)	F	Pa	SA	W
Salmonidae	<i>Coregonus clupeaformis</i> (Mitchill, 1818)	M, F	Cri, N-I	NA	W
Salmonidae	<i>Salmo salar</i> Linnaeus, 1758	M, F	Il, Cri, N-I	NA	W/I
Salmonidae	• <i>Salmo salar</i> Linnaeus, 1758 (saumon d'eau douce)	F	Il	NA	W
Salmonidae	• <i>Salmo salar</i> Linnaeus, 1758 (saumon anadrome)	M, F	Il, Cri, N-I	NA	I
Salmonidae	<i>Salvelinus namaycush</i> (Walbaum in Artedi, 1792)	M, F	Il, Cri	NA	W
Sciaenidae	Voir la famille (akup)	F	Pa	SA	W
Serrasalmodidae	Voir la famille (umayan)	F	Pa	SA	W
Unknown	Animal 6	F	Pa	SA	W
<i>Reptiles</i>					
Alligatoridae	Voir la famille (pareine)	F, M	Pa	SA	W
Alligatoridae	• <i>Caiman crocodilus</i> (Linnaeus, 1758)	F	Pa	SA	W
Alligatoridae	• <i>Paleosuchus palpebrosus</i> (Cuvier, 1807)	F	Pa	SA	W
Alligatoridae	• <i>Paleosuchus trigonatus</i> (Schneider, 1801)	F	Pa	SA	W
Boidae	<i>Eunectes murinus</i> (Linnaeus, 1758)	F, M	Pa, N-I	SA	W
Chelidae	<i>Mesoclemmys nasuta</i> (Schweigger, 1812)	F	Pa	SA	W
Iguanidae	<i>Iguana iguana</i> (Linnaeus, 1758)	F, M	Pa	SA	W
Podocnemididae	<i>Podocnemis unifilis</i> Troschel, 1848	F	Pa	SA	W
Testudinidae	<i>Chelonoidis</i> spp.	F, M	Pa, N-I	SA	W

Famille	Nom latin	Usage	Groupe	Origine	Statut
<i>Oiseaux</i>					
Accipitridae	<i>Aquila chrysaetos</i> (Linnaeus, 1758)	M	Il, Cri, N-I	NA	W
Accipitridae	<i>Busarellus nigricollis</i> (Latham, 1790)	M	Pa	SA	W
Anatidae	<i>Branta canadensis</i> (Linnaeus, 1758)	M, F	Il, Cri, N-I	NA	W
Anatidae	<i>Chen caerulescens</i> (Linnaeus, 1758)	M, F	Il, Cri	NA	W
Anatidae	Voir la famille (canard)	M, F	Il, Cri	NA	W
Anatidae	Voir la famille (kanar)	F	Pa	SA	W
Anatidae	• <i>Cairina moschata</i> (Linnaeus, 1758)	F	Pa	SA	W
Anatidae	• <i>Dendrocygna autumnalis</i> (Linnaeus, 1758)	F	Pa	SA	W
Columbidae	<i>Leptotila rufaxilla</i> (Richard & Bernard, 1792)	F, M	Pa	SA	W
Corvidae	<i>Perisoreus canadensis</i> (Linnaeus, 1766)	M	Cri	NA	W
Cracidae	<i>Crax alector</i> Linnaeus, 1766	F, M	Pa	SA	W
Cracidae	<i>Penelope marail</i> (Statius Müller, 1776)	F	Pa	SA	W
Phasianidae	<i>Gallus gallus domesticus</i> (Linnaeus, 1758)	F, M	Pa	AS	D
Phasianidae	Voir la famille (perdrix)	M, F	Il, Cri, N-I	NA	W
Phasianidae	• <i>Falcipecten canadensis</i> (Linnaeus, 1758)	M, F	Cri	NA	W
Phasianidae	• <i>Lagopus lagopus</i> (Linnaeus, 1758)	F	Il	NA	W
Psittacidae	<i>Amazona</i> spp.	F	Pa	SA	W
Psittacidae	Voir la famille (ara)	F	Pa	SA	W
Psophiidae	<i>Psophia crepitans</i> Linnaeus, 1758	F	Pa	SA	W
Ramphastidae	Voir la famille (yahok)	F, M	Pa	SA	W
Tinamidae	<i>Tinamus major</i> (Gmelin, 1789)	F, M	Pa	SA	W
<i>Mammifères</i>					
Atelidae	<i>Alouatta macconnelli</i> (Elliot, 1910)	F, M	Pa	SA	W
Atelidae	<i>Ateles paniscus</i> (Linnaeus, 1758)	F, M	Pa	SA	W
Bovidae	<i>Bos taurus</i> Linnaeus, 1758	F, M	Pa	AS	D
Bovidae	<i>Ovis aries</i> Linnaeus, 1758 (?)	M	Pa	EU/AS	D
Castoridae	<i>Castor canadensis</i> Kuhl, 1820	M, F	Il, Cri, N-I	NA	W

Famille	Nom latin	Usage	Groupe	Origine	Statut
Caviidae	<i>Hydrochoerus hydrochaeris</i> (Linnaeus, 1766)	F, M	Pa	SA	W
Cebidae	Voir la famille (wakukwa)	F, M	Pa	SA	W
Cebidae	• <i>Cebus olivaceus</i> Schomburgk, 1848	F, M	Pa	SA	W
Cebidae	• <i>Sapajus apella</i> (Linnaeus, 1758)	F, M	Pa	SA	W
Cervidae	<i>Alces americanus</i> (Clinton, 1822)	M, F	Il, Cri, N-I	NA	W
Cervidae	<i>Mazama</i> spp.	F	Pa	SA	W
Cervidae	• <i>Mazama americana</i> (Erxleben, 1777)	F	Pa	SA	W
Cervidae	• <i>Mazama gouazoubira</i> (Fischer, 1814)	F	Pa	SA	W
Cervidae	<i>Odocoileus virginianus</i> (Zimmermann, 1780)	M, F	Il, Cri	NA	W
Cervidae	<i>Rangifer tarandus</i> subsp. <i>caribou</i> (Linnaeus, 1758)	M, F	Il, Cri, N-I	NA	W
Cricetidae	<i>Ondatra zibethicus</i> (Linnaeus, 1766)	M, F	Il, Cri	NA	W
Cuniculidae	<i>Cuniculus paca</i> (Linnaeus, 1766)	F, M	Pa	SA	W
Dasypodidae	<i>Dasypus</i> spp.	F, M	Pa	SA	W
Dasypodidae	• <i>Dasypus kappleri</i> Krauss, 1862	F, M	Pa	SA	W
Dasypodidae	• <i>Dasypus novemcinctus</i> Linnaeus, 1758	F, M	Pa	SA	W
Dasyproctidae	<i>Dasyprocta leporina</i> (Linnaeus, 1758)	F	Pa	SA	W
Erethizontidae	<i>Erethizon dorsatum</i> (Linnaeus, 1758)	F	Il	NA	W
Felidae	<i>Panthera onca</i> (Linnaeus, 1758)	M	Pa	SA	W
Hominidae	<i>Homo sapiens</i> Linnaeus, 1758	M	Il, Cri	NA	W
Leporidae	<i>Lepus americanus</i> Erxleben, 1777	M, F	Il, Cri, N-I	NA	W
Mephitidae	<i>Mephitis mephitis</i> (Schreber, 1777)	M	Il, Cri	NA	W
Mustelidae	<i>Lontra canadensis</i> (Schreber, 1777)	M	Il, Cri, N-I	NA	W
Myrmecophagidae	<i>Myrmecophaga tridactyla</i> Linnaeus, 1758	M	N-I	SA	W
Phocidae	Voir la famille (phoque)	M, F	Il, Cri	NA	W
Procyonidae	<i>Potos flavus</i> (Schreber, 1774)	F	Pa	SA	W
Sciuridae	<i>Marmota monax</i> (Linnaeus, 1758)	F	Il	NA	W
Sciuridae	<i>Tamiasciurus hudsonicus</i> (Erxleben, 1777)	F	Il	NA	W

Famille	Nom latin	Usage	Groupe	Origine	Statut
Suidae	<i>Sus domesticus</i> Erxleben, 1777	F	Pa	EU/AS	D
Tapiridae	<i>Tapirus terrestris</i> (Linnaeus, 1758)	F	Pa	SA	W
Tayassuidae	Voir la famille (kavine, pakih)	F, M	Pa	SA	W
Tayassuidae	• <i>Pecari tajacu</i> (Linnaeus, 1758)	F	Pa	SA	W
Tayassuidae	• <i>Tayassu pecari</i> (Link, 1795)	F, M	Pa	SA	W
Ursidae	<i>Ursus americanus</i> Pallas, 1780	M, F	Il, Cri, N-I	NA	W
<i>Insectes</i>					
Apoidea (Superfamily)	Animal 7 (abeilles à miel)	F, M	Pa, N-I	SA	W
Formicidae	Animal 12 (fourmis)	M	Pa	SA	W
Formicidae	Animal 14 (fourmis)	M	Pa	SA	W
Formicidae	<i>Atta</i> spp.	M	Pa	SA	W
Isoptera (Infraorder)	Animal 11 (termites)	M	Pa	SA	W
<i>Crustacés, mollusques et autres</i>					
Amphibia	Animal 15	M	Pa	SA	W
Ampullariidae	<i>Pomacea guyanensis</i> (Lamarck, 1822)	F	Pa	SA	W
Decapoda (Order)	Animal 1 (crevettes)	F	Pa	SA	W
Lumbricina (Suborder)	Animal 10 (vers de terre)	M	Pa	SA	W
Portunidae	<i>Callinectes exasperatus</i> (Gerstaecker, 1856)	F, M	Pa	SA	W
Lichens et champignons					
Cantharellaceae	<i>Craterellus tubaeformis</i> (Fr.) Quél.	F	Il	NA	W
Cladoniaceae	<i>Cladonia</i> spp.	M, F	Il, Cri	NA	W
Hymenochaetaceae	<i>Inonotus obliquus</i> (Ach. ex Pers.) Pilát	M	Il	NA	W
Morchellaceae	<i>Morchella</i> spp.	F	Il	NA	W
Umbilicariaceae	<i>Umbilicaria</i> spp.	F	Cri	NA	W
Plantes					
Amaranthaceae	<i>Salicornia depressa</i> Standl.	F	Il	NA	W
Amaryllidaceae	<i>Allium cepa</i> L.	F, M	Il, Pa	AS	C/I

Famille	Nom latin	Usage	Groupe	Origine	Statut
Amaryllidaceae	<i>Allium sativum</i> L.	F, M	Pa, N-I	AS	C/I
Amaryllidaceae	<i>Allium tricoccum</i> Aiton	F	II	NA	W
Anacardiaceae	<i>Anacardium occidentale</i> L.	F, M	Pa	SA	R/C
Anacardiaceae	<i>Mangifera indica</i> L.	F, M	Pa, N-I	AS	C
Anacardiaceae	<i>Rhus typhina</i> L.	M	II	NA	W
Anacardiaceae	<i>Spondias dulcis</i> Parkinson	F, M	Pa, N-I	SA	C
Anacardiaceae	<i>Spondias mombin</i> L.	F, M	Pa	SA	W/C
Anacardiaceae	<i>Tapirira</i> spp.	M	Pa	SA	W
Annonaceae	<i>Annona montana</i> Macfad.	F	Pa	SA	W
Annonaceae	<i>Annona mucosa</i> Jacq.	F	Pa	SA	W
Annonaceae	<i>Annona muricata</i> L.	F, M	Pa, N-I	SA	C
Annonaceae	<i>Annona paludosa</i> Aubl.	F	Pa	SA	W
Apiaceae	<i>Eryngium foetidum</i> L.	F, M	Pa	SA	C
Apiaceae	<i>Foeniculum vulgare</i> Mill.	M	N-I	EU/AS	C/I
Apiaceae	<i>Ligusticum porteri</i> J.M. Coult. & Rose (?)	M	Cri	NA	I
Apocynaceae	<i>Ambelania acida</i> Aubl.	F, M	Pa	SA	W
Apocynaceae	<i>Bonafousia albiflora</i> (Miq.) Boiteau & L. Allorge	M	Pa	SA	W
Apocynaceae	<i>Bonafousia angulata</i> (Mart. ex Müll. Arg.) Boiteau & L. Allorge	M	Pa	SA	W
Apocynaceae	<i>Couma guianensis</i> Aubl.	F, M	Pa	SA	W
Apocynaceae	<i>Geissospermum</i> spp.	M	Pa	SA	W
Apocynaceae	<i>Pacouria guianensis</i> Aubl.	M	Pa	SA	W
Apocynaceae	<i>Parahancornia fasciculata</i> (Poir.) Benoist	M	Pa	SA	W
Apocynaceae	<i>Tabernaemontana siphilitica</i> (L. f.) Leeuwenb.	M	Pa	SA	W/C
Araceae	<i>Colocasia esculenta</i> (L.) Schott	F	Pa	AS	C
Araliaceae	<i>Aralia nudicaulis</i> L.	M, F	II	NA	W
Arecaceae	<i>Astrocaryum paramaca</i> Mart.	F, M	Pa	SA	W
Arecaceae	<i>Astrocaryum vulgare</i> Mart.	F, M	Pa	SA	W

Famille	Nom latin	Usage	Groupe	Origine	Statut
Arecaceae	<i>Attalea maripa</i> (Aubl.) Mart.	F, M	Pa	SA	W/C
Arecaceae	<i>Bactris gasipaes</i> Kunth	F	Pa	SA	C
Arecaceae	<i>Bactris major</i> Jacq.	F, M	Pa	SA	W
Arecaceae	<i>Cocos nucifera</i> L.	F, M	Pa	AS	C
Arecaceae	<i>Desmoncus</i> spp.	M	Pa	SA	W
Arecaceae	<i>Euterpe oleracea</i> Mart.	F, M	Pa	SA	W/C
Arecaceae	<i>Manicaria saccifera</i> Gaertn.	M	Pa	SA	W
Arecaceae	<i>Mauritia flexuosa</i> L. f.	F, M	Pa	SA	W
Arecaceae	<i>Oenocarpus bacaba</i> Mart.	F	Pa	SA	W/C
Arecaceae	<i>Oenocarpus bataua</i> Mart.	F, M	Pa	SA	W/C
Arecaceae	<i>Syagrus inajai</i> (Spruce) Becc.	M	Pa	SA	W
Aristolochiaceae	<i>Aristolochia</i> spp.	M	Pa	SA	W
Asphodelaceae	<i>Aloe vera</i> (L.) Burm. f.	M	Pa, N-I	AS/AF	C/I
Asteraceae	<i>Achillea millefolium</i> L.	M	Il, Cri	NA/EU/AS	R
Asteraceae	<i>Anaphalis margaritacea</i> (L.) Benth. & Hook. f.	M	Il	NA	W
Asteraceae	<i>Cichorium intybus</i> L.	M	Il	EU	R
Asteraceae	<i>Helianthus tuberosus</i> L.	F	Il	NA	C/I
Asteraceae	<i>Matricaria chamomilla</i> L.	M	N-I	EU/AS	I
Asteraceae	<i>Matricaria</i> spp.	M	Il	EU/AS	C/I
Asteraceae	<i>Mikania</i> spp.	M	Pa	SA	R
Betulaceae	<i>Alnus incana</i> subsp. <i>rugosa</i> (Du Roi) R.T. Clausen	M	Il, Cri	NA	W
Betulaceae	<i>Betula papyrifera</i> Marshall	M	Il, Cri, N-I	NA	W
Betulaceae	<i>Corylus cornuta</i> Marshall	M, F	Il, N-I	NA	W
Bignoniaceae	<i>Crescentia cujete</i> L.	M	Pa	SA	C
Bignoniaceae	<i>Tabebuia serratifolia</i> (Vahl) G. Nicholson	M	Pa	SA	W
Bixaceae	<i>Bixa orellana</i> L.	F, M	Pa	SA	C
Brassicaceae	<i>Brassica oleracea</i> L.	M, F	Il	EU	C/I

Famille	Nom latin	Usage	Groupe	Origine	Statut
Brassicaceae	Voir la famille (moutarde)	M, F	Il, Cri, N-I	?	I
Bromeliaceae	<i>Ananas comosus</i> (L.) Merr.	F	Pa	SA	C
Bromeliaceae	<i>Bromelia</i> sp.	M	Pa	SA	W
Burseraceae	<i>Tetragastris altissima</i> (Aubl.) Swart	M	Pa	SA	W
Calophyllaceae	<i>Calophyllum brasiliense</i> Cambess.	M	Pa	SA	W
Caprifoliaceae	<i>Diervilla lonicera</i> Mill.	M	Il	NA	W
Caprifoliaceae	<i>Valeriana</i> sp.	M	Il	NA	W
Caricaceae	<i>Carica papaya</i> L.	F	Pa, N-I	SA	C
Caryocaraceae	<i>Caryocar glabrum</i> (Aubl.) Pers.	F	Pa	SA	W
Caryocaraceae	<i>Caryocar villosum</i> (Aubl.) Pers.	F	Pa	SA	W
Chrysobalanaceae	<i>Chrysobalanus icaco</i> L.	F	Pa	SA	R/C
Clusiaceae	<i>Clusia</i> spp.	M	Pa	SA	W
Combretaceae	<i>Terminalia catappa</i> L.	F, M	Pa	AS	C
Convolvulaceae	<i>Ipomoea batatas</i> (L.) Lam.	F	Pa	SA	C
Cordiaceae	<i>Cordia</i> spp.	M	Pa	SA	R
Cornaceae	<i>Cornus canadensis</i> L.	M	Il	NA	W
Cornaceae	<i>Cornus sericea</i> L.	M	Il	NA	W
Costaceae	<i>Costus</i> spp.	F, M	Pa	SA	R
Cucurbitaceae	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	F	Pa	AF	C
Cucurbitaceae	<i>Cucumis anguria</i> L.	F	Pa	AF	C/I
Cucurbitaceae	<i>Cucumis sativus</i> L.	F	Pa	AS	C/I
Cucurbitaceae	<i>Cucurbita moschata</i> Duchesne	F	Pa	SA	C
Cucurbitaceae	<i>Momordica charantia</i> L.	M	Pa, N-I	AF	R
Cupressaceae	<i>Juniperus communis</i> L.	M	Cri	NA	W
Cupressaceae	<i>Thuja occidentalis</i> L.	M	Il, Cri, N-I	NA	W
Dilleniaceae	<i>Doliocarpus</i> spp.	F, M	Pa	SA	W
Dioscoreaceae	<i>Dioscorea cayenensis</i> Lam.	F	Pa	SA	C

Famille	Nom latin	Usage	Groupe	Origine	Statut
Dioscoreaceae	<i>Dioscorea trifida</i> L. f.	F	Pa	SA	C
Ericaceae	<i>Empetrum nigrum</i> L.	M, F	Cri	NA	W
Ericaceae	<i>Gaultheria hispidula</i> (L.) Muhl. ex Bigelow	M, F	Il, Cri	NA	W
Ericaceae	<i>Gaultheria procumbens</i> L.	M, F	Il, Cri, N-I	NA	W
Ericaceae	<i>Kalmia angustifolia</i> L.	M	Cri	NA	W
Ericaceae	<i>Rhododendron groenlandicum</i> (Oeder) Kron & Judd	M, F	Il, Cri, N-I	NA	W
Ericaceae	<i>Rhododendron tomentosum</i> Harmaja	M	Cri, N-I	NA	W
Ericaceae	<i>Vaccinium</i> spp. (bleuets et canneberges)	M, F	Il, Cri, N-I	NA	W
Ericaceae	• <i>Vaccinium angustifolium</i> Aiton	M, F	Il, Cri, N-I	NA	W
Ericaceae	• <i>Vaccinium myrtilloides</i> Michx.	M, F	Il, Cri, N-I	NA	W
Ericaceae	• <i>Vaccinium oxycoccos</i> L.	M, F	Il, Cri, N-I	NA	W
Ericaceae	• <i>Vaccinium vitis-idaea</i> L.	M, F	Il, Cri, N-I	NA	W
Euphorbiaceae	<i>Jatropha curcas</i> L.	M	Pa	SA	C
Euphorbiaceae	<i>Jatropha gossypifolia</i> L.	M	Pa	SA	C
Euphorbiaceae	<i>Manihot esculenta</i> Crantz	F, M	Pa	SA	C
Euphorbiaceae	• <i>Manihot esculenta</i> Crantz (manioc amer)	F, M	Pa	SA	C
Euphorbiaceae	• <i>Manihot esculenta</i> Crantz (manioc doux)	F	Pa	SA	C
Euphorbiaceae	<i>Ricinus communis</i> L.	M	Pa	AF/EU/AS	C
Euphorbiaceae	<i>Sapium argutum</i> (Müll. Arg.) Huber	M	Pa	SA	W
Fabaceae	<i>Bauhinia forficata</i> Link	M	Pa	SA	C
Fabaceae	<i>Copaifera guianensis</i> Desf.	M	Pa	SA	W/I
Fabaceae	<i>Dalbergia monetaria</i> L.f.	M	Pa, N-I	SA	R
Fabaceae	<i>Eperua falcata</i> Aubl.	M	Pa	SA	W
Fabaceae	<i>Erythrina fusca</i> Lour.	M	Pa	SA	W
Fabaceae	<i>Hymenaea courbaril</i> L.	M	Pa	SA	W/C
Fabaceae	<i>Inga capitata</i> Desv.	F	Pa	SA	W/C
Fabaceae	<i>Inga edulis</i> Mart.	F	Pa	SA	W/C

Famille	Nom latin	Usage	Groupe	Origine	Statut
Fabaceae	<i>Inga</i> spp. (avukun)	M	Pa	SA	W
Fabaceae	<i>Paramachaerium ormosioides</i> (Ducke) Ducke	M	Pa	SA	W
Fabaceae	<i>Phaseolus vulgaris</i> L.	F, M	Pa	SA	C/I
Fabaceae	<i>Pterocarpus officinalis</i> Jacq.	M	Pa	SA	W
Fabaceae	<i>Senna</i> spp.	M	Pa	SA	R
Gentianaceae	<i>Coutoubea spicata</i> Aubl.	M	Pa	SA	W
Grossulariaceae	<i>Ribes oxyacanthoides</i> L.	F	Cri	NA	W
Hypericaceae	<i>Hypericum</i> spp.	M	N-I	NA	W
Hypericaceae	<i>Vismia</i> spp.	M	Pa	SA	W
Iridaceae	<i>Cipura paludosa</i> Aubl.	M	Pa	SA	C
Iridaceae	<i>Eleutherine bulbosa</i> (Mill.) Urb.	M	Pa	SA	C
Lamiaceae	<i>Marsypianthes chamaedrys</i> (Vahl) Kuntze	M	Pa	SA	R
Lamiaceae	<i>Mentha</i> sp.	M	Il	NA	C/I
Lamiaceae	<i>Ocimum campechianum</i> Mill.	F, M	Pa	SA	R/C
Lamiaceae	<i>Orthosiphon aristatus</i> (Blume) Miq.	M	Pa, N-I	AS	C
Lamiaceae	<i>Plectranthus neochilus</i> Schltr.	M	Pa, N-I	AS/AF	C
Lamiaceae	<i>Salvia apiana</i> Jeps.	M	Il, Cri, N-I	NA	I
Lauraceae	<i>Cinnamomum</i> spp.	M	N-I	AS	I
Lauraceae	<i>Laurus nobilis</i> L.	M	Pa	EU	I
Lauraceae	<i>Ocotea guianensis</i> Aubl.	M	N-I	SA	W
Lauraceae	<i>Persea americana</i> Mill.	F, M	Pa	SA	C
Lecythidaceae	<i>Bertholletia excelsa</i> Bonpl.	F, M	Pa	SA	W
Lecythidaceae	<i>Couratari multiflora</i> (Sm.) Eyma	M	Pa	SA	W
Lecythidaceae	<i>Gustavia augusta</i> L.	M	Pa	SA	W
Lecythidaceae	<i>Lecythis zabucajo</i> Aubl.	M	Pa	SA	W
Linaceae	<i>Linum usitatissimum</i> L.	M	N-I	EU/AS	I
Loranthaceae	Voir la famille (waigusis)	M	Pa	SA	R

Famille	Nom latin	Usage	Groupe	Origine	Statut
Malpighiaceae	<i>Byrsonima crassifolia</i> (L.) Kunth	M	Pa	SA	W
Malpighiaceae	<i>Malpighia emarginata</i> DC.	F	Pa	SA	C
Malvaceae	<i>Gossypium barbadense</i> L.	M	Pa, N-I	SA	C
Malvaceae	<i>Hibiscus sabdariffa</i> L.	F, M	Pa, N-I	AF	C
Malvaceae	<i>Theobroma cacao</i> L.	F	Pa	SA	C
Malvaceae	<i>Theobroma grandiflorum</i> (Willd. ex Spreng.) K. Schum.	F	Pa	SA	C
Melastomataceae	<i>Bellucia grossularioides</i> (L.) Triana	F	Pa	SA	W
Melastomataceae	<i>Mouriri sagotiana</i> Triana	M	Pa	SA	W
Melastomataceae	Plant 24	M	Pa	SA	R
Meliaceae	<i>Carapa</i> spp.	M	Pa, N-I	SA	W
Menispermaceae	<i>Tinospora crispa</i> (L.) Hook. f. & Thomson	M	Pa	AS	R
Moraceae	<i>Artocarpus altilis</i> var. <i>non-seminiferus</i> (Duss) Fournet	F	Pa	OC	C
Moraceae	<i>Artocarpus altilis</i> var. <i>seminiferus</i> (Duss) Fournet	F	Pa	OC	C
Moraceae	<i>Artocarpus heterophyllus</i> Lam.	F	Pa	AS	C
Moraceae	<i>Brosimum acutifolium</i> subsp. <i>acutifolium</i> Huber	M	Pa	SA	W
Moraceae	<i>Brosimum parinarioides</i> Ducke	F, M	Pa	SA	W
Moraceae	<i>Ficus catappifolia</i> Kunth & Bouché	M	Pa	SA	W
Musaceae	<i>Musa paradisiaca</i> L.	F, M	Pa, N-I	AS	C
Myricaceae	<i>Comptonia peregrina</i> (L.) J.M. Coult.	M	Il	NA	W
Myristicaceae	<i>Iryanthera</i> spp.	M	Pa	SA	W
Myristicaceae	<i>Myristica fragrans</i> Houtt.	M	Pa	AS/OC	C/I
Myristicaceae	<i>Virola</i> spp.	M	Pa	SA	W
Myrtaceae	<i>Campomanesia aromatica</i> (Aubl.) Griseb.	M	Pa	SA	R
Myrtaceae	<i>Eugenia patrisii</i> Vahl	F	Pa	SA	W
Myrtaceae	<i>Eugenia uniflora</i> L.	F, M	Pa, N-I	SA	C
Myrtaceae	Plant 3	F	Pa	SA	W
Myrtaceae	<i>Psidium guajava</i> L.	F, M	Pa, N-I	SA	R/C

Famille	Nom latin	Usage	Groupe	Origine	Statut
Myrtaceae	<i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry	F, M	Pa	AS	C
Nymphaeaceae	<i>Nuphar</i> sp.	M	II	NA	W
Ochnaceae	<i>Ouratea impressa</i> (Tiegh.) Lemée	M	Pa	SA	W
Olacaceae	<i>Ptychopetalum olacoides</i> Benth.	M	Pa	SA	W
Oleaceae	<i>Fraxinus nigra</i> Marshall	M	II	NA	W
Oleaceae	<i>Olea europaea</i> L.	M, F	II	EU/AS/AF	I
Oxalidaceae	<i>Averrhoa carambola</i> L.	M	Pa	AS	C
Passifloraceae	<i>Passiflora edulis</i> Sims	F	Pa, N-I	SA	C
Passifloraceae	<i>Passiflora laurifolia</i> L.	F	Pa	SA	R/C
Passifloraceae	<i>Passiflora nitida</i> Kunth	F, M	Pa	SA	R/C
Phyllanthaceae	<i>Phyllanthus</i> spp.	M	N-I	SA	R
Pinaceae	<i>Abies balsamea</i> (L.) Mill.	M	II, Cri, N-I	NA	W
Pinaceae	<i>Larix laricina</i> (Du Roi) K. Koch	M	II, Cri, N-I	NA	W
Pinaceae	<i>Picea</i> spp.	M	II, Cri	NA	W
Pinaceae	• <i>Picea glauca</i> (Moench) Voss	M	II, Cri	NA	W
Pinaceae	• <i>Picea mariana</i> (Mill.) Britton, Sterns & Poggenb.	M	II, Cri, N-I	NA	W
Pinaceae	<i>Pinus</i> spp.	M	II	NA	W
Pinaceae	• <i>Pinus banksiana</i> Lamb.	M	II, Cri	NA	W
Pinaceae	• <i>Pinus strobus</i> L.	M	II	NA	W
Piperaceae	<i>Piper nigrum</i> L.	M, F	II	AS	I
Plantaginaceae	<i>Digitalis purpurea</i> L.	M	N-I	EU	R/I
Plantaginaceae	<i>Plantago major</i> L.	M	II	EU/AS	R
Poaceae	<i>Anthoxanthum</i> spp.	M	II, Cri	NA	W
Poaceae	<i>Coix lacryma-jobi</i> L.	M	Pa	AS	C
Poaceae	<i>Cymbopogon citratus</i> (DC.) Stapf	M	Pa	AS	C
Poaceae	<i>Elymus repens</i> (L.) Gould	M	II	EU/AS	R
Poaceae	<i>Oryza sativa</i> L.	F, M	Pa	AS	I

Famille	Nom latin	Usage	Groupe	Origine	Statut
Poaceae	Plant 7	M	Pa	SA	W
Poaceae	<i>Saccharum officinarum</i> L.	F	Pa	AS	C
Poaceae	<i>Triticum aestivum</i> L.	M†, F	Il, Cri, Pa, N-I	AS	C/I
Poaceae	<i>Zea mays</i> L.	M†, F	Il, Cri, Pa, N-I	AM	C
Polygalaceae	<i>Moutabea guianensis</i> Aubl.	F	Pa	SA	W
Ranunculaceae	<i>Coptis trifolia</i> (L.) Salisb.	M	Il	NA	W
Rhizophoraceae	<i>Rhizophora racemosa</i> G. Mey.	M	Pa	SA	W
Rosaceae	<i>Amelanchier</i> spp.	F	Il	NA	W
Rosaceae	<i>Fragaria virginiana</i> Mill.	F	Il, Cri	NA	W
Rosaceae	<i>Malus domestica</i> (Suckow) Borkh.	F	Pa	AS	I
Rosaceae	<i>Prunus pensylvanica</i> L. f.	M, F	Il	NA	W
Rosaceae	<i>Prunus virginiana</i> L.	F	Il	NA	W
Rosaceae	<i>Rosa</i> sp.	M, F	Il	NA	W
Rosaceae	<i>Rubus chamaemorus</i> L.	F	Cri	NA	W
Rosaceae	<i>Rubus idaeus</i> L.	M, F	Il, Cri	NA	W
Rosaceae	<i>Rubus pubescens</i> Raf.	F	Il	NA	W
Rosaceae	<i>Sorbus</i> spp.	M, F	Il, Cri	NA	W
Rosaceae	• <i>Sorbus americana</i> Marshall	M, F	Il, Cri	NA	W
Rosaceae	• <i>Sorbus decora</i> (Sarg.) C.K. Schneid.	M, F	Il, Cri	NA	W
Rosaceae	<i>Spiraea alba</i> var. <i>latifolia</i> (Aiton) Dippel	M	Il	NA	W
Rubiaceae	<i>Capirona decorticans</i> Spruce	M	Pa	SA	W
Rubiaceae	<i>Chimarrhis turbinata</i> DC.	M	Pa	SA	W
Rubiaceae	<i>Coffea arabica</i> L.	F, M	Pa	AF	C/I
Rubiaceae	<i>Genipa americana</i> L.	M	Pa	SA	W
Rubiaceae	<i>Morinda citrifolia</i> L.	M	Pa, N-I	AS/OC	C
Rutaceae	<i>Citrus aurantifolia</i> Swingle	F, M	Pa, N-I	AS	C
Rutaceae	<i>Citrus reticulata</i> Blanco	F	Pa	AS	C

Famille	Nom latin	Usage	Groupe	Origine	Statut
Rutaceae	<i>Citrus sinensis</i> (L.) Osbeck	F, M	Pa	AS	C
Rutaceae	<i>Citrus</i> sp.	F	Pa	AS	C
Rutaceae	<i>Zanthoxylum rhoifolium</i> Lam.	M	Pa	SA	W
Salicaceae	<i>Populus</i> spp.	M	Il, Cri	NA	W
Salicaceae	• <i>Populus balsamifera</i> L.	M	Il	NA	W
Salicaceae	• <i>Populus tremuloides</i> Michx.	M	Il, Cri	NA	W
Salicaceae	<i>Salix</i> spp.	M	Il, Cri	NA	W
Sapindaceae	<i>Acer rubrum</i> L.	F	Il	NA	W
Sapotaceae	<i>Chrysophyllum cainito</i> L.	F, M	Pa	SA	C
Sapotaceae	<i>Chrysophyllum cuneifolium</i> (Rudge) A. DC.	F	Pa	SA	W
Sapotaceae	Voir la famille (zoliv)	F	Pa	SA	C
Sarraceniaceae	<i>Sarracenia purpurea</i> L.	M	Cri	NA	W
Scrophulariaceae	<i>Verbascum thapsus</i> L.	M	Il	EU	R
Simaroubaceae	<i>Picrolemma sprucei</i> Hook. f.	M	Pa	SA	W
Simaroubaceae	<i>Quassia amara</i> L.	M	Pa, N-I	SA	W/C
Simaroubaceae	<i>Simaba orinocensis</i> Kunth	M	Pa	SA	W
Siparunaceae	<i>Siparuna</i> spp.	M	Pa	SA	W
Solanaceae	<i>Capsicum annuum</i> L.	F	Pa	SA	C
Solanaceae	<i>Nicotiana tabacum</i> L.	M	Il, Cri, Pa	AM	C
Solanaceae	<i>Physalis pubescens</i> L.	M	Pa	SA	R
Solanaceae	<i>Solanum stramonifolium</i> Jacq.	M	Pa	SA	R
Solanaceae	<i>Solanum tuberosum</i> L.	M†, F	Il, Pa	SA	I
Solanaceae	<i>Solanum vanheurckii</i> Müll. Arg.	M	Pa	SA	W
Sphagnaceae	<i>Sphagnum fuscum</i> (Schimp.) H. Klinggr.	M	Il, Cri, N-I	NA	W
Taxaceae	<i>Taxus canadensis</i> Marshall	M	Il	NA	W
Typhaceae	<i>Typha latifolia</i> L.	F	Il	NA	W
Unknown	Plant 1	F	Pa	SA	W

Famille	Nom latin	Usage	Groupe	Origine	Statut
Unknown	Plant 2	F, M	Pa	SA	W
Unknown	Plant 5	M	Pa	SA	W
Unknown	Plant 6	M	Pa	SA	W
Unknown	Plant 8	M	Pa	SA	W
Unknown	Plant 9	M	Pa	SA	C
Unknown	Plant 10	M	Pa	SA	W
Unknown	Plant 11	M	Pa	SA	W
Unknown	Plant 12	M	Pa	SA	W
Unknown	Plant 13	M	Pa	SA	W
Unknown	Plant 14	M	Pa	SA	W
Unknown	Plant 15	M	Pa	SA	W
Unknown	Plant 16	M	Pa	SA	W
Unknown	Plant 17	M	Pa	SA	W
Unknown	Plant 18	M	Pa	SA	W
Unknown	Plant 19	M	Pa	SA	W
Unknown	Plant 21	M	Pa	SA	W
Urticaceae	<i>Cecropia</i> spp.	M	Pa	SA	R/W
Urticaceae	• <i>Cecropia obtusa</i> Trécul	M	Pa	SA	R
Urticaceae	• <i>Cecropia sciadophylla</i> Mart.	M	Pa	SA	W
Urticaceae	<i>Urtica dioica</i> L.	M	N-I	NA	W
Vitaceae	<i>Cissus erosa</i> Rich.	M	Pa	SA	W
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	M	Pa	AS	C/I

† Espèce utilisée de manière médicinale par les Cris d'Eeyou Istchee et/ou les Pekuakamilnuatsh uniquement