

## The peopling of Europe since the Upper Paleolithic: prehistoric encounters between locals and migrants

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# Université Paris Cité

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## The peopling of Europe since the Upper Paleolithic: Prehistoric encounters between locals and migrants

Par Oğuzhan PARASAYAN

Thèse de doctorat de Génétique

### Dirigée par Thierry GRANGE

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### Abstract

# The peopling of Europe since the Upper Paleolithic: Prehistoric encounters between locals and migrants

Patterns of genetic diversity in present-day human populations are reflecting the past demographic fluctuations, migrations and admixture in human (pre)history. Paleogenomics, the generation and analysis of genome-wide data from ancient degraded specimens, allows us to study these demographic events by directly accessing time series comprising their occurrence. European prehistory recurrently witnessed population expansions associated with various climatic changes and/or cultural transitions during which local populations encountered migrating populations resulting in admixture at both the population and individual levels. We focused on three key transition periods in human history, generated ancient genomes of contemporary witnesses and used various state-of-the-art population genomics methods to reconstruct human genome evolution.

First, we analyzed the genomes of two ~37,000-year-old individuals from Crimea and showed them to belong to the first migration wave of anatomically modern humans into Europe carrying ancestry found in present-day Europeans. This expansion corresponds to a period just following a major climatic change known as Heinrich 4 cold period comprising the Campanian Ignimbrite volcanic super-eruption that coincided with human population turnover in Europe and a cultural transition (Mid/Upper Paleolithic). We show the evidence of admixture between earlier inhabitants of Europe and both ancient Crimean individuals. We further reveal the previously unknown genetic links between these Early European individuals and later groups that are important for the understanding of the early peopling of Europe.

Second, we focused on major demographic events in Western Europe during the Holocene that shaped the present-day European genome. We generated genomic data from 116 individuals dating from the Late Mesolithic to the beginning of the Bronze Age, between 8,200 and 4,200 years ago covering two large-scale populational turnover events in Europe.

We analyzed the genomes of Mesolithic groups in Europe and characterized the population history of a local group in Northwestern Europe. By investigating the earliest Neolithic population that arrived in the Paris Basin during the expansion of farming into Western Europe we show their complex admixture with these preexisting Mesolithic groups leading to a highly heterogenous population structure. Our results highlight that Neolithic genomes from France are essential to understand the Neolithization of the West. Indeed, our genomic analyses identify in northern France a likely source population for Neolithic Britain and Ireland, which has been sought for by both geneticists and archeologists. We also identify hitherto undetected high hunter-gatherer ancestry levels in individuals from Middle Neolithic contexts that might be meaningful for the social structure of these communities.

The third transition period we studied took place during the 3rd millennium BCE, which was a period of both cultural and genomic transformations associated with migrations of populations from the Pontic-Caspian steppe. Our high-resolution analysis of whole genomes of a family burial in France dating to about 2,500 BCE allowed us to reveal the Europe-wide admixture dynamics during this eventful period. On the territory of present-day France, we observed admixture between local Neolithic farmers and steppe-ancestry carriers coming from the north. We discovered previously undetected admixture pulses coinciding with the cultural transformation events of the 3rd millennium BCE.

In conclusion, our detailed studies of ancient genomes covering a large time interval of human history with major transition periods adds valuable insights to the knowledge of the genetic history of human populations. Key words: Paleogenomics, ancient DNA, evolutionary genomics, population genomics, peopling, admixture, Upper Paleolithic, Mesolithic, Neolithic, Bell Beaker, Bronze Age

### Resumé

# Le peuplement de l'Europe depuis le Paléolithique supérieur: des rencontres préhistoriques entre locaux et migrants

La diversité génétique des populations humaines actuelles reflète les fluctuations démographiques, migrations et métissages du passé. La paléogénomique, la production et l'analyse de données génomiques à partir de spécimens anciens dégradés, nous permet d'étudier ces événements démographiques grâce à l'accès direct à des séries temporelles. Au cours de la préhistoire européenne, plusieurs expansions populationnelles associées à des changements climatiques et des transitions culturelles ont conduit à des rencontres et métissages entre populations locales et migrantes. Nous avons ciblé des périodes de transition clé, avons généré des génomes anciens correspondants et utilisé des méthodes de génomique des populations pour reconstruire l'évolution des génomes humains.

Nous avons d'abord analysé les génomes de deux individus de Crimée vieux de ~37,000 ans et montré qu'ils appartenaient à la première vague de migration en Europe des Humains anatomiquement modernes qui étaient porteurs de l'ascendance qui a persisté dans les génomes des Européens actuels. Cette expansion correspond à une période suivant un changement climatique majeur, la période glaciaire Heinrich 4, et l'éruption ignimbrite campanienne du super-volcan Archiflegréen qui a coïncidé avec un renouvellement de populations en Europe et la transition culturelle Paléolithique moyen/supérieur. Nous avons mis en évidence le métissage entre les habitants européens préexistants et les deux individus de Crimée ainsi que des liens insoupçonnés entre les premiers H. sapiens européens et les groupes plus tardifs qui éclairent notre compréhension du premier peuplement d'Europe par H. sapiens.

Puis, nous avons étudié des événements démographiques majeurs en Europe de l'Ouest durant l'Holocène qui ont façonné le génome des Européens actuels. Nous avons produit des données génomiques à partir de 116 individus datés du Mésolithique final jusqu'à l'âge du Bronze (6 200-2 200 ans av.n.e.) couvrant deux grands événements de renouvellement des populations en Europe.

Les génomes de groupes mésolithiques européens analysés nous ont permis de caractériser l'histoire populationnelle d'un groupe local en Europe du nord-ouest. Au travers de l'analyse de la population néolithique la plus ancienne arrivant dans le Bassin Parisien, nous montrons des métissages complexes avec les groupes mésolithiques préexistants conduisant à une structure de population très hétérogène. Nos résultats soulignent la position clé des génomes néolithiques du nord de la France pour la compréhension de la néolithisation de l'Ouest européen. En effet, nos analyses génomiques identifient dans le nord de la France une probable population source à l'origine de la néolithisation de la Grande-Bretagne et l'Irlande longtemps recherchée par les généticiens et les archéologues. Dans des individus du Néolithique moyen, nous avons identifié une ascendance chasseur-cueilleur élevée suggérant une structure sociale particulière de ces communautés.

La troisième période de transition analysée se situe au 3ème millénaire av.n.e, une période où des transformations culturelles et génomiques étaient associées avec des migrations de populations de la steppe pontique-caspienne. Notre analyse génomique à haute résolution d'une sépulture familiale en France datant de 2 500 av.n.e. nous a permis de mettre en évidence des dynamiques de métissage ayant eu lieu partout en Europe. Nous avons observé que le métissage au Nord de la France s'est produit entre des agriculteurs néolithiques du Sud et des porteurs de l'ascendance des steppes venant du Nord. Nous avons découvert que ce métissage s'est effectué en deux vagues qui coïncide chacune avec des transformations culturelles au 3ème millénaire av.n.e.

En conclusion, nos études détaillées de génomes anciens couvrant un intervalle de temps large de l'histoire humaine éclairent l'histoire génétique des populations humaines à des périodes clés de transition.

Mots clés: Paléogénomique, ADN ancien, génomique évolutive, génomique des populations, peuplement, métissage, Paléolithique supérieur, Mésolithique, Néolithique, Campaniforme, Age du Bronze

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# List of Abbreviations

ALP	Alföld Linear Pottery
AMHs	Anatomically Modern Humans
ANF	Anatolian Neolithic Farmers
BCE	Before Common Era
BP	Before Present
BVSG	Blicquy/Villeneuve-Saint-Germain
cal	calibrated
CHG	Caucasian Hunter-Gatherers
cM	centiMorgan
EEF	Early European Farmers
EHG	Eastern Hunter-Gatherers
ICC	Impressa-Cardial Complex
IUP	Initial Upper Paleolithic
kya	kilo years ago
LBK	Linearbandkeramik
LBKT	LBK in Transdanubia
LGM	Last Glacial Maximum
MDS	Multi-Dimensional Scaling
PCA	Principal Component Analysis
ROH	Runs of Homozygosity
RRBP	Rubané Récent du Bassin Parisien
SNP	Single Nucleotide Polymorphism
SWA	South West Asia

# **Résumé Détaillé**

L'extraction d'ADN et la génération de données génomiques à partir de spécimens anciens ont considérablement transformé notre compréhension de l'histoire génétique des populations humaines. La paléogénomique, c'est-à-dire la génération et l'analyse de données génomiques à partir de spécimens anciens dégradés, nous permet de reconstruire l'histoire génétique des populations humaines en accédant directement à des séries chronologiques depuis le Paléolithique supérieur. Les archives archéologiques en Europe laissent entrevoir des rencontres préhistoriques récurrentes entre populations locales et migrantes, même si de nombreuses questions demeurent. Les populations sont censées migrer en raison de changements climatiques et environnementaux, de la pression démographique et/ou de développements culturels. Les mouvements de populations seraient accompagnés d'événements de brassage local ou de remplacement de population. Ces événements auraient laissé des traces dans les génomes des descendants qui pourraient être analysées par une approche paléogénomique.

Grâce aux développements méthodologiques de ces dernières années, tant en biologie moléculaire qu'en bioinformatique, la contribution de la paléogénomique aux questions fondamentales de la biologie évolutive et de l'histoire humaine croit de façon spectaculaire. Cependant, les processus de peuplement associés aux événements mentionnés ci-dessus, et en particulier ceux liés aux transitions des cultures archéologiques, sont encore mal compris pour la plupart des périodes et des zones géographiques. Pour éclairer ces points, nous nous sommes concentrés sur trois périodes de transition clés de l'histoire de l'humanité pour lesquelles nous avons généré des génomes anciens de témoins contemporains et utilisé une diversité de méthodes avancées de génomique des populations pour reconstruire l'évolution du génome humain en visant la compréhension au niveau génétique du mélange entre les populations.

Tout d'abord, il y a environ 38 000 ans, après un refroidissement climatique majeur, l'événement de Heinrich 4, et une éruption volcanique dramatique (la super-éruption de l'Ignimbrite Campanienne (CI)) affectant le sud et l'est de l'Europe a conduit à une crise de l'écosystème. À la suite de cette crise, l'Europe a connu un renouvellement de sa population humaine, qui a introduit pour la première fois une ascendance européenne ayant persisté jusqu'à nos jours. Nous avons produit des séquences génomiques à faible couverture à partir de fragments crâniens, dans lesquels l'ADN est très mal conservé, de deux individus européens du Paléolithique supérieur précoce âgés de 36 200 et 36 800 ans, provenant du site de l'abri sous roche de Buran-Kaya III sur la péninsule de Crimée. Ces individus étaient des témoins de la dynamique des populations post-CI. Pour maximiser la quantité de données comparables entre ces individus et d'autres génomes paléolithiques, nous avons exploité le panel SNP du Human Genome Diversity Project (HGDP). L'analyse combinée de ces génomes avec d'autres données génomiques anciennes en Europe publiées récemment nous a permis de créer un modèle large et actualisé des mouvements de population, des interactions et des remplacements pendant les premières vagues de peuplement de l'Europe par Homo sapiens au début du Paléolithique supérieur. Les deux individus de Crimée se sont révélés plus similaires aux populations européennes ultérieures qu'aux premiers habitants de l'Europe associés au Paléolithique supérieur initial (PSI). L'individu BuKa3C, plus ancien, était peu mélangé avec une ascendance similaire à celle trouvée dans le groupe IUP du site de Bacho Kiro et portait un haplogroupe Y associé à l'IUP, alors que l'individu BuKa3A, plus récent, était plus fortement mélangé avec les populations pré-CI. Tous deux partageaient plus d'ascendance avec des individus vivant des milliers d'années plus tard en Europe occidentale et centrale qu'avec tout autre groupe contemporain découvert à ce jour. Puisque les individus de Buran Kaya III portaient une ascendance européenne associée à l'IUP, nous pouvons conclure qu'une partie de cette ascendance a persisté après la crise écologique durant le sévère stade de Heinrich 4 et la superéruption de l'IC qui a dévasté le sud et l'est de l'Europe au début de cet événement Heinrich 4. Ainsi, des mélanges ont dû se produire entre les populations locales et les premières populations migrantes, au cours desquels les populations migrantes semblent avoir été plus nombreuses que les populations locales, un phénomène que l'on retrouvera avec les expansions à l'Holocène ultérieures. Ce modèle met en évidence que ces différentes populations qui ont successivement colonisé l'Europe ont divergé à partir d'une source similaire, tout en se mélangeant à différents degrés avec des populations AMH pré-CI dont la divergence était plus précoce, et qui sont arrivées plus tôt. Ces interactions entre groupes voisins ont formé les premières ascendances détectables par la suite chez les Européens actuels. En outre, nous avons constaté que les habitants de Buran-Kaya III partageaient le plus de similitudes génomiques avec les groupes du Paléolithique supérieur moyen trouvés en Europe centrale et occidentale plusieurs milliers d'années plus tard, mais aussi avec les groupes du Paléolithique supérieur tardif du Caucase. Cette similitude génétique, associée à un horizon archéologique similaire à celui trouvé sur

plusieurs sites contemporains du Caucase du Nord, suggère que le Caucase pourrait être le point d'entrée de l'ascendance liée à Buran-Kaya III. Cette ascendance est mieux modélisée comme se ramifiant à partir d'une population source menant à une ascendance de type de celle des individus trouvés sur le site de Kostenki après s'être séparée des lignées qui donneraient naissance aux population représentée par les individus GoyetQ116-1 et BK\_1653, trouvées plus tard en Europe centrale et occidentale, et Sunghir3 en Orient. Nous observons également que les seuls groupes qui ne portaient pas d'ascendance européenne pré-CI, Sunghir3 et Kostenki14, datent d'avant 34 000 ans et ne se trouvent qu'en Europe de l'Est, ce qui indique un point d'entrée oriental possible pour ces lignées à partir d'une zone qui pouvait être dépourvue ou peu habitée par les populations européennes pré-CI à cette époque.

La deuxième période sur laquelle nous nous sommes concentrés est la transition entre le Mésolithique et le Néolithique, consécutive aux expansions de populations en provenance d'Asie du Sud-Ouest qui ont entraîné la diffusion de l'agriculture en Europe au cours de l'Holocène. Pour ce faire, nous avons généré et analysé les données génomiques de 109 individus anciens provenant de 20 sites du Bassin parisien au sens large, comprenant les régions actuelles de Picardie, Champagne et Nord-Pas-de-Calais au nord de la France. Les sites correspondant sont associés à des cultures néolithiques couvrant une période allant de 5100 à 2500 avant notre ère, à l'exception d'un individu mésolithique datant d'environ 6200 avant notre ère. En générant des données génomiques à partir de la plus ancienne population d'agriculteurs arrivée dans le Bassin parisien, dernière étape de l'expansion du Néolithique précoce, nous avons pu discriminer les génomes des populations se déplaçant le long des routes migratoires continentales et méditerranéennes bien qu'elles aient divergé d'un ancêtre commun dans le sudest de l'Europe environ mille ans auparavant. La néolithisation précoce de l'Europe met en évidence l'émergence d'un processus continu de différenciation progressive du génome des premiers agriculteurs. Cette différenciation est devenue plus apparente dans les populations ultérieures lorsque l'expansion précoce de l'agriculture a pris fin et que la taille des populations des différents groupes a augmenté. La détection de telles structures préhistoriques à haute résolution en Europe nous a permis de localiser les origines possibles des individus ou des groupes dont les ancêtres se déplaçaient et de révéler des interactions qui ne pouvaient pas être détectées par les seules données archéologiques. Nos estimations des dates de métissage pour les individus du Néolithique ancien ont détecté différentes phases principales de mélange des populations se déplaçant par la route de l'Europe centrale associée à la céramique rubanée, dite

LBK, et par la route de la Méditerranée associée à la céramique cardiale, dite ICC. Les individus associés à l'ICC résultent de deux vagues de mélange, l'une correspondant à l'arrivée de cette vague en Europe du sud vers 5900 avant notre ère, et une seconde vague centrée autour de 5500 avant notre ère. Les individus LBK ont également connu deux grandes vagues de mélange, mais à des moments distincts, l'une centrée sur 5600 avant notre ère, la seconde sur 5400 avant notre ère. En utilisant des méthodes basées sur l'inférence d'ascendance locale, nous montrons que la principale source de différenciation entre les agriculteurs néolithiques d'Europe occidentale ne sont pas les différentes ascendances des chasseurs-cueilleurs occidentaux. Lorsque cette approche a été appliquée aux individus LBK du Bassin parisien, nous avons détecté diverses affinités d'ascendance chasseurs-cueilleurs. Notre détection de différences dans la chronologie des principales vagues de mélange avec les populations locales de chasseurscueilleurs, ainsi que dans les sources de ces ascendances chasseurs-cueilleurs chez les agriculteurs néolithiques migrant en Europe le long des routes continentales et méditerranéennes indique des différences géographiques et temporelles dans les interactions entre les agriculteurs néolithiques migrants et les chasseurs-cueilleurs mésolithiques locaux. Ces différences ont contribué à la formation phylogéographique du génome européen précoce, même si la diversité de ces modèles de mélange ne semble pas être le seul générateur de différenciation génétique. En effet, la dérive génétique au cours des migrations jouerait aussi un rôle important dans cette différenciation qui, dans de nombreux cas, ne peut être simplement corrélée à l'ascendance chasseur-cueilleur.

D'autre part, en analysant les génomes d'individus de la fin du Néolithique moyen ayant une ascendance chasseur-cueilleur très élevée, nous avons détecté que les ancêtres de ces individus étaient des chasseurs-cueilleurs qui ont reçu un flux génétique récent des groupes néolithiques tout en conservant leur ascendance chasseur-cueilleur. Cela signifie qu'ils provenaient d'une population qui est restée longtemps à l'écart des migrants néolithiques et qu'ils n'ont pas reçu ensuite de flux génétique supplémentaire provenant d'individus néolithiques, c'est-à-dire qu'ils se sont plutôt accouplés au sein de leurs groupes. Les individus et les groupes ayant une forte ascendance de chasseur-cueilleur n'étaient pas identifiables archéologiquement mais semblent avoir été intégrés dans les villages néolithiques, bien qu'ils étaient enterrés ensemble. Les résultats des datations de métissages indiquent que le mélange entre les chasseurs-cueilleurs et les agriculteurs néolithiques a eu lieu dans la première moitié du 4<sup>ème</sup> millénaire avant notre ère, ce qui confère une importance particulière à cette période pour les études futures. Nous avons analysé ensuite une population du site du Néolithique moyen d'Escalles "Mont d'Hubert", Pas-de-Calais, la région des Flandres du Nord de la France près du "Cap blanc Nez" au sud-ouest de Calais, datée de 4230-3879 avant notre ère. Notre analyse a montré que cette population forme un groupe distinct très liée aux populations néolithiques des Iles britanniques plutôt qu'aux autres génomes néolithiques. Leur proximité génétique suggère que la population du Néolithique moyen de la région des Flandres est la population source des agriculteurs néolithiques qui ont colonisé l'Angleterre. Nous avons également analysé les sépultures de deux hypogées à Chouilly " la Grifaine " dans la vallée de la Marne au sud de Reims, datées entre 3500-2900 et 3400-2500 avant J.-C., c'est-à-dire au Néolithique récent. Le cimetière qui comprend ces hypogées et d'autres a été utilisé pendant  $\sim$ 900 ans. Les génomes de l'hypogée F10, légèrement plus ancien, dont les sépultures couvrent la période entre 3500-2900 avant J.-C., se regroupent avec les génomes néolithiques du nord de la France, tandis que les génomes de l'hypogée F11, légèrement plus récente, dont les sépultures sont datées entre 3400-2500 avant J.-C., se regroupent avec les génomes néolithiques du sud de la France et de la péninsule ibérique. Cela suggère que deux populations différentes ont été inhumées à cet endroit, la plus récente avant une origine différente. Ceci indique que ces populations avaient une identité différente influençant le choix des hypogées utilisées pour enterrer leurs morts. Aucun lien de parenté ayant été détectés entre les individus analysés, nous pouvons inférer que cette identité n'était pas particulièrement liée à l'appartenance à une même famille.

Dans un troisième volet de ma thèse nous avons analysé la période pendant laquelle l'ascendance steppique apparentée aux populations kourganes ou Yamnaya a été introduite en Europe occidentale. Cette ascendance constitue la troisième composante majeure du génome européen actuel et son apparition est associée à l'émergence de nouvelles cultures qui paraissent résulter des rencontres entre populations associées à des ascendances différentes. Nous avons généré des données génomiques à partir des os pétreux de chacun des individus d'une sépulture du Néolithique récent de " Bréviandes les Pointes et les Grèvottes " près de Troyes dans le sud du Bassin parisien avec une couverture de 0,75X à 4,6 X (couverture médiane 1X) et d'un individu de Saint-Martin-la-Garenne (SMGB54), à l'ouest de Paris dans les Yvelines, daté par radiocarbone à 2410-2129 cal BCE (97,8%) et enterré selon les rituels funéraires de la culture campaniforme. Grâce à une analyse à haute résolution, à la reconstitution des phases haplotypiques des génomes et à la reconstruction du génome d'un individu non échantillonné à travers les génomes de ses parents, nous avons mis en lumière les mécanismes et la direction des processus de mélange en Europe occidentale entre les agriculteurs du Néolithique tardif et les descendants des nomades de la steppe pontique-caspienne. Nous avons identifié deux principales pulsations de mélange entre ascendance néolithique et steppiques. La première datant de l'arrivée des populations de la steppe en Europe de l'Est vers 2900 avant notre ère tandis que la seconde date de leur progression en Europe occidentale vers 2500 avant notre ère. Ces pulsations révèlent des dynamiques d'expansion différentes à travers l'Europe, avec des liens frappants avec des phénomènes culturels différents, à savoir la culture de la céramique cordée et celle du campaniforme. Ce résultat met en évidence les principes fondamentaux du processus de mélange entre les groupes néolithiques locaux et les groupes de migrants d'ascendance steppique avec lesquels l'ascendance steppique s'est introduite dans le pool génétique néolithique européen. La première phase de mélange intense s'est produite à l'arrivée en Europe orientale des migrants originaires des steppes au cours de laquelle on observe l'émergence d'une nouvelle culture, celle de la céramique cordée, qui ne semblait pas pratiquée sous cette forme par aucune des deux populations initiales. Cette population mélangée s'est ensuite déplacée vers l'Ouest tout en se mélangeant à faible fréquence avec les chasseurs cueilleurs rencontrés jusqu'à ce qu'ils arrivent sur un territoire chevauchant le Nord de la France ou une deuxième phase de mélange avec les populations néolithiques se produit. Bien que cet évènement de mélange se produise au Nord de la France, les populations néolithiques concernées semblent provenir principalement du Sud. On observe cette configuration aussi bien dans la tombe de Bréviandes, contemporaine à ce moment de mélange, pris ainsi sur le fait, mais aussi dans les individus campaniformes plus tardifs, comme celui de Saint-Martin-la-Garenne. Ainsi, cette deuxième phase de mélange est-elle associée à l'émergence d'une nouvelle culture, le campaniforme. Le campaniforme semble résulter de la combinaison de deux traditions, celle des tombes individuelles caractéristiques du Nord de l'Europe et des populations d'ascendance steppique (associées aux cultures «All Over Corded» et «All Over Ornamented »), et celles des gobelets maritimes associées aux populations néolithiques du Sud-Ouest de l'Europe, et donc caractéristiques des deux ascendances génétiques identifiées ici.

En conclusion, au cours de cette thèse, nous avons ciblés différents objets d'étude correspondants à des phases de mélange entre populations d'origine différentes en utilisant des méthodes avancées adaptées à la rareté des restes humains analysés, au degré modéré de préservation de l'ADN, à la quantité et à la qualité des données publiées pour les analyses comparatives. Nous avons échantillonné des individus, témoins contemporains de ces périodes clés mentionnées ci-dessus, et généré des génomes anciens pour pouvoir aborder des questions scientifiques précises liées à ces mélanges de population. Nous avons mis en évidence des processus complexes de flux génétiques en analysant les schémas spatio-temporels des événements de mélange entre les populations rencontrées lors des périodes de transition du Paléolithique supérieur, du Mésolithique au Néolithique et du Néolithique tardif à l'âge du Bronze, la plupart du temps grâce à la résolution fine permise par l'utilisation de blocs haplotypiques phasés.

# Introduction

## **Paleogenomics**

The generation of genome-wide data from ancient specimens with spatiotemporal diversity using high-throughput sequencing technologies gave rise to ancient genomics as a revolutionary field in the last decade. Ancient DNA (aDNA) research has become a powerful tool providing better understanding and reconstruction of the past of different populations and species from the evolutionary biology and (pre) historical point of view. As a multidisciplinary field, the analysis of ancient DNA requires a collaboration between genomics, bioinformatics, archaeological sciences and other humanities allowing us to study many hypotheses that could not be tested by analyzing only genomes of present-day populations or archaeological remains using conventional archaeological and anthropological approaches. The phenomena that can be analyzed through paleogenomics include past population dynamics of humans and other extinct/extant species, archaic introgressions, migratory population movements and the associated spread of cultures, animal and plant domestication, past epidemics and their responsible pathogens etc.

However, there are some challenges that might prevent the recovery of DNA and the production of genomic data from ancient calcified or mummified remains, which can be both technological and ethical. The former includes (i) the extremely low quantity of endogenous DNA preserved in ancient remains, (ii) its dilution in environmental, mostly microbial DNA from the burial environment that constitute the vast majority of the recovered DNA (up to 100%), (iii) as well as postmortem DNA damage leading to very short DNA molecules (around 30-50 bp) and to modified bases. The small size of ancient DNA molecules is due to DNA fragmentation resulting first from postmortem enzymatic degradation, then from depurination through hydrolysis and β-elimination <sup>1</sup>. The major DNA damage pattern is an elevated C to T-substitution frequency, in particular at the ends of the DNA fragments, due to deamination of cytosine to uracil resulting in incorrect incorporation of nucleotides during DNA replication

<sup>2</sup>.These base misincorporations often represent a problem since the discrimination between true C/T or G/A heterozygous sites and deaminated sites becomes very challenging, especially in sequencing data with low coverage that are the consequence of low quantities of preserved endogenous DNA in ancient specimens <sup>3</sup>.This impacts the research field at several levels: (i) well-preserved remains are scarce and therefore precious resulting in extreme competition between research groups and attempts to monopolize the collection of archaeological remains; (ii) destructive sampling of unique or precious remains prevent the reproduction of the data produced; (iii) restrictions to access archaeological specimens for analysis due to national regulations and religious beliefs; (iv) commercial conventions between some laboratories and biotechnology companies granting exclusive access to custom in-solution probe sets.

Despite these challenges, the available genomic data obtained from ancient specimens, generated via either whole-genome shotgun sequencing or in-solution hybridization capture methods, has dramatically increased since the last decade. Among this massive data production, some groundbreaking studies of ancient genomics has contributed significantly to the study of human evolution and the peopling of Eurasia and the Americas and shed light on the genetic diversity and ancestry defining present-day human populations. Archaic introgression events were detected from Neandertals and Denisovans, a previously unknown Late Pleistocene hominin group contemporary to the Neanderthals whose remains were found in Siberia and the Tibetan plateau, into anatomically modern humans (AMHs) in Eurasia. These introgression events led to regional variations in the genomes of present-day populations of both Neanderthal and Denisova ancestry. In particular, non-Africans were shown to harbor around 2% of Neanderthal ancestry and Oceanians up to 3% of Denisovan ancestry 4-9. Genomes of presentday Europeans were found to be the product of past admixture events during Holocene with varying proportions of three ancestral populations including indigenous Mesolithic huntergatherers, who preserved their ancestry since the Last Glacial Maximum (LGM), early Neolithic farmers, who introduced Aegean/Anatolian Neolithic ancestry into Europe starting ~8,500 years ago and steppe pastoralists introducing Yamnaya-like ancestry starting  $\sim 5,000$  years ago (e.g., Allentoft et al., 2015; Fu et al., 2016; Haak et al., 2015; Lazaridis et al., 2014) 10-13. Furthermore, the analysis of our past migration and admixture history also allows us to identify the resulting complex phenotypic traits including immune response, metabolism, pigmentation, diet and behavior that can be under selection as well as the contributions coming from adaptive introgression and admixture in human history 5,14-18. Overall, access to genomes from time series greatly improves our understanding of the evolution of human populations. Depending

on the sampling strategy and the quality of ancient genome data, one can reconstruct population movements, admixture, and the evolution of genetic traits and selected genomic regions. Today, we have a better understanding of demographic changes occurring over large geographical regions and wide time periods compared to what was previously known. Nevertheless, there are many gaps concerning the early dispersal of human populations as well as the more regional population history of later periods at higher resolution. Hence, this thesis will focus on the more recent human past including Eurasian expansions following the out-of-Africa event and population dynamics and admixture histories during the Holocene in Western Europe.



Figure 1: Maximum likelihood tree of present-day human populations from The Simons Genome Diversity Project and ancient anatomically modern and archaic humans (Skoglund and Mathieson 2018)

## **Prehistorical Encounters**

### **Eurasian Expansions of the AMHs**

The model for an African origin of all populations outside of Africa coming from a strong bottleneck during the out-of-Africa event is supported by the much higher genetic diversity detected in African populations than any other population outside of Africa (e.g., Tishkoff et al., 2009; Vigilant et al., 1991)<sup>20,21</sup>. A further evidence comes from the fact that all non-African populations form a clade in relation to African populations while all world-wide present-day populations and ancient AMHs are more closely related to each other than to Neanderthal and Denisovan archaic humans (Fig. 1) (e.g., Mallick et al., 2016; Posth et al., 2016; Skoglund & Mathieson, 2018) <sup>7,19,22</sup>. There are different lines of evidence indicating that the out-of-Africa event gave rise to world-wide expansions into Western and Eastern Eurasia and Oceania resulting in diversification of present-day non-African populations. Estimations of the effective population size and the cross-coalescent rates between African and non-African populations indicate a population divergence date varying between 50 to 160 kilo years ago (kya) depending on which reference population from Africa is used <sup>4</sup>. When taking the Yoruba as the African reference population estimations mostly indicate a date around 70 kya (Fig. 2A) 4,7,23-25, which might still show differences depending on which coalescent method is used <sup>26</sup>. The presence of Neandertal-derived ancestry in both present-day and ancient non-African humans might be considered as the strongest evidence supporting the out-of-Africa hypothesis and a single origin of non-African lineages <sup>6,7,11</sup>. Indeed, this phenomenon seems to be the result of a single episode of admixture outside of Africa since this ancestry is not detected in African populations, except some cases of later gene flow from Eurasia to Africa few millennia ago <sup>27</sup>. This hypothesis got further support through several different estimations of the date of gene flow that indicates a time range between 50 - 60 kya independently of the level of these ancestry proportions (e.g., Bergström et al., 2020; Fu et al., 2015, 2016; Hajdinjak et al., 2021; Moorjani et al., 2016; Sankararaman et al., 2016).



Figure 2: MSMC2 cross-population, coalescent rates estimated from four physically phased haplotypes across non-African (Han) and African populations (A) and across different non-African populations (B) (Bergström et al., 2020).

All these estimations about the singular origin of non-African populations contribute to our understanding of the further divergence and diversification of early Eurasian lineages since it is expected that the population split in Eurasia occurred after the Neanderthal-derived gene flow. It is likely that this encounter happened somewhere in the Middle East, which could also be considered as a reasonable location for an expansion into different directions. While estimations from both coalescent-based and demographic modelling indicate a divergence between Western Eurasians, Eastern Eurasians, and Oceanian populations following out-of-Africa and Neanderthal gene flow around 35-50 kya, there are some discrepancies in the date estimations concerning the divergence between Oceanian and Eurasian lineages. While a recent cross coalescent rate estimates across Han – Sardinian and Han – Papuan Highlands genomes gives midpoint dates around 35 kya (Fig. 2B), different studies of coalescent-rate estimates as well as demographic modelling indicate an earlier divergence between Oceanians and the rest of the out-of-Africa metapopulation <sup>5,23,31</sup>. Since the inferred dates for the first pulse of Denisovanderived gene flow into Papuan-related populations is estimated to be around 46 kya, the model of an earlier split dates for Oceanians seems a more likely scenario. These discrepancies between estimated dates depending on the models used reveal that we should take all these date estimations with a grain of salt. It should be noted, however, that the estimates of the divergence time between the Western and Eastern Eurasian lineages are consistent with the dates and genetic profiles of the earliest AMHs.



Figure 3: Illustration of the population history of archaic humans and early modern humans of interest (Liu et al., 2021).

The earliest Eurasian AMHs, Ust-Ishim from Siberia (Fu et al., 2014), early Bacho Kiro individuals from Bulgaria 29, and Zlaty-kun from Czechia 33, dating to ~45 kya, could be considered as the most basal group to more recent individuals representing populations in both western and eastern Eurasia. Indeed, these Initial Upper Paleolithic (IUP) specimens share similar genetic characteristics and they have apparently not contributed directly to the presentday populations. In contrast, individuals dating to later periods between 40 - 35 kya, Tianyuan from China <sup>34</sup>, Goyet-Q116-1 from Belgium <sup>11</sup> and Kostenki14 from western Russia <sup>11,35</sup> have contributed genetic ancestry that can be detected in present-day local populations (Fig. 3). which could be considered as the signatures of the diversification between Western and Eastern Eurasia. Surprisingly, if the geographic origins of Goyet Q116-1 and Tianyuan clearly identify them as representatives of the Western and Eastern expansion routes postdating the bifurcation of these expansions, they share some detectable drift despite their large geographical distance <sup>11</sup>. It was proposed that this shared genetic drift results from gene flow(s) from a population related to IUP Bacho Kiro individuals<sup>29</sup>. If the IUP lineage was still present when the second wave arrived that gave rise to modern populations, the earlier populations could have admixed with the newcomers in different places, thus resulting in shared genetic drift between two populations that were separated previously. Nevertheless, there are still many aspects in the

population history of early AMHs that are unclear and require much more samples and analyses to fill the gaps in order to better understand the genetic diversity in the Upper Paleolithic.

What is better known so far is the population history around the LGM, a  $\sim$ 7,500-year-long period of extreme cold climatic conditions due to the formation of ice-sheets starting from 26,5 kya. During this period the northern parts of Eurasia and Northern America were inhabitable. These environmental conditions exerted a significant environmental constraint on human populations <sup>36</sup>. Consequently, the genetic diversity of the populations following this period was strongly reduced compared to the relatively high heterozygosity levels detected in pre-LGM individuals demonstrating the occurrence of LGM bottlenecks <sup>37</sup>. Such bottlenecks are also supported by demographic modelling of Mesolithic hunter-gatherers <sup>38</sup>, as well as observed shifts in mitochondrial haplogroup frequencies during the LGM <sup>22</sup>. During the post-LGM period, different hunter-gatherer lineages appeared showing east-west and north-south genetic clines likely connected to post-LGM expansions of European hunter-gatherers that survived in southern refugia. Regional differences were detected in Scandinavia, Iberia, Northwestern Europe as well as in the Caucasus and in Southwest Asia (SWA) in general <sup>11,13,38-42</sup>. Some of the earliest members of the post-LGM period, which are associated with the Magdalenian culture and dating back to 19-15 kya in Spain (El Miron) and Belgium (Goyet Q2), preserved the ancestry closely related to the pre-LGM Goyet Q116-1-like population that was detected in later Mesolithic individuals in Spain <sup>11,43</sup>. Another group of the earliest post-LGM members includes individuals associated with the Epi-Gravettian culture dating back to 17-14 kya in Northern Italy. This group possesses a new ancestry that was undetected during the pre-LGM and found in most of the later Western European Mesolithic individuals <sup>44</sup>. However, the genomic data dating back to the early post-LGM period are still scarce so far and the subsequent cold intervals during the following millennia must have had certain consequences for the surviving human populations that remain to be understood.



Figure 4: Reconstructed temperatures based on isotope measurements showing prehistoric Heinrich events (H1-6). Different colors indicate isotopic values per mil versus time (Hydrogen on top, Oxygen on bottom) coming from datasets obtained from different geographical locations (Heinrich event, The Azimuth Project)

## **Early Holocene Expansions**

#### The Pleistocene/Holocene Transition

During the Pleistocene the climate was characterized by strong temperature oscillations leading to a sequence of alternating warm and cold periods. The latter became more severe with time. The Last Glacial Maximum, which was the most severe one, ended about 14,500 years ago with global warming. This post-glacial warming period was interrupted by a cold spill of 1,000 years, the Younger Dryas, that lasted from 12,700 to 11,700 BP. The Younger Dryas period was followed by a period of relatively stable and warmer climate lasting up to now, the Holocene (Fig.4). These climatic changes with their associated dramatic changes in environmental conditions must have had a major impact on human behavior. Indeed, the

environmental transition to the Holocene coincides in SWA with the Neolithic transition from a foraging lifestyle to a sedentary farming lifestyle, which was the beginning of the formation in SWA of complex societies that are the ancestors of our present-day societies.

The main hypothesis concerning the driving force to farming practices is the population growth model proposing that the change of the subsistence strategy occurred under population pressure in order to provide sufficient food to the larger number of people. This hypothesis finds support in the observation that life style changes had some negative consequences on the actors. Indeed, there is evidence that the health of agriculturalists was generally worse than the one of foragers since farming represented heavy physical labor and might have led to a less healthy, balanced diet <sup>45,46</sup>. It remains to be seen whether this transition was only caused by the changing and fluctuating environmental conditions at the end of the Late Pleistocene. It is conceivable that the idea of farming arose earlier since there is evidence of early plant exploitation dating back to 23 kya in the Levant that was not continued <sup>47,48</sup>. The idea itself, however, might have been preserved. Indeed, the Early Natufian Culture that is nearly contemporary with warm interval of the Bølling-Allerød phase lasted approximately from 14,500 to 13,000 BP (Fig.4) shows the earliest example of sedentary life style before the Holocene in the southern Levant <sup>49</sup>. This culture was, however, likely disturbed by the extremely arid period of the Younger Dryas





Figure 5 :Distribution of main Late Epipaleolithic and Neolithic sites in the Near East. 1, Ohalo II; 2, Ein Gev IV; 3, Neve David; 4, Kharaheh IV; 5, Beidha; 6, Hayonim; 7, Wadi al-Hammeh 27; 8, Ain Mallaha; 9, Jericho; 10, Iraq ed Dubb; 11, Hatoula; 12, Dhra; 13 (Zeder 2011)

### The origins of the Neolithic

The Neolithic transition from foraging to food producing subsistence strategies with cultivated crops and domesticated animal took place in the Fertile Crescent spanning a large region from the Southern to the Northern Levant and from Northern Mesopotamia to the Zagros Mountains (Fig. 5). However, this transition was not a homogenous process in terms of both plant and animal domestication and human populations. The earliest spread of agriculture in SWA was a cultural diffusion with the transmission of ideas and farming technologies. This was demonstrated by the strong genetic differentiation between pre-pottery (aceramic) Neolithic farmers dating to the  $\sim$ 12th millennium BP in the Western and Eastern Fertile Crescent. The genetic continuity between Late Epipaleolithic hunter-gatherers and local Neolithic farmers indicates a local transition from foraging to farming practices <sup>51,52</sup>. In Central Anatolia, where aceramic Neolithic period started in the ~11th millennium BP, a demographic pattern similar to the one in the Fertile Crescent was detected since local Central Anatolian forager populations adopted the farming practices possibly via cultural diffusion <sup>40,53,54</sup>. Based on demographic modelling inferences, it was proposed that the Central Anatolian ancestry found in both Epipaleolithic and aceramic Neolithic individuals was a product of an admixture between Southeastern European and Levantine hunter-gatherers that took place in the final phase of the Late Pleistocene <sup>38</sup>. Agriculture spread to the West including the Aegean and Marmara regions up to Northern Greece during the 9th millennium BP <sup>46</sup>.Although later Anatolian Neolithic farmers of ceramic Neolithic sites such as Barcın in the Marmara region and Çatalhöyük in Central Anatolia are assumed to originate from the westward expansion of earlier Central Anatolian farmers, the genomes of later ceramic farmers show slight differences compared to both aceramic and Epipaleolithic individuals, which is so far explained by potential gene flow coming from the Fertile Crescent populations 40,54. However, the genetic structure of the Aegean Mesolithic population is yet to be understood due to the lack of genetic data which might change the perception about the transition to farming in western Anatolia. What is clearer so far is that the ancient population found in Northwestern Anatolia and the Marmara and Aegean regions is the most plausible source of the first farmers of Europe, based on both genetic and archaeological data 38,46,52,53,55-57.

#### The Neolithic expansion into Europe

These early farmers expanded into Europe through demic diffusion, during which they inhabited new areas and introduced their farming technology and animal and crop domesticates, and interacted with pre-existing forager populations to varying extents in different parts of Europe <sup>39,41,58–64</sup>.



Figure 6: Condensed and simplified map of the spread of farming in western Eurasia. Gronenborn/Horejs/Börner/Ober 2021.2 (RGZM/ÖAI)

Southeastern Europe is a core zone for the understanding of the Neolithization of Europe as it is connected to both the earliest expansion of farming from the Northern Aegean area and the further spread of farming into the West and North. This region hosted Mesolithic forager populations with their unique archaeological culture and genetic structure recorded in many sites along the Danube gorges of the Iron Gates in present-day Serbia and Romania, which showed short lived interactions between foragers and farmers based on both material and genomic evidence <sup>65</sup>. Southeastern European Mesolithic foragers have their distinct genetic ancestry with a West-to-East cline, while they show stronger genetic affinity to the Mesolithic individuals in Western Europe compared to the ones in Eastern Europe <sup>66</sup>. This ancestry

possibly appeared during the LGM bottlenecks as suggested by the previously discussed demographic models <sup>38</sup>. Moreover, the genomes of these foragers show higher affinity to the ancestry that is found in Anatolian farmers relative to contemporary foragers in the West. This could be explained if they were one of the ancestral source populations of Anatolian foragers, as proposed, or through more recent interactions between these populations in Southeastern Europe and Northwestern Anatolia<sup>38,66</sup>. However, some later individuals in the site of Lepenski Vir dating to ~8,200 BP, the time period of the post-early Neolithic expansion, show a mixture of both farmer and forager ancestries that is a strong evidence of a local interaction of two distinct populations <sup>66</sup>.Admixture between Neolithic farmers and European hunter-gatherers was nevertheless rare since most of this early expansion was driven by farmers having Northwestern Anatolian/Aegean farmer ancestry and the pre-existing Mesolithic ancestry was not found in the majority of farmers. Another significant feature of the earliest farming communities in the Balkans that hints to links with their Aegean ancestors is the pottery. Some well-known Early Neolithic material cultures include the pre-Karanovo and Karanovo I in Bulgaria, the Starcevo in mostly Serbia, the Cris in Romania and the Korös in Hungary, which show a strong similarity of patterns from Thrace to the Carpathian Basin despite local variations 46



Figure 7 : Geographical distribution of the Starčevo, LBK cultures and the Continental route of the European Neolithization. The shaded areas of the maps show the distribution of the Starčevo culture (STA) and the LBK in Transdanubia (LBKT) and Central Europe (LBK) (Szécsényi-Nagy A. et al.2015)

The expansion of farming in Southeastern Europe that started around 8200 BP and took place through the Balkans reached the south of the Carpathian Basin and Transylvania by 8,000 BP. After this rapid expansion, however, the farmers did not continue to move to further locations for around 400 -500 years. During this time period, the Starčevo culture of the earliest farmers in the Balkans occupied a territory including present-day Serbia, northern Croatia and western Hungary. During the last phase of the Starčevo culture, a new decoration pattern with incised bands originated in Transdanubia that is referred to as Linearbandkeramik (Linear Band Pottery) Culture, commonly abbreviated as LBK, which became the main Early Neolithic culture (Middle Neolithic in Hungary) of continental Europe. This culture expanded west, north and eastwards, up to the Paris Basin in France, the Baltic Sea in Poland and to Western Ukraine, respectively (Fig. 7) <sup>46,68,69</sup>. Local subcultures of the LBK Culture developed in western Hungary, called LBK in Transdanubia (LBKT), and in eastern Hungary, called Alföld Linear Pottery (ALP), as well as the Bükk cultures spread in the opposite directions <sup>70</sup>.

Genetic analyses of individuals from Neolithic Hungary showed low differentiation between the Early Neolithic individuals associated with the Starçevo on one hand and the Körös cultures on the other hand, both having close relatedness to Anatolian farmers. However, one of the most striking findings from these studies was some Neolithic individuals in the Early Neolithic Körös site of eastern Hungary, who were carriers of a hunter-gatherer genome, showing a strong evidence of interaction between hunter-gatherers and Neolithic farmers and of possible acculturation of the former ones <sup>61,71</sup>. Furthermore, in western Hungarian sites associated with the LBKT culture, the estimated hunter-gatherer ancestry is quite limited compared to contemporary eastern Hungarian sites associated with the ALP culture, where hunter-gatherer ancestry is found to be higher than 10%. The genomic difference is in agreement with cultural differences and different levels of interactions in both earlier Körös and later ALP sites <sup>61</sup>.

Contrary to Eastern Hungary, the LBK expansion through the Danube valley into Central Europe does not provide much evidence for interactions between farming and foraging populations. The areas occupied by early LBK populations, which were mostly highly fertile fields for agriculture called loess soils, were not populated by Late Mesolithic groups <sup>46,72</sup>. Even though both Late Mesolithic and LBK-associated groups lived contemporarily, the archaeological evidence of interaction in Central Europe, as restricted as it is, is in accordance with genetic data since LBK-associated individuals from present-day Germany and Austria show limited evidence of admixture <sup>61,63,73</sup>. The spread of farming in continental Europe shows a pattern similar to the one in the Balkans, and it is described as an overwhelmingly

demographic expansion by migrating long-distances and colonizing new settlement areas. However, the appearance of the LBK material culture represents a break with the ancestral cultures from the Aegean and Anatolian regions although it preserved the uniformity of its pottery style and of the architecture and the similarity between colonized areas along its expansion <sup>46</sup>. This pattern could be explained by a founder effect. This view finds support in the genetic similarity between different LBK-associated groups <sup>61</sup>.Both genetic and archaeological data provide evidence for a scenario in which LBK-associated populations migrating to the West originated from LBKT-associated groups in Hungary and mixed with hunter-gatherers since their admixture proportions slightly increased with a range of 0-5% <sup>61</sup>. However, the details of these early interactions remain unclear in the absence of a high-resolution genetic study focusing on this specific question.

#### The Early Neolithic West of the Rhine river

On the western end of the Continental route, the earliest farmers that were associated with the LBK culture crossed the Rhine river around 5,300 BCE and settled first in Alsace and moving from there further westward. Both the properties of the areas inhabited and the material culture including architecture, lithic tools and ceramics resembled the ones of the Central European LBK sites in the East of the Rhine with local decorative characteristics <sup>74</sup>. The Alsace region can be further divided into two groups based on cultural LBK differences. The differences found in southern Alsace (Haute-Alsace) and northern Alsace (Basse-Alsace) might be explained by different LBK origins between southern and northern Alsace or the presence and input of indigenous pre-Neolithic groups 75. The genetic data so far published include three LBK-associated individuals, two from northern Alsace and one from southern Alsace <sup>75</sup>. The two northern Alsatian individuals show the genetic characteristics of eastern LBK populations with small proportions of hunter-gatherer ancestry while the southern Alsatian individuals have much higher hunter-gatherer ancestry, a proportion that was not detected in any other LBK individuals. These results might provide some genetic support to the archaeologically defined differences between southern and northern Alsace, which is further supported by the cultural connection between Northern Alsace and Baden-Württemberg <sup>75</sup>. The genetic data are not conclusive enough, however, given the low number of genomes sequenced.

The final phase of the LBK culture dates back to ~5,100-5,000 calBCE until 4,900 calBCE in the Paris Basin and it is traditionally referred to as RRBP – "le Rubané Récent du Bassin

Parisien" <sup>74,76</sup>. Based on some shared properties of lithic technologies, there is a relation attested between LBK sites of the Northeast Paris Basin and Belgium <sup>74</sup>. However, there is also archaeological evidence connecting the Paris Basin to southern Alsace <sup>75</sup>.



Figure 8: Distribution of Linear Pottery (LBK) and Blicquy/Villeneuve-Saint-Germain (BVSG) sites in the Aisne valley study zone (map after Chartier 2010, with modifications). Sites mentioned in the text: 1 Bazoches-sur-Vesle; 2 Berry-au-Bac "le Chemin de la Pêcherie"; 3 Berry-au-Bac "le Vieux Tordoir"; 4 Bucy-le-Long "la Fosselle"; 5 Bucy-le-Long "la Fosse Tounise"; 6 Bucy-le-Long "le Fond du Petit Marais"; 7 Cuiry-lès-Chaudardes: 8 Chassemy "le

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A highly notable example of the late LBK are the man<sup>-1</sup> linearly distributed LBK sites in the Aisne Valle ris Basin, which were tho decades (Fig. 8). Although the sites have some unique prope the Aisne river, and the presence of both short-lived and covering a time span of 200 years, they represent the characteristics of the typical West-Central European LBK culture <sup>76</sup>

At the final stage of this Late LBK period, a new local Early Neolithic culture emerged in Northern France and Belgium, especially in the Paris Basin, referred to as Blicquy/Villeneuve-Saint-Germain (BVSG). The BSVG is assumed to follow the late LBK lasting from 4,900 to 4,700 BCE <sup>77</sup>. However, there are indications of shifts in the settlement patterns based on house

plans and ceramic decorations and a striking absence of continuity between the usage of LBK and BVSG sites despite the proximity of the sites to each other (Fig. 8) <sup>76,78</sup>. Since the Paris Basin represents the end of the Continental Neolithic route, understanding the final phase of LBK in this area is essential to complete our view of the European Neolithization including its migration history, the Neolithic-Mesolithic admixture as well as inter and intra-regional Neolithic admixture history in Western Europe and the general history of interactions that can be deduced from it.



Figure 9: Main cultural horizons associated with the earliest Neolithic of Central and Western Europe approximately 6,000–5,500 cal BCE. 1, Cova Bonica; 2, Cova de la Sarsa; 3, Cova de l'Or; 4, Galeria da Cisterna-Almonda (Olalde et al., 2015)

#### The Mediterranean route of Neolithization

Prior to the LBK expansion into Central Europe, farming spread into Western Europe between 8,000 - 7,500 years ago via the Northern Mediterranean coast. The early members of this maritime expansion with origins in Northwestern Greece were associated with the Impressed Ware (Impresso-Cardial Complex - ICC) culture and inhabited the Adriatic coast and mainland Italy (Fig. 9)<sup>46</sup>. The two different expansions, the Continental and the Mediterranean expansion, have their roots the same metapopulation in Southeastern Europe since the genomes of the Early Neolithic individuals from Croatia are not separable from
contemporary individuals in the Balkans, both preserving their ancestry from Northwestern Anatolia <sup>66</sup>. Contrary to Neolithic Central Europe, the Neolithic populations spreading along the Mediterranean coast occupied mostly caves, rock shelters, and open camps sites. Some of these sites have evidence of occupation by both Late Mesolithic and Early Neolithic groups <sup>79</sup>. The Early Neolithic individuals from Central Italy dating to between 6,000-5,500 calBCE show similar patterns to Balkan and Central European Early Neolithic population, all having little to no hunter-gatherer ancestry. However, later Early Neolithic individuals dating to 5,500-5,200 calBCE have slightly elevated hunter-gatherer ancestry, while the latest member of this group has an ancestry proportion of around 15%, which separates this individual from other Early Neolithic individuals in Italy <sup>58</sup>. In Southern France and Iberia, where Early Neolithic sites are associated with the Cardial culture (Fig. 9), a newly established cultural complex dating to 5,500-5,400 calBCE, the genetic profile is overall different from the one of the Early Neolithic groups in Italy and in Central Europe. There are genome-wide data available for only four Early Neolithic Individuals dating to earlier than 5,000 BCE in Southern France <sup>63</sup>. Strikingly, their genomes reveal very recent hunter-gatherer admixture, around 4 generations ago, and HG ancestry proportions varying between 20-50%. This genomic profile makes this group of individuals unique among other contemporary individuals, and is in agreement with the archaeological findings about Mesolithic and Neolithic interactions in this part of Europe <sup>63</sup>. However, the amount of genomic data is insufficient to disentangle the hypotheses on the genesis of the Cardial culture, and in particular the question whether the input from the Mesolithic groups was responsible for changes in cultural practices <sup>80</sup>. Moreover, the pattern observed in Southern France is not reflecting the Cardial groups in the Iberian Peninsula, a region for which much more genetic data have been produced. Early Neolithic Iberian populations dating to 5,200-5,000 calBCE have around 10% hunter-gatherer ancestry, which is much less than in the French Cardial group yet higher than in Central European Early Neolithic populations <sup>43,61,62,81</sup>. Therefore, the modalities of the expansion of farming via the Mediterranean route remain elusive since only very little genetic information from Early Neolithic sites associated with the Impresso-Cardial cultures is available.

#### Spread of farming into Scandinavia and the British Isles

The spread of farming into Southern Scandinavia and the British Isles was delayed by  $\sim$ 1,000 years, as it only took place independently around 4,000 BCE(Fig. 6). In Scandinavia, the Neolithic transition was the result of the expansion of farmer populations associated with the Funnel Beaker (TRB - Trichterbecher) Culture, which emerged from the Early Neolithic culture in Northern Germany and Southern Scandinavia starting from 4,100 calBCE <sup>46</sup>. These farmers do not show any signal of admixture with local Scandinavian hunter-gatherers. However, a pottery-producing group of foragers associated with the Pitted Ware Culture (PWC), which had a subsistence strategy based on marine hunting and fishing, was contemporary to the later TRB population and received gene flow from TRB farmers <sup>82</sup>.



Figure 10: Fig. 15.8. Interpretive map of suggested dates, source areas and directions in the spread of Neolithic things and practices across Britain and Ireland. The colors denote contacts at different dates (A. W. R. Whittle et al., 2011).

The Neolithization of Britain and Ireland occurred almost at the same time as in Southern Scandinavia. It is not clear what was the driving force for northward migrations or why there was such a delay compared to the more southern regions of Europe. Concerning the arrival of the first farmers to the British Isles there are many unknowns regarding their origin. Based on the archaeological evidence different potential routes were described (Fig. 10). The "Atlantic, Breton Neolithic" model argues in favor of an origin in Brittany whose farmers spread to the Northern British Isles. The "Trans-Channel East strand" suggests the Northeastern coast of France as the source of Neolithic Britain via the southeastern corner of the island (also called the 'Carinated Bowl Neolithic')<sup>84</sup>. The "Trans-Channel West strand" proposes a population on the Northwestern coast of France as the source of Neolithic Britain via the southwestern corner of the island <sup>84</sup>. One way to identify the potential source of Early Neolithic Britain is to compare the genetic affinity of Neolithic British individuals to Iberian and Central European Early Neolithic groups. Consequently, it was proposed that the Neolithic population in Britain was likely to descend from an Iberian population that had arrived there via the Mediterranean route rather than the Continental route <sup>59</sup>. These results were also confirmed by another study including Neolithic individuals from France and which connected the populations in Northern and Southern France to the previously proposed connections between Iberia and Britain <sup>63</sup>. However, these studies were based on the genetic affinity between British and other western Neolithic groups but were unable to detect a contemporary population that was more strongly associated with Neolithic populations from Britain and Ireland. Furthermore, all the statistical tests of the genetic data that were performed included Central European LBK groups, which carry less hunter-gatherer ancestry compared to British and other Western Neolithic individuals. This introduced a potential bias since the Central LBK groups do not represent the end of the Continental expansion route, contrary to Iberia. It would be more relevant to include individuals from the Paris Basin LBK, but such data have not been produced yet.

## **Population Dynamics of the 3rd Millennium**

The 3rd millennium BCE was a period of both cultural and genomic transformations in Europe, which led for the first time to the appearance of most of the present-day European genetic structure. These transformations have their origins in the westward expansions of steppe-ancestry populations related to those associated with the Yamnaya culture from the Pontic-Caspian steppes (Fig. 11)<sup>10,12</sup>. In Eastern Europe, this westward expansion coincided with another expansion by people from a Late Neolithic culture called Globular Amphora that occurred in the opposite direction around 3,000-2,800 BCE, which possibly led to the emergence of a new culture and genetic structure found in the groups associated with the Corded Ware culture (CWC) (Fig. 12)<sup>85</sup>. However, these two interacting groups were genetically (and culturally) highly differentiated. While the Yamnaya pastoralists were genetically a mix of well-structured Caucasian and Eastern hunter-gatherer-related groups <sup>86</sup>, the Late Neolithic people, who encountered this Yamnaya-related ancestry, were a mix of Aegean farmer and Western hunter-gatherer groups <sup>87</sup>. The individuals analyzed that belonged to this newly emerged CWC group in Central Eastern Europe carried small portions of Late Neolithic ancestry but most of their genomes resembled the Yamnaya profile (Fig. 11) (Haak et al., 2015; Linderholm et al., 2020; Papac et al., 2021; Saag et al., 2021). In less than two centuries, CWCassociated people expanded to the borders of the Volga and Rhine rivers in the East and the West, respectively. Although there are some analogies to the Early Neolithic expansions in terms of directionality and possibly interactions between locals and migrants, the Corded Ware transmission was more complex due to its high speed and the way of forming a new culture <sup>85</sup>.



Figure 11: The Bronze Age spread of Yamnaya Steppe pastoralist ancestry into two subcontinents—Europe and South Asia. Pie charts reflect the proportion of Yamnaya ancestry, and dates reflect the earliest available ancient DNA with Yamnaya ancestry in each region. Ancient DNA has not yet been found for the ANI and ASI, so for these the range is inferred statistically (Narasimhan et al., 2019).

During this time period, the Yamnaya-related steppe ancestry was not present on the Western side of the Rhine river. In the following centuries, this new ancestry rapidly spread into Western Europe. However, the spatial distribution of steppe ancestry was highly heterogenous and this spread was strongly associated with the Bell Beaker Complex (BBC) <sup>93</sup>. Although the archaeological origin of BBC is ambiguous due to different hypotheses supporting different locations and time periods that are controversially discussed, mainly due to dating uncertainties (discussed in more details later), there is a connection between the spread of the BBC and the spread of steppe ancestry especially after 2500 calBCE. One notable example is the rapid turnover in the population structure with the spread of BBC in Britain, where steppe ancestry is found at levels exceeding 50% in the second half of the third millennium BCE and is still representing a major contribution to the present-day populations (Haak et al., 2015; Olalde et al., 2018). However, concerning the others parts of Western Europe, such as France and Iberia, the arrival of this ancestry and its admixture dynamics are less well-known. High levels steppe-ancestry were found in Northern France, while some individuals from BBC graves do not have any steppe ancestry in their genomes showing there is no absolute connection between this

cultural complex and steppe ancestry  $^{60,93}$ . In Iberia, the overall steppe ancestry found in BBCassociated individuals is much lower compared to Britain and the Netherlands  $^{93,94}$ . Further studies comprising these key periods around ~2,500 calBCE in France (Fig. 11, Fig. 12) are necessary in order to better understand the mechanisms behind the spread of steppe-ancestry in Western Europe.



Figure 12: Yamnaya – Corded Ware – Bell Beaker distribution in Europe (reproduced from Lemercier 2018, Fig. 7) (Heyd, 2019)

## **Rationale of the Thesis**

The briefly reviewed genetic history of human populations since the Upper Paleolithic in Europe shows recurring prehistorical encounters between local and migrating populations. People migrated due to climatic and environmental changes, demographic pressure, and/or cultural developments. Population movements were accompanied by local admixture (e.g. Cassidy et al., 2020; Fu et al., 2015; Martiniano et al., 2017) or population replacement events (e.g. Brace et al., 2019, Olalde et al., 2018). However, the mechanisms of these populational events are still elusive for most time periods and geographic areas. Therefore, we aimed at revealing and understanding at the genetic level admixture between populations by focusing on three key transition periods in European prehistory. First, the time  $\sim 38,000$  years ago following major climatic changes and an ecosystem crisis beginning with a dramatic volcanic eruption (the Campanian Ignimbrite (CI) super-eruption at the beginning of the Heinrich Event 4 (Fig. 4)). In the aftermath of this crisis Europe experienced human population turnover that introduced the present-day European like ancestry for the first time. Second, the transition from the Mesolithic to the Neolithic lifestyle following the population expansions from Southwest Asia that resulted in the spread of farming into Europe during the Holocene (Fig.6). The last period we focused on is the 3rd millennium BCE, which was a period of both cultural and genomic transformations associated with migrations of populations from the Pontic-Caspian steppe forming the present-day European genome.

Within the framework of this thesis project, we sampled individuals, who were contemporary witnesses of these key periods, and generated ancient genomes. We performed various state-of-the-art population genomics methods to reconstruct the population history of the corresponding human groups. First, we analyzed the genomes of two early ~36,000 and 37,000-years-old European individuals from the rock shelter site of Buran-Kaya III in the Crimean Peninsula that were witnesses of the post-CI population dynamics. Then, we generated genomic data from 116 individuals dating from the Late Mesolithic to the beginning of the Bronze Age, between 8200 and 4200 years ago covering two large-scale populational turnover events in Europe. To provide genomic insights into the Neolithization of western Europe, we focused on the Paris Basin including the archaeologically well-studied Aisne Valley (Fig. 8) as the final phase of the continental expansion of farmer populations, where archaeological evidence for interactions between farmers and foragers were found (Allard,

2007). Lastly, we analyzed a collective burial dating back to 2500 BCE, a time when Yamnayarelated steppe ancestry was introduced in western Europe (Fig. 10) contributing the third major component of the present-day European genome and triggering the emergence of new cultures as a consequence of the encounters of populations associated with this new ancestry (Fig. 11).

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# **Chapter I**

# Early Upper Paleolithic genomes of Crimea show migration and admixture dynamics of the first modern European ancestries in relation to climatic crisis

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### **Abstract**

We describe the genomes of two c. 37,000-year-old individuals from the site of Buran-Kaya III in Crimea as belonging to the first migration wave of humans carrying ancestry found in present-day Europeans. These genomes allowed us to model admixture and infer population movements, interactions and turnovers during the peopling of Europe in the Early Upper Paleolithic, and revealed that admixture with preexisting populations in Europe accompanied the population turnover events prior to and following Heinrich Stadial 4 and the Campanian Ignimbrite super-eruption. The inhabitants of Buran-Kaya III shared the highest genomic similarities with Middle-Upper Paleolithic groups found in central and western Europe several thousands of years later and with Caucasus Late Upper Paleolithic groups. Since these remains are associated with the oldest appearance of a cultural assemblage with features reminiscent of the later Gravettian assemblages, these genetic links open up the possibility of technological continuity despite temporal and geographic distances.

## **Introduction**

Archeological and genetic data show anatomically modern humans (AMHs) to be present in Europe by at least 45,000 BP (years Before Present)<sup>1</sup>, and possibly earlier<sup>2</sup>. Genomic analyses of AMH remains prior to 40,000 years ago have revealed diverse and poorly characterized populations<sup>1,3–5</sup>. All of these showed evidence of admixture with Neanderthals either largely predating the 31-52,000-year-old woman from Zlatý Kůň in Czechia<sup>4</sup>, or more recent, local events in the case of genomes from Peştera cu Oase in Romania (Oase1)<sup>6</sup> and Bacho Kiro in Bulgaria<sup>1</sup>. Only the individuals from Bacho Kiro, who were found associated with Initial Upper Paleolithic archeological assemblages (IUP), have demonstrated some genomic relationship with modern human populations, specifically those found in East Asia<sup>1</sup>. At some point after 40,000 years ago, these early ancestries appear to vanish from Europe as a new genomic profile appears, a timing concurrent with changing climatic and environmental conditions after the Campanian Ignimbrite super-eruption in Italy, which blanketed southern and eastern Europe in ash 39,490-39,170 BP, at the beginning of the nearly 2,000-year-long Heinrich Stadial 4 cold period (H4) with potentially catastrophic impact on the ecosystems<sup>7,8</sup>. This post-Campanian Ignimbrite (post-CI) wave of ancestry first appears after the Heinrich Stadial 4 and is present in Europe in various forms during the Early and Mid-Upper Paleolithic (EUP and MUP, respectively), such as in genomes from the sites of Kostenkil4 (~38,000 cal BP)<sup>9</sup> and Sunghir (~34,000 cal BP)<sup>10</sup> in the eastern European Plain and in two ~35,000-year-old individuals, GoyetQ116-1 from Belgium<sup>3</sup> and BK1653<sup>1</sup> from the MUP deposits of Bacho Kiro, Bulgaria, both of whom also contain trace ancestry linked to the previous IUP inhabitants of Bacho Kiro<sup>1</sup>. Post-CI ancestry is also found in central Europe beginning at least 31,000 years ago in individuals belonging to the "Věstonice" genetic cluster, found in direct association with Gravettian cultural assemblages<sup>3</sup>. Unlike the IUP occupants of Europe, this post-CI wave of ancestry shares genetic drift with modern Europeans<sup>3,9</sup>, but due to the sparseness of genomic data from EUP humans in Europe, the origins of this ancestry, the timing of its appearance(s), and the routes that populations bearing this ancestry took into the European continent, as well as their interactions with preceding IUP-contemporary groups are unknown.

Discovered in 1990, the rock shelter site of Buran-Kaya III in the Crimean Peninsula contains rich deposits of human activity dating from the Middle Paleolithic until the Middle Ages<sup>11-14</sup>. The assemblages of layers 6-5 to 5-2, dated to ca. 38-34,000 cal BP<sup>12,14</sup>, have vielded backed microliths, microgravette points, bone tools, ochre, and body ornaments of ivory, shell, and teeth, as well as multiple human skull fragments, some with post-mortem cut marks<sup>12</sup>. The similarity of the cultural deposits to later Gravettian assemblages of Europe have led the excavating archeologists to assign this material to the earliest appearance of a Gravettian cultural layer, a designation that has recently been challenged on the basis of the considerable gap of time and geography between these artefacts and those appearing 5,000 years later in Gravettian layers of central Europe<sup>15–18</sup>. Other arguments consider that the assemblages of the EUP layers of Buran-Kaya III can be more parsimoniously associated with a cluster of non-Aurignacian contemporaneous EUP layers found in the Caucasus also containing backed lithics<sup>15,18,19</sup>, such as those at Ortvale Klde, layers 4d-4c<sup>20</sup>, Mezmaiskaya, layers 1c-1a<sup>21</sup>, and Dzudzuana, layer D<sup>22</sup>. Still others have proposed a dual approach and termed EUP layers of Buran-Kaya III along with those in the northern Caucasus sites as "proto-Gravettian"<sup>23,24</sup>, and the similarities of these backed-lithic Caucasus sites with the Early Ahmarian lithics produced in the Levant has been used by some to suggest connections between these industries<sup>22,25,26</sup>. While a strict correlation between the continuity of cultural and technological practices and the genetic continuity of the creators of archeological material cannot always be expected, genomic

characterization, where possible, of human remains associated with archeological assemblages provides additional keys to understanding the cultural and historical contexts of the material and the behaviors, adaptations and cultural contacts of ancient human groups. To define the population associated with the earliest appearance of this cultural assemblage in Europe, and to determine how the EUP occupants of Crimea fit into our current knowledge of the AMH settlement dynamics of Europe at the close of the Heinrich 4 period 38,000 years ago, we investigated the genetic identity of the human remains of the EUP layer of Buran-Kaya III.

## **Results**

Two cranial fragments (BuKa3A and BuKa3C), one with cut marks (BuKa3A), were aseptically excavated in 2009 from layers 6-1 (BuKa3A) and 6-2 (BuKa3C) of Buran-Kaya III (see Supplementary Information). Radiocarbon (AMS) dates from associated material ranged from 36,260 to 35,280 cal BP (31,900+240-220 <sup>14</sup>C BP) for BuKa3A and 37,415 - 36,245 cal BP (32,450+250-230 <sup>14</sup>C BP) for BuKa3C (Fig. S1 and Table S1). Initial genetic characterization of the samples revealed extremely poor preservation of endogenous DNA, both in fragment length (average 36 bp) and in low quantity relative to environmental DNA (<0.1%). Applying various pretreatments and extraction buffers<sup>27,28</sup> (see Supplementary Material for details) to the samples, we identified conditions that considerably increased the endogenous DNA content enough to allow genomic analysis ( $\sim 0.5\%$  for BuKa3A and  $\sim 4\%$  for BuKa3C). Enrichment for mitochondrial DNA and shotgun sequencing resulted in 82- (BuKa3A) and 11-(BuKa3C) fold coverage of the mitogenomes. Reads mapping to the mitochondrion were used to determine the posterior probability for contamination with modern human sequences using the program Schmutzi<sup>29</sup>, which estimated a contamination rate below 1% for BuKa3A, and haplocheck<sup>30</sup> detected no mitochondrial contaminants above 1% in either sample (see Methods). Both individuals were determined to be male using the ratios of reads mapping to chromosome X and Y31 and chromosome X-mapped reads to the average of autosomalmapped reads<sup>32</sup>. The older sample, ~36,800 year-old BuKa3C, belonged to a mitochondrial haplogroup basal to haplogroup U, a lineage not found in modern humans and branching prior to the split that gave rise to U-haplogroups found in E/MUP Europe and present in Kostenki14, the Sunghir group, Dolni Věstonice in Czechia, and Peştera Muierii, 34,000 year-old remains found in Romania<sup>33</sup> (Fig. S2). The mitochondrial haplogroup of BuKa3A was determined to

belong to an early branch of the N lineage, N1. This assignment falls outside of the lineages previously reported for N in UP Europe, nearly all of which derive from later N branches (U and R haplogroups, Fig. S2). The N1 of BuKa3A is notably distinct from the N haplogroups identified from the 40,000-year-old Oase1 from Romania and those of the 45,000-year-old occupants of Bacho Kiro Cave in Bulgaria, all of which belong to more basal branches that have no modern descendants<sup>6,34</sup>. Additionally, the BuKa3A mitochondrial DNA sequence contains three of the eight mutations beyond N1 to N1b, a modern rare haplogroup most highly concentrated in the Near East, yet appearing broadly from western Eurasia to Africa. Among ancient samples, the mitochondrial sequence of an 11,000-year-old Epipalaeolithic Natufian from the Levant (Natufian9)35 is also a later derivative of this pre-N1b branch. The Y haplogroup for BuKa3C was determined to belong to a basal F branch that has not been found among modern humans younger than 38,000 years-old, but clustering instead with Y haplogroups previously reported in southeastern Europe for the IUP BK (Bacho Kiro)\_F6-620<sup>1</sup> and 40,000 year-old Oase1<sup>6</sup> (Fig. S3). All three of these Y chromosomes carry ancestral bases at diagnostic sites that exclude their assignment to any modern F lineages, which are principally found in East Asia. A single transversion may also point to a similar basal F haplogroup for BuKa3A but the lower coverage of this sample does not allow a reliable placement beyond haplogroup CT.

#### Neanderthal admixture

Neanderthal settlements attributed to the Micoquian, Kiik-Koba type were also found at Buran-Kaya III (layer B) and have been dated through faunal bone fragments from 43,200 to 41,000 cal BP<sup>12</sup>, demonstrating an earlier Neanderthal presence at the site up to the time of the CI eruption. AMH remains dating to this period found in Romania and Bulgaria have documented local admixture with late Neanderthals in southeastern Europe<sup>1,6</sup>, leading us to investigate whether admixture with local Neanderthals in Crimea could be detected in early AMHs living at most several thousand years after the last Neanderthals in the region<sup>12,36</sup>. Neanderthal ancestry calculated using the direct f4-ratio method<sup>37</sup> determined that BuKa3A and BuKa3C possess 3.8 (SE 3.3-5.3) and 2.2 (SE 1.2-3.2) percent Neanderthal ancestry, respectively (Fig. S4). Although the Neanderthal ancestry was slightly higher in BuKa3A than BuKa3C, it is in line with that calculated for other post-CI individuals from Europe using the same method, indicating Neanderthal populations had likely disappeared from the region prior

to the arrival of AMHs ancestral to the population to which the Buran-Kaya III individuals belonged.

#### Admixture among UP humans in Europe

To maximize the comparable data between BuKa3 and other Paleolithic genomes, single nucleotide polymorphisms (SNPs) were called from 929 high-coverage modern genomes38 and filtered to remove population-specific variants and those occurring in repetitive regions. This left ~13 million genome-wide SNPs, of which 265,510 and 537,076 overlapped with BuKa3A and BuKa3C respectively. The combined ~740,000 SNPs that occurred in at least one BuKa3 individual were then called from 38 previously published shotgun or high-coverage captured western Eurasian genomes from the Paleolithic to the Neolithic (Table S2). Outgroup f3statistics were carried out on sample combinations including a minimum of 10,000 shared SNPs. Overall, both BuKa3 genomes were more similar to genomes younger than 38,000 years than to those older, and were more similar to modern European populations than those outside Europe (Fig. S5). Among the Paleolithic genomes available for analysis, both BuKa3 individuals were found to share the highest amount of drift with the roughly contemporary ~35,000-yearold GoyetQ116-1 from Goyet Cave in Belgium<sup>3</sup> and the younger  $\sim$  31,000-year-old infant twins from Krems-Wachtberg in Austria, KremsWA, which were buried with a Gravettian assemblage<sup>39</sup>. Although both had a similar genetic distance to the 34,000 year-old individual from Peştera Muierii in Romania and the 35,000 year-old BK1653 from Bacho Kiro in Bulgaria (Fig. 1A, Table S3), the two BuKa3 individuals did not belong to a uniform population, and shared unequal amounts of drift with several individuals older than 30,000 years. BuKa3A showed a higher affinity than BuKa3C to the 40,000-year-old genomes of Oase1 and Tianyuan from East Asia<sup>40</sup>, and also had a slightly greater affinity with several IUP Bacho Kiro individuals (Fig. 1A). Notably, BuKa3A, but not BuKa3C, shared a similar amount of drift with the pre-CI Oase1 as with more contemporary post-CI genomes from Romania and Bulgaria (Table S3). These results, and in particular the higher affinity of the East Asian Tianyuan to BuKa3A than BuKa3C, indicate that, similar to GoyetQ116-1, BuKa3A is also likely to contain ancestry present in Europe prior to the Heinrich 4 Stadial and the CI eruption. BuKa3A also shared more drift than BuKa3C with the ~6,000 year younger Věstonice16 from central Europe, associated with a Gravettian assemblage<sup>3</sup>, whereas BuKa3C had a slightly higher genetic affinity to the ~38,000-year-old Kostenkil4 from the eastern European plain, and a lower

affinity to post-Last Glacial Maximum (LGM) populations from central and western Europe (Fig. 1A.). These *f3* results were explored in greater detail through Multi-Dimensional Scaling (MDS) and plotted on a 3-D scatter plot (Fig. 1B. Fig. S6), which can be used to visualize the global genomic relationships of the ancient populations of Europe composed of genomes dating between 38,000 and 29,000 years ago. This cluster corresponds to a wave of ancestry that first occurred in Europe at some point following Heinrich Event 4 including the CI eruption, and appears to have largely replaced the genomically distinct earlier AMH inhabitants of Europe associated or contemporary with IUP technologies<sup>1,3–5</sup>. Of the E/MUP Europe cluster, the two individuals plotting the farthest along the D3 axis, which differentiates the older pre-CI individuals, are GoyetQ116-1 and BuKa3A, supporting a degree of shared drift between these and the oldest Eurasian AMH genomes.

We attempted to model the possible UP population movements and admixtures involved in the early AMH settlement of Europe using a qpGraph framework that could explain many of the relationships we identified. The best-fitting model with no outlier f4-statistics using the modern African Mbuti population as an outgroup, and having the lowest absolute Z-score of 2.6 is shown in Fig. 2A. This model describes the migration of groups into Europe following Heinrich Event 4 and the CI eruption as having occurred in various waves, originally deriving from a population or populations with a common ancestor that had separated much earlier from the pre-CI ancestry found across Eurasia and represented in Europe by the IUP Bacho Kiro group. The first of these incoming populations admixed with the pre-existing inhabitants, some retaining as much as 18% of the pre-CI ancestry several thousands of years later. GoyetQ116-1, BK1653, and the BuranKaya3 group later descended from these admixed populations. These admixture events appear to be constrained to central and western Europe, since notably, groups in eastern Europe, such as those ancestral to Kostenkil4 and Sunghir3, lack a pre-CI ancestry component, detectable either by affinity with East Asian genomes or pre-CI individuals in Europe. Later unions among admixed and unadmixed groups are adequate to explain much of the ancestry identified to date in UP Europe. BuKa3C can be described as descended from a population derived from one ancestral to Kostenki14 and having 17% ancestry from an IUP Bacho Kiro-like group (denoted as "BuKa-α" in Fig. 2A). BuKa3A could be successfully modeled as having descended from "BuKa-\beta", a population resulting from admixture between "BuKa- a" and another admixed group ancestral to GoyetQ116-1. This model, although a simplification that does not address all pre-CI-related sources found in

BuKa3A, accounts for the affinities revealed though f3- and f4-statistics between BuKa3C and Kostenkil4, BuKa3A and GoyetQ116-1, both BuKa3C and BuKa3A with KremsWA (Fig. 2B), and the divergent affinities between the BuKa3 individuals and those from IUP Bacho Kiro. The MUP individual from Bacho Kiro, BK1635, is modeled as having derived from an early-arriving population ancestral to the eastern Europe Sunghir3 and Kostenki14 lineages, which admixed with IUP Bacho Kiro-like ancestry, in a process parallel to that which gave rise to GoyetQ116-1. BK1635 is representative of the most likely candidate population to serve as the western source of the Věstonice group, which would later receive additional gene flow from a Sunghir-like population, presumably from the east. The placement of Muierii as a mixture between BK1653-like ancestry and an unsampled population ancestral to Sunghir3 and Kostenkil4 gave the only successful model including this sample, and refines the previous placement reported for this individual as a mixture of a pre-Sunghir-like ancestry and a sister group to GovetQ116-133. Post-LGM Epi-Gravettian individuals from northern Italy such as the 17,000-year-old Tagliente<sup>41</sup> (or later Villabruna<sup>3</sup>) were modeled as a lineage from the same source population as GoyetQ116-1 although with a considerable amount of temporal and genetic distance. This placement agrees roughly with previous models<sup>3,10,41,42</sup>, but it is evident that there is a need for more clarification considering the genetic history of the ancestors of post-LGM populations in Europe.

#### Pre-CI geneflow into Buran-Kaya III

To date, two incidents of ancestry present in Europe before 40,000 years ago appearing 5,000 years later in Europe have been reported (GoyetQ116-1 and BK1653)<sup>1,3</sup>, although little genomic data exist from the earliest period of these admixtures that could assist in better characterizing these events. To investigate this aspect further, we compared BuranKaya3 and other pre-LGM individuals through *f4*-statistics. Overall, BuKa3C was found to be more genetically similar to contemporary and younger groups than older ones, sharing significantly more alleles with any individual younger than 38,000 years when compared with any individual older than 40,000 years (*f4(EUP/MUP, IUP; BuKa3C, Mbuti*), Z = 3.4 - 11.9), Fig. 3A and 3B, Table S4). While BuKa3C was equally distant from most pairs of pre-CI individuals, several significant *f4*-statistical results indicate that BuKa3C contained at least some ancestry found in earlier inhabitants of Europe, showing heightened affinities to Oase1 and BK\_CC7\_335 in some contexts (Fig.3A). The presence of preCI ancestry in BuKa3A was more pronounced.

Similar to BuKa3C, BuKa3A showed a significantly higher affinity to groups younger than 38,000 years compared to older groups, unless the test involved Oase1 (Fig. 3B), where allele sharing between BuKa3A and Oase1was found to reduce the affinity of BuKa3A to post-CI genomes. To verify whether this affinity could not be due to elevated Neanderthal content in BuKa3A and Oase1, we recalculated the statistic after masking the increased Neanderthal content found in the Oase1 genome<sup>5</sup>. Excluding excess Neanderthal ancestry increased the shared drift between BuKa3A and Oase1, indicating that this affinity could be traced to shared non-Neanderthal ancestry (Table S5). Through comparisons of pre-CI groups with BuKa3A, significant allele sharing could also be seen with the 31-52,000-year-old woman from Czechia, Zlatý Kůň<sup>4</sup> with respect to either IUP Bacho Kiro individuals or the 45,000-year-old Ust-Ishim from western Siberia<sup>43</sup>. In multiple f4-statistics, Zlatý Kůň, Oase1, and Tianyuan were found to share roughly the same proportion of alleles with BuKa3A (Table S4). MDS analysis of inverted f3-statistics including only UP samples also placed BuKa3A between fellow post-CI individuals and a pre-CI group comprising Oase1 and Zlatý Kůň (Fig. S7). The identification of a shared ancestry between BuKa3A and Oase1 was unexpected since Oase1 ancestry had not previously been detected in any subsequent Eurasian populations<sup>1,3,6</sup>. A recent analysis of UP genomes, however, could successfully model Oase1 as belonging to a population similar to the IUP Bacho Kiro group with additional Neanderthal admixture<sup>5</sup>, and groups related to Bacho Kiro have contributed ancestry to modern East Asians and GoyetQ116-1<sup>1,3</sup>. Zlatý Kůň had been previously shown not to have contributed gene flow to later groups<sup>4</sup>, which is contradicted by the allele sharing demonstrated here between Zlatý Kůň and BuKa3A relative to Ust-Ishim. More recent analyses, however, presented admixture models that can support gene flow of between 2-29% from Zlatý Kůň into Bacho Kiro<sup>5</sup>, which would support our observations.

#### Genetic relationships with post-CI populations

Among the genomes between 38,000 and 30,000 cal BP, which represent the post-CI wave of ancestry arriving into Europe beginning in the EUP, BuKa3C shared similar amounts of drift with the contemporary Kostenki14 as with the younger GoyetQ116 and KremsWA, but shared more ancestry with the 5,000-year younger KremsWA from Central Europe than the more contemporary Sunghir3 to the northeast, revealing a key difference between the otherwise similar Kostenki14 and Sunghir3 genomes (Fig. 2B). The Věstonice genetic cluster has been associated with Central European Gravettian assemblages<sup>3</sup>. Two Central European Gravettian burials, Věstonice16 and KremsWA, share an excess of alleles relative to other MUP individuals, yet they behaved differently when tested with respect to both BuKa3 individuals. Although Věstonice16 shows higher affinity towards KremsWA, Sunghir3, BK1653, GoyetQ116-1, and Kostenki14 with respect to one or both BuKa3 genomes, KremsWA could not similarly differentiate any contemporaries from the BuKa3 individuals (Fig. 2B), indicative of gene flow from a BuKa3-like population to KremsWA which is also supported by the high outgroup f3-values observed between KremsWA and BuKa3 (Fig. 1A, Table S3). These results show that while the makers of Gravettian assemblages of central Europe exhibited an overall genomic similarity, they can be distinguished by a differential presence of ancestry found thousands of years earlier on the shores of the Black Sea.

#### Caucasian Hunter Gatherer connections

A Late Upper Paleolithic (LUP) population was identified from 13,300-year-old remains at Satsurblia Cave in western Georgia, whose distinct ancestry was defined, along with similar nearby 9,800-year-old remains at Kotias Klde, as Caucasus Hunter Gatherer (CHG)<sup>44</sup>, also known as the Satsurblia genetic cluster<sup>3</sup>. CHG ancestry has been estimated to have separated from Western Hunter Gatherers (WHG) approximately 45,000 year ago and existed as an isolated population during the LGM, later contributing ancestry to several distinct populations that played roles in developing the modern European genomic identity<sup>35,44,45</sup>. CHG ancestry has been identified in the same Caucasus region dating back to the MUP, making up roughly half of the ancestry of two 26,000-year-old individuals from Dzudzuana Cave<sup>42</sup> and 25,000year-old remains from Kotias Klde<sup>46</sup>, both in Georgia. Given the geographical proximity and cultural links between the contemporary layers of these Caucasus sites and Buran-Kaya III, we additionally investigated whether continuity with the CHG ancestry could extend 10,000 years earlier at BuranKaya3. We show that one or both individuals from BuranKaya3 share significantly more alleles with the CHG cluster than any other post-CI individual older than 30,000 years (Z = 2.2-6.6), with the exception of KremsWA (Z = 0.08-1.9) (Fig. 3C, Table S4). The identification of CHG-related ancestry at Buran-Kaya III, which appears in early Gravettian-associated ancestry found 5,000 years later in Central Europe, highlights the Caucasus as a potential entry point in repopulating Europe beginning at least 38,000 years ago.

UP samples from the Caucasus and surrounding regions will be required to better resolve these movements and interactions of these groups before and after this transition period.

## **Discussion**

With these two individuals from Buran-Kaya III we genetically characterize one of the earliest facets of the EUP wave of ancestry appearing in Europe between 40,000 and 38,000 cal BP at Crimea, and associate it with a backed-bladed, microlaminar lithic industry well established in the northern and southern slopes of the Caucasus which has been compared to Gravettian assemblages appearing later in central Europe<sup>11,13,25</sup>. Disparities in the ancestries of the two individuals, occupying the same place some 1,000 years apart, reflect the non-uniform nature of the relationships among these early migrant groups, and propose a model of complex interactions and exchange not only at the interface of this incoming ancestry, but continuing among their descended lineages. The earlier BuKa3C was minimally admixed with ancestry similar to one found within the IUP Bacho Kiro group and carried an IUP-associated Y haplogroup, whereas the later BuKa3A was more heavily admixed with several pre-CI populations. Both shared more ancestry with individuals living thousands of years later in western and central Europe than with any other contemporary groups found to date. This model reflects a broad pattern of incoming ancestries that had diverged from a similar source, mixing to different degrees with deeper-branching, pre-CI AMH populations who arrived earlier, and interacting with neighboring groups to form the earliest ancestries detectable in present-day Europeans. The elevated pre-CI admixture in the more recent BuKa3A compared to the ~700-years older BuKa3C is reminiscent of population dynamics following the Neolithic migration into Europe, where evidence of admixture increases some time following the initial appearance of new migrants<sup>32</sup>. The degree of admixture between these incoming AMHs with the pre-CI ancestry of the exiting inhabitants has not previously been appreciated. Of the seven genomes now available from Europe dating to between 38,000 and 34,000 years ago, all five located in southern, central, and western Europe can be modeled as having admixed with the pre-existing AMH groups (Fig. 2A). The regularity of this phenomenon suggests the possibility that the earliest AMH settlers in Europe, perhaps belonging to populations substantially reduced in size by the preceding climatic changes of the Heinrich 4 cold period and the CI eruption, may have been absorbed into the incoming EUP migration wave.

Identifying the geographical areas where these newly arrived populations developed, which had to have been isolated long enough to establish distinct genetic profiles will require a better genetic characterization of EUP populations of the surrounding regions: the Caucasus, eastern Europe, Anatolia and the Levant. Genetic similarities between BuKa3A and BuKa3C with CHG ancestry documented in the Caucasus 10,000 years later, coupled with a similar archeological horizon to that found across several contemporary northern Caucasus sites, argues for the Caucasus as the point of entry of Buran-Kaya III-linked ancestry, which is best modeled as branching from a source population leading to Kostenki-like ancestry after separating from the lineages that would give rise to GoyetQ116-1 and BK\_1653, later found in central and western Europe, and Sunghir3 in the east. We also observe that the only groups unadmixed with pre-CI European ancestry, Sunghir3 and Kostenki14, date to before 34,000 years ago and are found only in eastern Europe, which indicate a possible eastern entry point for these lineages from an area that may have been devoid or sparsely inhabited by pre-CI European populations at the time.

The timing of this EUP movement into Europe, coinciding with the close of the lengthy Heinrich 4 period of extreme cold encompassing the CI super-eruption, suggests that climatic changes may have contributed to this migration. Eastern Europe in particular would have been less habitable between 40,000 and 38,000 years ago, and existing IUP populations within Europe may have contracted, as attested by the disappearance of European Neanderthals<sup>36</sup>, the scarcity of human settlements, and the reduction of forest cover and ungulate populations during this time<sup>7,47</sup>. Gradually increasing temperatures towards the end of the Heinrich Event 4 and the onset of the warmer Greenland Interstadial 8 (~38,000–35,000 BP)<sup>7,8</sup> would favor northward population expansions from refuges in the south<sup>26</sup>.

The population change in Europe during this period is also highlighted by the introduction of EUP lithic innovations and cultural practices. Backed blades and bladelet industries begin to appear in Europe<sup>48,49</sup>, different from the Levallois blade production techniques characteristic of the IUP<sup>50</sup>, accompanied by an increased diversity in the raw materials incorporated into personal adornments and portable art<sup>12,48</sup>. An awareness of past population dynamics can deepen the interpretation of the existing archeological record and assist in reconstructing the development and dispersal processes of technologies and artefacts associated with these populations. In this light, it is compelling to contrast the genetic similarities between the BuKa3 group and KremsWA with the similarities between the backed-blade and micro-laminar lithics associated with these remains, as well as the collection of cultural artefacts found at Buran-

Kaya III and contemporary sites in the Caucasus, with Gravettian assemblages appearing later in central Europe. With such a large gap in the archeological record between these sites, in both time and geography, it is difficult to estimate the degree to which these similarities may be due to a continuity of EUP practices at Buran-Kaya III being maintained through tradition in descendant communities over thousands of years. On the other hand, given the interactions between MUP groups in Europe documented through genetic exchange, it is easy to imagine multiple paths through which technical innovations can be communicated across Europe. Similar local and climate-specific functional requirements may also play a role in the correlation of lithic industries<sup>24</sup>. Addressing the links between central European Gravettian assemblages and the EUP backed microblade industries of Buran-Kaya III and the northern Caucasus, and perhaps also by extension the Early Ahmarian of the Levant as previously suggested<sup>26</sup>, may complement our growing understanding of EUP population movements into Europe.

## **Methods**

#### Dating

All radiocarbon dates were recalibrated using the software OxCal v4.4.4 based on the IntCal20 calibration data set<sup>51</sup>. The calibrated dates are rounded to 5.

#### Sample handling, DNA extraction, library construction, and sequencing

Three human parietal fragments were excavated aseptically or semi-aseptically from layer 6-1 and 6-2 during the 2009 excavation season at Buran-Kaya III. All pre-amplification sample preparation was performed in the dedicated ancient DNA facility using decontamination and clean-room protocols as described in Bennett, *et al.*<sup>52</sup>. All buffers and solutions were prepared using water decontaminated by gamma-irradiation (8 kGy). The surface of the bone was wiped three times with a cotton tip soaked in water, then bleach, then water again, and a small part was removed using a flame-sterilized diamond-disc of a Dremel saw (Dremel, Europe, The Netherlands). Bone fragments were then ground to fine powder in a 6775 Freezer/Mill®Spex SamplePrep in liquid nitrogen as described previously<sup>32</sup>. Powder from each sampling was divided into two equal portions, one of which was subject to a bleach treatment with a 1:20 dilution of hypochlorite followed by a washing step with water, as described<sup>27</sup>. Phosphate buffer washes, described in Korlević<sup>27</sup>, were collected and combined for DNA purification. Both

phosphate and non-phosphate buffer treated samples, including reagent-only mocks, were then incubated in 1.5 mL LoBind microcentrifuge tubes (Eppendorf, Hamburg, Germany) with 1 mL 0.5M EDTA, pH 8.0 (Sigma-Aldrich, St. Louis, MO), with 0.25mg/mL proteinase K (Sigma-Aldrich), 0.14M beta-mercaptoethanol and 0.05% UV-irradiated Tween-20 (Sigma-Aldrich), at 37°C for 24 H. This step was repeated for another 24 H and the two fractions were pooled. Following incubation, all tubes were centrifuged at maximum speed for 10 min, and 1 mL supernatant was mixed with 10 times its volume of "2M70" binding buffer (2M guanidine hydrochloride and 70% isopropanol) in a 15 mL tube and passed through QIAquick silica columns (Qiagen, Hilden, Germany) using 25 mL tube extenders (Qiagen) and a vacuum manifold (Qiagen) as described<sup>52</sup>. 2M70 binding buffer has been shown to retain the smaller DNA fragments lost during purification with traditional binding buffers<sup>28</sup>. Columns were washed twice with 1 mL PE Buffer (Qiagen) then transferred to a micro-centrifuge and dried by spinning 1 minute at  $16,100 \times g$ , turning tubes 180° and repeating. DNA was eluted in a total of 60 µl of 10mM EBT (Tris-HCl pH 8.0 containing 0.05% Tween-20) performed in two elution steps of 30 µl each, by spinning  $16,100 \times g$  for 1 minute after a 5-minutes incubation. The second 1 mL of extract was purified according to the same protocol but using 5M40 "binding buffer" (5M guanidine hydrochloride and 40% isopropanol). 5M40 binding buffer has been shown to remove more inhibitors than the 2M70 binding buffer but to result in a higher loss of smaller DNA molecules<sup>28</sup>.

For the first series of screening steps, single-stranded libraries were constructed using either 2  $\mu$ L (for screening) or 6  $\mu$ L (for mitochondrial capture) of the eluted DNA, including mocks of all treatments, water only samples, and a positive control oligo following the protocol of Gansauge, *et al.*<sup>53</sup> using the splinter oligonucleotide TL110, and eluting in 50  $\mu$ L EBT. Either 40  $\mu$ L (for mitochondrial capture) or 4  $\mu$ L (for screening) of each library was used for bar-coding amplification using dual-barcoded single-stranded library adapters<sup>54</sup> as primers in the following 100  $\mu$ L volume reaction: 10  $\mu$ L 10x PCR Buffer + MgCl<sub>2</sub> (Roche, Basel, Switzerland) 0.4  $\mu$ M of each primer, 80  $\mu$ M dNTPs (Roche), and 15 units of FastStart Taq (Roche). Reactions were heated 95°C for 5 minutes, followed by 35 cycles of 95°C 20 s, 53°C for 45 s, 68°C for 45 s, and then 68°C for 5 minutes. Heteroduplexes that could confound size selection were resolved by diluting the PCR product 1:5 in a 100  $\mu$ L reaction containing 20  $\mu$ L of the initial reaction, 8  $\mu$ l PCR Buffer + MgCl<sub>2</sub>, 0.4  $\mu$ M of standard Illumina primers P5 and P7, and 80  $\mu$ M dNTPs, and amplified a single cycle of 95°C for 1 minute, 60°C for 2 minutes and 68°C for 5 minutes. Products were then purified and size-selected using NucleoMag beads (Macherey-Nagel, Düren, Germany) for two rounds of purification/size selection according to the supplied

protocol at a ratio of bead solution 1.3 times the reaction volume and eluted in 30 µl EBT. Purified libraries were quantified using a Nanodrop ND-1000 spectrophotometer (Thermo Fisher Scientific, Waltham, Massachusetts, USA), Bioanalyzer2100 (Agilent, Santa Clara, California, USA), Qubit 2.0 Fluorometer (Thermo Fisher Scientific), and qPCR reaction. 46 to 148 ng of DNA were enriched for human mitochondrial sequence in two rounds of capture using 1200 ng of biotinylated RNA baits reverse transcribed from human mitochondrial PCR products<sup>32</sup> following the protocol described in Massilani et al.<sup>55</sup> but with four changes: (1) for hybridization and wash steps, 60°C was used instead of 62°C. (2) DNA/RNA-bait solution was incubated 96 hours instead of 48 hours. (3) Elution of the bead-bound enriched DNA was performed with a 5 minute incubation in 30 µL EBT at 95°C followed by a magnetic bead separation and the transfer of the eluate to a new tube rather than a 0.1N NaOH elution followed by silica column purification. (4) All post-capture amplifications were performed for 35 cycles followed by a heteroduplex resolution step as described above. Enriched DNA was then quantified as above, and products from all libraries were pooled in equimolar amounts and sequenced on an Illumina MiSeq using a v3 reagent kit for 2x76 cycles, substituting primer CL72 for the Read1 sequencing primer as described<sup>54</sup>.

Eight additional libraries along with positive and negative controls were made from 3-8 µL each of the remaining extract BuKa3A\_4B, which had the highest relative endogenous DNA content. It should be noted that this extract was derived from the portion of the cranial fragment which included the cranial suture. Libraries were prepared as described above except one library was first treated with USER enzyme (New England Biolabs, Ipswich, Massachusetts, USA) for 30 minutes to remove deaminated cytosine damage. Prior to the barcoding amplification, a 6-cycle amplification of pre-barcoded libraries was performed using 45 µL of each library with 45 µL OneTaq 2X Master Mix with Standard Buffer (New England Biolabs), and 0.1µM internal primers CL72<sup>54</sup> and CL130<sup>53</sup> with the above PCR conditions. Three pairs of different dual-barcoded adapters were then used to amplify 20 µL of each amplified library, followed by purification and size selection as described above, which allowed the later pooling of two different enrichment protocols and non-enriched DNA from the same library. An average of 1.2 µg of DNA to 1 µg RNA-baits was used for each mitochondrial enrichment, as above, however, an additional alternative "touch-down" hybridization protocol consisting of 60°C for 12 h, 59°C for 12 h, 58°C for 12 h, 57°C for 12 h, and 56°C for 48 h was tested for each library. For selected libraries, an alternative wash protocol described in Fu et al.40 was also tested. Neither of these alternative protocols had a substantial impact on the results obtained. Enriched and shotgun libraries were then pooled separately and size selected on an E-Gel

SizeSelect 2% agarose gel (Thermo Fisher). Enriched libraries were then sequenced on an Illumina MiSeq, as above, and shotgun libraries were sequenced on an Illumina NextSeq 500/550 High Output Kit v2 (2x75 cycles). The shotgun libraries were further gel-purified on a 6% polyacrylamide gel and sequenced again on the NextSeq as above.

Additional libraries from fresh extractions of BuKa3A and BuKa3C samples were constructed using 6 µL of extract and the NEBNext Ultra II DNA Library Prep Kit for Illumina (NEB, Ipswich, MA, USA) after a pretreatment with USER enzyme mix (NEB, Ipswich, MA, USA) as described by the manufacturer. An unindexed Y-shaped adapter was ligated, the ligated libraries were first amplified for 8 cycles with the Illumina Rd1 and Rd2 sequencing primers, then 20% of the library was further amplified for 12 cycles with Illumina unique dual indexed adapter primers. The libraries were purified independently using 1.3 volume of SPRI beads (Macherey-Nagel™ NucleoMag™ NGS Clean-up and Size Select) for two successive rounds of purification followed after pooling of three successive rounds of purification with SPRI beads as above. Sequencing was performed on an Illumina NovaSeq 6000 sequencer in paired-end mode.

#### **Processing of Sequencing Data**

All data processing steps were performed using shell instructions and in-house written scripts. Demultiplexing and fastq conversion of the raw output of Illumina sequencers in the BCL format was performed using bcl2fastq (Illumina). Sequence quality was assessed using (https://www.bioinformatics.babraham.ac.uk/projects/fastqc/). Paired-end reads FastOC were merged and trimmed for adapters using leeHom<sup>56</sup>. Reads larger than 28 base pairs (bp) were selected using awk and mapped onto the Human Reference Genome hs37d5 using BWA (Burrows-Wheeler Aligner) version 0.7.17<sup>57</sup> with a seed length of 18. A minimum length of 28 bp was chosen following analysis to identify the size limit minimizing spurious mapping reads following the approach described in<sup>58</sup> (Fig. S8). Aligned sequences in BAM format were processed with Samtools v.1.9.59 to create index files and flagstat reports, and to select and sort mapped reads. Picard tools (http://broadinstitute.github.io/picard/) was used to remove duplicates. Multiple libraries were first merged by Samtools v.1.9, followed by filtering for mapping quality (-q 20). Reads smaller than 35 bp containing indels were then removed using an awk script to minimize spurious alignments<sup>60</sup>. Damage patterns were analyzed using  $v.2.2.1^{61}$ mapDamage (Fig. **S**9) followed by end-clipping using BamUtil (https://genome.sph.umich.edu/wiki/BamUtil:\_trimBam). According to the damage pattern,

three to four bases at the ends of each read were clipped for the UDG-treated libraries and 10 bases for non-UDG treated libraries. Library details are given in Table S6.

#### Sex Identification, Uniparental Haplogroups and Contamination Estimation

The sex of the BuKa individuals was determined by chromosome counting using Qualimap 2<sup>62</sup> and Samtools v.1.9 idxstats using reads mapped with a mapping quality higher than 20. Haplogrep263 and Haplocheck<sup>30</sup> were used to classify the mitochondrial haplogroups and to estimate the contamination level. Schmutzi<sup>29</sup> was additionally used to estimate contamination of the higher coverage mitochondrial reads of BuKa3A. Mitochondrial haplogroups were verified manually. A Bayesian tree of 35 ancient, 1 modern and 2 canonical mitochondrial sequences, excluding the hypervariable regions, was constructed using MrBayes (v3.2.6)<sup>64</sup> using a HKY+i+G nucleotide substitution model, which gave the highest log-likelihood for the tree out of all models tested (GTR and HKY with all combinations of four invariant sites and gamma distributions) using JModelTest2 (v2.1.10)<sup>65</sup>. The chain was run for 1,100,000 iterations, subsampled every 200 after discarding a 9% burn-in period and visualized using FigTree v. 1.4.4 (http://tree.bio.ed.ac.uk/software/figtree). A list of sources for the mitochondrial sequences is given in Table S7. Y chromosome haplogroups analysis was performed with a subset of reads mapping to the Y chromosome with a mapping quality 37 or above, and with the terminal two bases trimmed from each end. Y haplogroups were determined by placing alleles onto reference phylogenies to find the lowest supported downstream node using Pathphynder<sup>66</sup>.

#### **Dataset Preparation and Population Genetics Analyses**

In order to prepare a SNP panel, the GRCh38/hg38 genomic coordinates of genotype calls coming from 929 publicly available genomes (ftp://ngs.sanger.ac.uk/production/hgdp)<sup>38</sup> were lifted over the assembly of GRCh37/hg19 by using Picard tool (http://broadinstitute.github.io/picard/) UCSC liftOver based the tool on (http://genome.ucsc.edu/cgi-bin/hgLiftOver). The variants coming from repetitive regions of the human genome were filtered out with BEDTools<sup>67</sup> from genotype calls that were lifted over. The heterozygous positions from extracted Western Eurasian and Mbuti populations were filtered by removing the singletons from each population, which resulted in ~13 million biallelic autosomal variants. ~740,000 positions that overlapped with at least one of the BuKa3 genomes were used to curate a 740k SNP panel with a psesudo-haploid SNP calling approach of each

ancient genome using pileupCaller (https://github.com/stschiff/sequenceTools). The curation of another SNP panel was carried out for BuKa genomes by HaplotypeCaller tool in GenomeAnalysisTK v.4.1.9<sup>68</sup> using the variant panel of HGDP 929 genomes which led to  $\sim 1.7$  million biallelic autosomal positions after exclusion of heterozygous positions coming only from BuKa3.

For the Neanderthal ancestry analysis, the gvcf files of three high-coverage Neanderthal genomes, Altai, Vindija33.19, and Chagyrskaya were obtained from the website of the MPI of Evolutionary Anthropology in Leipzig (<u>http://cdna.eva.mpg.de/neandertal/</u>). The three genomes were merged using bcftools 1.9<sup>69</sup>. SNPs that were invariant in any of the Neanderthals and those residing in repeated DNA (as defined by the hg19 repeat mask from https://www.repeatmasker.org/) were removed. The overlapping sites between these positions and the 2200k SNP panel (described in Hajdinjak *et al.*<sup>1</sup>), amounting to 1.3 M sites, were used to call chimp sequences downloaded from ENA PRJEB36949 and mapped onto the hs37d5 human genome using bwa mem<sup>57</sup> deduplicated and filtered for a mapping quality higher than 30. SNP calling was performed using bcftools mpileup (options -B -q30 -Q30) and call (option -m). Five Mbuti genome sequences (SRR1157019, SRR1157021, SRR1157023, SRR1157024, and SRR1157055) were processed in the same way. All vcf files were merged and filtered to remove invariant, missing and multiallelic sites, which left ~800k autosomal positions that were used to call ancient genomes, including the two BuKa individuals. All files were then merged together for the estimation of the Neanderthal ancestry.

The outgroup-f3 and f4 statistics and admixture graph were computed using qp3P, qpDstat and qpGraph programs from the ADMIXTOOLS package (version 5.0)<sup>70</sup>, respectively. The outgroup-f3 statistics were calculated in a pairwise manner in the form of f3(Mbuti;ind1,ind2) for 38 individuals. A distance matrix coming from inverted pairwise values (1-f3) was used to compute Multi-Dimensional Scaling (MDS) analysis (cmdscale package in R). To estimate the Neanderthal ancestry a direct f4-ratio was used in the form of  $\alpha = (Vindija33.19, Chimp;$  $Ancient_test, Mbuti)/(Vindija33.19, Chimp; Chagyrskaya, Mbuti).$ 

#### Data and materials availability

Sequence data generated in this study are available through the NCBI Sequence Read Archive SRA ID PRJNAXX and XXX. The mitochondrial sequences are available through GenBank (accession number MKXXX and XXX).

## **References**

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#### **Author contributions**

EMG, SaP and StP initiated the project. EMG and TG supervised the study. EAB, EMG and TG produced data. OP and EAB performed formal analyses. OP, EAB, TG and EMG interpreted the data. SaP, StP, LC and AY provided samples and information to the archaeological context. EAB wrote the paper with input from all authors.

### **Figures**



Figure 1. Genetic affinities between Buran-Kaya III and other ancient individuals. A, Heatmap showing the shared genetic drift calculated by f3-statistics in the form of f3(Mbuti; BuKa3, ancient test). Higher f3 values indicate greater allele sharing between Buran-Kaya III (BuKa3) and other individuals. The left half of the circles show f3 values tested with BuKa3C and the right side with BuKa3A. Individuals that do not fit on the map due to geographical distance or overlapping locations of archaeological sites are placed as close as

possible to their correct locations. **B**, Multidimensional scaling (MDS) of ancient individuals calculated using the pairwise genetic distance matrix coming from inverted f3 values (1-f3) in the form of f3(Mbuti; ancient1, ancient2). The three main dimensions are represented. Additional angles are visible on Fig. S6. A video of the rotating three dimensional MDS is available as supplementary information (SV1).



Figure 2. Population history of Buran-Kaya III individuals. A, Estimation of admixture graph using qpGraph that models the different waves of AMHs into Europe and their population history. The model has no outlier (highest |Z-score| = 2.6). Hypothetical populations nodes are written in italics. **B**, Genetic affinities within the post-CI cluster using f4-statistics in the form of f4(Mbuti, Goyet Q116-1/Kostenki14/Krems 1283-4/Sunghir3/Vestonice16; BuKa3A/BuKa3C, test\_post-CI). Black outlines indicate |Z-score| >= 2.



Figure 3. Detection of Buran-Kaya III gene-flow events. A, Gene flow from an Oase1-like population into BuKa3, tested using f4 statistics in the form of f4(Mbuti, BuKa3A/BuKa3C; Oase1, IUP). IUP represents individuals dating before ~40,000 cal BP. **B**, Genetic affinities and possible gene flow from Oase1-like population to BuKa3 tested using f4 statistics in the form of f4(Mbuti, BuKa3A/BuKa3C; Oase1, EUP/MUP). EUP/MUP represents individuals dating between ~39 – 30,000 cal BP. Neanderthal alleles from recent admixture were masked in Oase1. **C**, Genetic affinities between BuKa3 and the CHG cluster tested using f4 statistics in the form of f4(Mbuti, CHG; BuKa3A/BuKa3C, EUP/MUP). CHG represented by Kotias and Satsurblia individuals. Each test is highlighted with heatmap of Z-score values. Black outlines indicate |Z-score| >= 2.

#### Supplementary Information pdf file:

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Figure S2. Bayesian phylogenetic tree of mitochondrial sequences

Figure S3. Positions for BuKa3C, Oase1 and BK\_F6-620 (Bacho Kiro) on Y chromosome tree

Figure S4. Neanderthal ancestry calculated for ancient individuals

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**Fig. S8.** Observed ratio of mismatches to the reference sequence by read length (in bp) of Buran-Kaya III libraries

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Supplementary Video SV1: Rotating 3D MDS scatterplot featured in Figure 1B

Table S2. References for genomes used in this analysis

**Table S7.** References for mitochondrial sequences

**Supplementary Text 1**: Buran-Kaya III site, chronological, cultural and anthropological information

Supplementary Text 2: Strategy of collection and sampling protocol

#### Supplementary excel tables:

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### **Supplementary Information**

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**Figure S1. Recalibration of comparative AMS** <sup>14</sup>**C dates of Buran-Kaya III,** layers 6-1 and 6-2 with Upper Paleolithic samples. All dates were recalibrated using the software OxCal v4.4.4 based on the IntCal20 calibration data set. Climatic events are represented by the orange band, the Campanian Ignimbrite (CI) volcanic super eruption event by the darker orange band, the Heinrich Event 4 by the lighter orange band.





**Figure S2**. **Bayesian phylogenetic tree of mitochondrial sequences**, excluding Hyper-Variable Regions, from Early and Mid-Upper Palaeolithic individuals including those from Buran-Kaya III (red). Posterior probability indicated at the nodes. Scale bar denotes substitutions per site. Sources for mitochondrial sequences are listed in Table S3. Additional ancient and canonical N sequences are included to give branching details. Inset gives detailed mutation information from mtphyl v.5.003 (https://sites.google.com/site/mtphyl/home) for both BuKa3 individuals. References for mitochondrial sequences are given in Table S7.



**Figure S3. Positions for BuKa3C, Oase1 and BK\_F6-620 (Bacho Kiro) on Y chromosome tree** following Best Path analysis of pathPhynder<sup>1</sup>. Green points on the tree show the numbers of supporting markers and red points, the numbers of non-supporting markers for the given branches for BuKa3C. Numbers following the sample names give supporting and non-supporting marker counts, respectively, for designations above the current branch followed by those for the current branch.



**Figure S4. Neanderthal ancestry calculated for ancient individuals** using direct f4-ratio test<sup>2</sup>. α values calculated in the form of (Vindija33.19, Chimp; Ancient\_test, Mbuti)/(Vindija33.19, Chimp; Chagyrskaya, Mbuti).



Figure S5: Genetic affinities between Buran Kaya III and present-day populations. Heatmap showing the shared genetic drift calculated by f3-statistics in the form of f3(Mbuti; BuKa3, modern). Higher f3 values indicate greater allele sharing between Buran Kaya III (BuKa3) and populations from HGDP dataset. The left half of the circles shows f3 values tested with BuKa3C while right side show those tested with BuKa3A.



Figure S6. Additional angles of the 3D MDS scatterplot featured in Figure 1.



Figure S7. Multidimensional scaling (MDS) calculated using the pairwise genetic distance matrix coming from inverted f3 values (1-f3) in the form of f3(Mbuti; ancient1, ancient2), for high-covered individuals older than 30,000 years only, showing the attraction between BuKa3A and a group consisting of Oase1 and Zlatý Kůň. Recent Neanderthal admixture regions have been masked for Oase1.



**Fig. S8. Observed ratio of mismatches to the reference sequence by read length (in bp) of Buran Kaya III libraries**. The increase mismatch percentage of shorter reads over the average of longer reads shows the rate of spurious mapping of shorter fragments. For Buran Kaya III libraries, this rate was 1.39% for reads 28-34 bp compared to an average of 1.32% for reads 35-60 bp.



Figure S9. Terminal damage patterns for different BuKa3 library treatments,

ss= single stranded, ds= double stranded libraries. UDG= Uracil-DNA Glycosylase.

# Supplementary Text 1. Buran Kaya III site, chronological, cultural and anthropological information

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#### Chronological, cultural context and settlement patterns

Buran-Kaya III is a rock shelter located on the eastern part of Crimea, in the Belogorsk region, in the middle basin of the Burulcha River (4 km south from the city of Aromatne). This site was discovered in 1990 by A. Yanevich and excavated initially until 2001 by a team directed by A. Yanevich (Neolithic to Palaeolithic layers) and A. Marks (Middle and Early Upper Palaeolithic layers) with the participation of V. Chabai, Y. Demidenko, K. Monigal, M. Otte and Y. Yamada, followed by new fieldwork conducted by A. Yanevich and S. Péan between 2009 and 2011. This rockshelter unearthed an exceptional stratigraphic sequence from the Middle Palaeolithic to the Neolithic which lead to multiple studies<sup>9,10,50–71</sup>.

Buran-Kaya III is a key site for understanding the Middle to Upper Palaeolithic transition and the arrival and dispersal of Anatomical Modern Humans (AMHs) in Europe as well their potential biological and/or cultural interactions with Neanderthals. During the excavation season of 2001 and 2009-2011, this site has yielded a Middle Palaeolithic layer (Micoquian, Kiik-Koba type, layer B), located unexpectedly above an Early Upper Paleolithic layer (Streletskian or eastern Szeletian, layer C) and below three Aurignacian layers (layers 6-5 to 6-3), followed by three Gravettian layers (layers 6-2, 6-1 and 5-2) and one Swiderian layer (layer 4), all densely layered across 1 to 2 meters of depth. The stratigraphical and radiochronological analyses<sup>10</sup> had emphasized an early chronological framework for the Middle to Upper Paleolithic period in southeastern Europe. These studies show the presence of Early Upper Paleolithic (early Streletskian or eastern Szeletian, layer C) populations in Crimea, before 40.0 ka cal BP confirming a previous dating of 44.2-39.2 ka cal BP (36.7  $\pm$  1500 ka BP, OxA-6868) of the Streletskaya or eastern Szeletian layer<sup>52</sup> and providing early evidence of this transitional industry. Based on the new radiocarbon dates, the late Middle Palaeolithic settlements (Micoquian layer, layer B) range between 35,390 + 290/-270 (GrA-47319) and  $37,700 \pm 900$  BP<sup>10</sup> (OxA-25879) (43.2-39.9 cal BP), showing that no Neanderthal settlements occurred at Buran-Kaya III after the Campanian Ignimbrite eruption around 39 ka cal BP. The two Upper Paleolithic cultural traditions, related to the Aurignacian and Gravettian complexes (layers 6-5 to 5-2), were successively present in Crimea during a relatively short time span between 38.7 and 34.4 ka cal BP. During the following period of about 20,000 years, no depositional processes occurred or were preserved and the site was presumed abandoned. The Final Paleolithic populations (Swiderian, layer 4) settled in Crimea between 11.8 and 11.3 ka cal BP, i.e. during MIS 1.

The layers 6-2, 6-1 and 5-2 yielded a large collection of human remains, and, during the 2001 field season, more than 28,000 lithic remains, representing a large spectrum of tool types (e.g. burins, end-scrapers, and backed microliths). The lithic industries exhibited a high percentage of microliths (more than 80%) and some microgravettes<sup>68</sup>, which are consistent with the Gravettian technocomplex. They do not present Dufour or pseudo-Dufour blades, often associated with Aurignacian technocomplex, which are present in layer 6-3, 6-4 and 6-5, stratigraphically located below<sup>68</sup>. As shown by the sedimentological and stratigraphic analyses conducted by S. Puaud during the 2009 and 2010 field seasons, there is continuity in the stratigraphic sequence from the lower layers (Aurignacian technocomplex: 6-5, 6-4, 6-3) to the upper layers (Gravettian technocomplex: 6-2, 6-1 and 5-2). The attribution of the upper layers to the Gravettian tradition is free from material sedimentary overlap.

The ornaments excavated from the layers 5-2, 6-1 and 6-2 consist of perforated mollusc shells, fox and red deer teeth, perforated mammoth ivory pendants and a thin blade of mammoth tusk ivory with engraved "meander". Concerning the bone industry, more than 60 bone tools have been discovered in the Gravettian layers corresponding to projectile points, awls, arrowheads, and assegai points<sup>68</sup>. The bone industry was probably imported from another site of production as indicated by the absence of manufacturing waste. This evidence, combined with the zooarchaeological results<sup>66</sup>, suggests a pattern of recurrent short-term occupations, such as seasonal hunting or temporary butchery camps, associated with exploitation of small or medium-sized mammals, such as saiga antelope (the main game exploited in these layers). The settlement of AMHs associated with the Gravettian layers of Buran-Kaya III occurred under interstadial climatic conditions, which became cooler and drier leading to an open steppe environment. The open and steppe-like periglacial environment, with a local transition zone between steppes and mountains located on the migration path of several species, provided a

diversified faunal spectrum (e.g., saiga antelope, hare, red and polar foxes, reindeer, woolly rhinoceros, marmot, wild cat and brown bear)<sup>10,66,70</sup>. The micromammal and palynological analyses<sup>58,72</sup> reveal a steppe environment with a climatic evolution towards an increasing aridity as recorded in the mammalian sequence. In the layer 6-2, the climate was relatively cold, but not harsh, and relatively dry. The climatic conditions recorded in layer 6-1, which yielded the most diversified faunal spectrum of the sequence, became significantly drier than before, with less-contrasting seasons.

#### Human remains

At Buran-Kaya III, more than 160 human remains were discovered in three welldocumented Gravettian layers (6-2, 6-1 and 5-2). Two of them unearthed from layer 6-1 and 6-2 have been directly dated to 31,900+240/-220 BP (36.7-35.7 ka cal BP), layer 6-1 (GrA-37938)<sup>9</sup>, and 32,450 +250/-230 BP (37.4-36.2 ka cal BP), layer 6-2 (GrA-50457)<sup>10</sup> (Table S1). They are among the oldest direct evidence of AMHs in Europe in a well-documented archaeological context (Gravettian sensu lato)<sup>9,10</sup>. The specimens from Buran-Kaya III represent, together with Bacho Kiro, Bulgaria (BK CC7-335: 42,450 +/-510 BP, 45.9-44.4 ka cal BP (ETH-86772); BK\_BB7-240: 41,850 +/- 480 BP, 45.5-43.9 ka cal BP(ETH-86770)<sup>4</sup>, Kostenki-Borshchevo, Russia (Kostenki 14: 33,250 +/-500 BP; 39.4-36.7 ka cal BP)<sup>8</sup>, and Peştera cu Oase, Romania (Oase 1: 34,290 +970/-870 BP, 41.8-36.9 ka cal BP, GrA-22810, 34,950 BP (combined age: 41.8-37.9 ka cal BP))<sup>6</sup> (Table S1), the earliest occurrence of AMHs in Eastern Europe. AMHs occurred later in Western Europe, e.g., at Goyet Cave in Belgium (Goyet Q116-1: 30,880 +170-160 BP; 35.6-34.7 ka cal BP, GrA-46175)11, in Russia, e.g., at Sunghir (Sunghir SI: 28,890 +/- 430 BP; 34.2-32.0 ka cal BP, OxA-X-2464-12; Sunghir SII: 30,100+/-550; 35.8-33.4 ka cal BP, OxA-A-2395-6; Sunghir SIII: 30,000 +/-550 BP; 35.6-33.3 ka cal BP, OxA-X-2395-7; Sunghir SIV: 29820 +/- 280 BP; 34.8-33.7 ka cal BP, OxA-X-2462-52)<sup>8,18</sup> and in the Czech Republic e.g., at Dolní Věstonice (Dolní Věstonice 16, associated with Gravettian tradition: 25,740 +/-210 BP (on charcoal); 30.4-29.3 ka cal BP, GrN-15277)<sup>8</sup> (Table S1).

Layer 6-1 has yielded the richest assemblage of human specimens with 150 highly fragmented remains (mostly cranial parts and teeth (95%) and several hand phalanges), corresponding to at least five individuals<sup>67</sup>. Due to the fragmentation of the remains, the taxonomic assignment as AMH could only be performed on an occipital bone fragment and the permanent teeth. Based on the combinations of morphological features on these anatomical

elements (Figure S11) (namely, absence of an occipital "bun" or a bilaterally transverse torus; lack of a well-developed metaconid and a transverse crest on the lower premolars; lack of shovelling, labial convexity and the presence of well-developed lingual tubercles on the upper first incisors; the lack of a well-developed mid-trigonid crest and a large anterior fovea on the lower molars), these individuals from layer 6-1 are allocated to AMHs<sup>9,70</sup>.

Isotopic analyses of bone collagen revealed that the diet of these individuals consisted mainly of terrestrial resources, mammoth meat playing a preponderant role in the protein intake, and of plant consumption<sup>69</sup>.

Among the human remains from the layer 6-1 (2001, 2009 and 2010 field seasons), only a few bones exhibit human modifications, such as cut marks. The human skulls were intentionally selected in association with post-mortem treatments of the corpses (ritual cannibalism or a specific mortuary practice, such as post-mortem disarticulation processing of corpses for secondary disposal)<sup>9,66,70</sup>. Based on these taphonomic observations, the specimens from layer 6-1 represent the oldest Upper Palaeolithic AMHs from Eastern Europe showing post-mortem treatment of the corpses.



**Figure S10** Remains from Buran-Kaya III (layer 6-1). From left to right, a) occipital bone; b) right lower second molar; c) right first upper incisor. Scale bar = 1 cm; photos © L.Crépin/S. Prat.

#### Supplementary Text 2: Strategy of collection and sampling protocol

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The excavations performed between 2009 and 2011 incorporated a multi-sampling strategy to better contextualize the site of Buran-Kaya III. Sampling for sedimentological, biogeochemical, and radiometric studies were performed on all Gravettian layers, and in 2009, the sampling for the palaeogenomic analyses was carried out focused on the two layers that contained most of the human remains (6-1 and 6-2). To this end, a one half-square meter section was excavated incorporating precautions against contamination: a maximum of two excavators dug the square wearing masks and gloves, and when potential human remains were discovered, one excavator put on a new full body protection suit, including masks and gloves, to perform the removal of the material using new tools (Figure SI3a).

This protocol was maintained over eight days, during which time layers 6-1 and 6-2 were entirely cleared. In total, six bones were identified and inventoried using the described procedure, of which four were certified as human remains after verification: three from layer 6-1 (two cranial fragments and one tooth) and one for layer 6-2 (a cranial fragment). These remains, separated from other archaeological remains, were transferred directly after the mission to the high containment laboratory at the "Institut Jacques Monod" (IJM), where they were analyzed and stored at -20°C. Additionally, all those working on the site during the excavation campaign provided a cheek-swab sample to control for possible contamination of the samples.

The anthropological and taphonomic study of the human remains was then carried out directly in the high containment palaeogenomic laboratory at the IJM using typical precaution measures for ancient DNA research (Figure SI3b). Finally, we decided to carry out the paleogenomics analysis on the bone fragments that we could identified anatomically in an unambiguous manner and that appeared to be the best preserved with a minimum of visible alteration: artefact number N.170, square 9Z, layer 6-1.a, called here *BuKa3A* (Figure S12c) and

artefact number N.473, square 9Z, layer 6-2.a, called here *BuKa3C*. *BuKa3A* is a posterior cranial bone fragment presumably belonging to a mature individual, measuring a maximum of 21 x 19 mm.



**Figure S11.** a) Sampling of human remains during the 2009 excavation season at Buran Kaya III; photo © A. Yanevich. b) Anthropological study of human remains in the high containment laboratory at the IJM; photo © E.M. Geigl. c) Images of the human cranial fragment from 6-1.a, *BuKa3A*, analyzed in the present study, taken under a stereomicroscope (Leica MZ FLIII, PLANAPO 0.63X); photo © E.M. Geigl.



**Figure S12.** *BuKa3C* cranial fragment from square 9Z, layer 6-2.a, taken under a stereomicroscope (Leica MZ FLIII, PLANAPO 0.63X); photo © E.M. Geigl

Supplementary Table	1. Comparative <sup>14</sup> C dates. All the	dates were calibrated using the softwar	e OxCal v4.4 based on the	Int Cal2	Okcali	bratio	a set (Reimer et al, 2020). The calibrated dates are r مما RP /۹۴. ۲۰%	ounded	to 5.	K)			
Site Koně prusy cave	Individual Zlatý Kůň	Cultural layer	Reference cultural layer	¹⁴C (BP	) a(+)	σ(-)	low h	ıigh	low	high	Laboratory Code	Material dated	Reference dating
Bacho Kiro Cave	BK_CC7-335	Layer N1-1 : Initial Upper Palaeolithic	Hublin <i>et al.</i> , 2020 <sup>4</sup>	42450	510	510	45925 44	4425	46646	44066	ETH-86772	Direct date on human remains	-ublin <i>et al.</i> , 2020 <sup>4</sup>
Bacho Kiro Cave		Layer N1-1 : Initial Upper Palaeolithic	Hublin et al., 2020 <sup>4</sup>	41850	480	480	45545 43	3945	45919	43291	ETH-86770	Direct date on human remains H	-ublin <i>et al.</i> , 2020 <sup>4</sup>
Ust-Ishim	Ust-Ishim	No direct cultural association	Fu <i>et <u>al.,</u> 2014<sup>5</sup></i>	41400	1400	1400	47501 42	2557	51244	42185	OxA-30190	Direct date on human remains	u et al., 2014 <sup>5</sup>
Bacho Kiro Cave	BK1653	Layer B: Aurignacian-like	Hublin <i>et al.</i> , 2020 <sup>4</sup>	30570	120	120	35282 34	4616	35405	34490	ETH-86768 AIX-12024	Direct date on human remains	Hublin <i>et al.</i> , 2020 <sup>4</sup>
1				34 290	970	870	41350 36	6960			GrA-22810		
reștera cu Oase	Uase1	NO DIFECT CULTURAL ASSOCIATION	i rinka us <i>et ar., 2</i> 003	34950	006	068	41858 37	7862	42425	30849	Combined age	Direct date on numan remains	Irinkaus <i>et al.,</i> 2003
Kostenki (Martina	Vortanui 11	No direct cultural accordation	Seguin-Orlando et al.,	22.250	5	ŝ	37000	6675	20075	0000	0~A-V-330E-1E	Direct date on human remains	
Gora)	Kostenki 14	No direct cultural association	20147	33250	500	500	39375	6675	39945	36220	OxA-X-2395-15	Direct date on human remains	Marom <i>et al.</i> , 2012 <sup>8</sup>
Buran-Kaya III	BuKa3A	Layer 6-1 Gravettian	Prat <i>et al</i> ., 2011 <sup>9</sup>	31900	240	220	36839 35	5684	37041	35409	GrA-37938	Direct date on human remains	<sup>p</sup> rat <i>et al</i> ., 2011 <sup>9</sup>
Buran-Kaya III	BuKa3C	Layer 6-2 Gravettian	Péan <i>et al .</i> , 2013 <sup>10</sup>	32450	250	230	37415 36	6245	38107	36047	GrA-50457	Direct date on human remains	<sup>5</sup> éan <i>et al</i> ., 2013 <sup>10</sup>
Goyet	Goyet Q116-1	No direct cultural association	Posth <i>et al</i> ., 2016 <sup>11</sup>	08805	170	160	35630 34	4720	35976	34602	GrA-46175	Direct date on human remains F	<sup>2</sup> osth <i>et al</i> ., 2016 <sup>11</sup>
		Late Sungirian	For the whole site : Late Sungirian: (Bader, 1978 <sup>12</sup> ; Vassilyev et al., 2017 <sup>13</sup> ) Late Streletskian:										
,	,	or Eastern Gravettian	Bradley et al., 1995 <sup>-,-</sup> , Marom et al., 2012 <sup>8</sup> ) <b>Eastern Gravettian:</b> (Pettit and Bader, 2000 <sup>16</sup> ; Dobrovolskaya et al., 2012 <sup>17</sup> )										
Peştera Mulerii	Muierii 1	No direct cultural association	Soficaru et al., 2006 <sup>19</sup>	29930	170	170	34682 34	4120	35070	33915	OxA-15529	Direct date on human remains s	oficaru et al., 200619
Dolní Věstonice II	DV 16	Gravettian (evolved Pavlovian)	Trinkaus & Svoboda, 2006 <sup>20</sup>	25740	210	210	30432	9282	30810	29224	GrN-15277	Associated charcoal	Trinkaus et Svoboda, 2006 <sup>20</sup>
Krems-Wachtberg	Krems-Wachtberg 12483/12484	Gravettian (Pavlovian)	Einwögerer <i>et al.,</i> 2006 <sup>21</sup>				,000 (IntCal 13-) 31,700 cal BP (CalPal2007HULU )					2	Teschler-Nicola <i>et al</i> ., 2020 <sup>22</sup>
Krems-Wachtberg	Krems-Wachtberg 12483/12484	Gravetti an (Pavlovian)	Einwögerer <i>et al.,</i> 2006 <sup>21</sup>	26520	210	200	31110 30	0310	31179	30111	VERA-3819	4 Associated charcoal (burial 1) 2	Einwögerer <i>et al.,</i> ?006 <sup>21</sup>
Tianyuan Cave	Tianyuan	No direct cultural association	Shang <i>et al.</i> , 2007 <sup>23</sup>	34430	510	510	40845 38	8079	41217	37418	BA-03222		Shang et al ., 2007 <sup>23</sup>
Satsurblia	Satsurblia	Eastern Epigravettian	Pinhasi, R. et al. , 2014 <sup>24</sup>	11415	50	50	13410 13	3174	13460	13160	OxA-34632	Direct date on human remains	ones et al. , 2015 <sup>25</sup>
*Radiocarbon dating on the The authors also found bovi	Z latý Kūň sk ull yie kled incohe rent re sults ine DNA in the skull extra ct and concludes	s (12,870 $\pm$ 70 years bp; GrA-13696; 23,080 $\pm$ 80 ys d that it was probably treated with a nimal glue, whi	ears bp; MAM S-36077; 15,537 ± incohen	65 y ears ent 14C-d	bp; OxA ates. Th	-38602 3refore	50 ± 650 years bp; O xA-38022). ku∥ was dated using Bay esian tip da ting of the mitochondria I DNA	sequence	produced. This a	pproach	suggested that Zlatý kůň live	d∼43 ka (95% highest posterior density = :	31.5–52.6 ka (Prüfer et al., 2021 <sup>3</sup> ).
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Péan, S., Puaud, S., Cr Pettitt, P. B. & Bader, Posth, C. et al. Pleisto Pinhasi, R. et al. Satsu Prat, S. et al. The Olde	Épin, L., Prat, S., Quiles, A., Van d N. O. Direct AMS radiocarbon da zene Mitochondrial Genomes Sug rblia: new insights of human res rst Anatomically Modern Humans	ler Plicht, J., Valladas, H., J. Stuart, A., Dr tes for the Sungir mid Upper Paleaolithic ggest a Single Major Dispersal of Non-Af ponse and survival across the Last Glacia s from Far Southeast Europe: Direct Dath	ucker, D., Patou-Mathis, M : burials. Antiquity 74, 269- ricans and a Late Glacial P I Maxi mum in the souther I Maxi mum in the souther 1g, Culture and Behavior. P	., Lanoë -270 (20 opulatic n Cauca LoS ON	, F., Y: )00). n Turr sus. Pl E 6, e2	anevic Iover I IoS Or 0834	The Middle to Upper Paleolithic Sequence of Buran-K rope. Current Biology 26, 827–833 (2016). e111271 (2014). 1).	Kaya III (	Crimea, Ukrai	nе): Ne	ew Stratigraphic, Paleoe	invironmental, and Chronological.	Results. Radiocarbon, 55(3),
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AT_Gra_KremsWA12483-4	Teschler-Nikola, et al. <sup>22</sup>
BE_Mag_GoyetQ2	Fu, <i>et al</i> . <sup>26</sup>
BE_UP_GoyetQ116-1	Fu, <i>et al</i> . <sup>26</sup>
BG_IUP_BK_CC7-335	Hajdinjak, et al. <sup>27</sup>
BG_IUP_BK_F6-620	Hajdinjak, et al. <sup>27</sup>
BG_UP_BK-1653	Hajdinjak, et al. <sup>27</sup>
BuKa3A	This study
BuKa3C	This study
CH_Meso_Bichon	Jones, et al. <sup>25</sup>
CN_UP_Tianyuan	Fu, <i>et al</i> . <sup>28</sup>
CZ_Gra_Vestonice16	Fu, <i>et al</i> . <sup>26</sup>
CZ_IUP_ZKU002	Prüfer, et al. <sup>3</sup>
ES_Mag_ElMiron	Fu, <i>et al</i> . <sup>26</sup>
ES_Meso_Canes	Gonzalez-Fortes, et al. <sup>29</sup>
ES_Meso_Chan	Gonzalez-Fortes, et al. <sup>29</sup>
ES_Meso_LaBrana	Olalde, et al. <sup>30</sup>
FR_Meso_PER503	Brunel, et al. <sup>31</sup>
GE_EpiPal_Saturblia	Jones, <i>et al.</i> <sup>25</sup>
GE_Meso_Kotias	Jones, <i>et al.</i> <sup>25</sup>
HU_HG_KO1	Gamba, et al. <sup>32</sup>
IR_Neo_AH1	Broushaki, et al. <sup>33</sup>
IT_EpiGra_Tagliente2	Bortolini, et al. <sup>34</sup>
IT_EpiGra_Villabruna	Fu, <i>et al</i> . <sup>26</sup>
IT_Meso_R15	Antonio, <i>et al</i> . <sup>35</sup>
JO_Neo_BAJOD	Feldman, et al. <sup>36</sup>
LU_Meso_Loschbour	Jones, <i>et al</i> . <sup>25</sup>
LV_Meso_ZVEJ25	Jones, et al. <sup>25</sup>
RO_IUP_Oase1	Fu, <i>et al</i> . <sup>37</sup>
RO_Meso_SC2	Gonzalez-Fortes, et al. <sup>29</sup>
RO_UP_Muierii	Svensson, et al. <sup>38</sup>
RU_IUP_Ust-Ishim	Fu, et al. <sup>5</sup>
RU_MA1	Raghavan, <i>et al</i> . <sup>39</sup>
RU_Meso_Karelia	Raghavan, <i>et al</i> . <sup>39</sup>
RU_UP_Kostenki14	Seguin-Orlando, et al. <sup>7</sup>
RU_UP_Sunghir3	Sikora, <i>et al</i> . <sup>40</sup>
SE_Meso_Motala12	Lazaridis, <i>et al</i> . <sup>41</sup>
TR_EpiPal_Pinarbasi	Feldman, <i>et al.</i> <sup>36</sup>
TR_Neo_Bar8	Hofmanová, <i>et al</i> . <sup>42</sup>
TR_Neo_Bon	Kılınç, <i>et al</i> . <sup>43</sup>

Table S2. References for genomes used in this analysis

Ancient1	Ancient2	Outgroup	f3	std err	z	SNPs
BuKa3A	AT Gra Krems 12483/4	Mbuti	0.253	0.008	30.2	12501
BuKa3A	BE Aur Govet0116-1	Mbuti	0.260	0.008	31.8	12911
BuKa3A	BE Mag GovetO2	Mbuti	0 245	0.008	31.6	11365
Bulka2A		Mbuti	0,243	0,006	26.2	22049
BuKa2A		Mbuti	0,214	0,000	24.2	21295
BuKaSA		Mbuti	0,208	0,000	34,2	21385
DUKd SA	BG_IUP_BK_F0-020	Nabuti	0,201	0,005	36,4	21225
BUKa3A	BG_UP_BK-1653	Nibuti	0,236	0,006	41,8	31235
BUKa3A	CH_IVIESO_BICHON	Mbuti	0,221	0,004	56,0	82289
BUKa3A	CN_IOP_ITanyuan	Mbuti	0,213	0,007	31,7	20273
BUKA3A		IVIbuti	0,245	0,007	33,6	15961
BuKa3A		Mbuti	0,204	0,004	52,4	77014
BuKa3A	DE_Meso_BDB001	Mbuti	0,234	0,007	33,2	16988
BuKa3A	ES_Mag_ElMiron	Mbuti	0,243	0,008	30,0	12350
BuKa3A	ES_Meso_Canes	Mbuti	0,227	0,004	51,6	44891
BuKa3A	ES_Meso_Chan	Mbuti	0,218	0,004	51,9	56642
BuKa3A	ES_Meso_LaBrana	Mbuti	0,220	0,004	55,8	/1521
BuKa3A	FR_Meso_PER503	Mbuti	0,214	0,006	35,9	22294
BuKa3A	GE_EpiPal_Satsurblia	Mbuti	0,221	0,004	54,0	56849
BuKa3A	HU_HG_KO1	Mbuti	0,218	0,004	56,5	81551
BuKa3A	IE_Meso_SRA62	Mbuti	0,217	0,004	55,2	82926
BuKa3A	IR_Neo_AH1	Mbuti	0,220	0,004	52,9	56150
BuKa3A	IT_EpiGra_Tagliente2	Mbuti	0,232	0,007	34,3	18445
BuKa3A	IT_EpiGra_Villabruna	Mbuti	0,245	0,006	38,7	20749
BuKa3A	IT_Meso_R15	Mbuti	0,224	0,004	55,8	79667
BuKa3A	JU_Neo_BAJ00	Mbuti	0,225	0,011	21,0	7174
BuKa3A	LU_Meso_Loschbour	Mbuti	0,218	0,004	54,0	82881
BuKa3A	LV_Meso_ZVEJ25	Mbuti	0,226	0,004	56,0	78125
BuKa3A	LV_Meso_ZVEJ32	Mbuti	0,226	0,005	48,1	50356
BuKa3A	RO_IUP_Oase1	Mbuti	0,226	0,009	25,9	9363
BuKa3A	RO_Meso_OC1	Mbuti	0,218	0,004	50,3	63276
BuKa3A	RO_Meso_SC2	Mbuti	0,223	0,004	52,5	74452
BuKa3A	RO_UP_Muierii	Mbuti	0,230	0,004	56,3	82647
BuKa3A	RU_IUP_Ust_Ishim	Mbuti	0,193	0,004	48,4	83103
BuKa3A	RU_MA1	Mbuti	0,217	0,004	53,1	62792
BuKa3A	RU_Meso_Karelia	Mbuti	0,218	0,004	52,3	68187
BuKa3A	RU_UP_Kostenki14	Mbuti	0,234	0,005	48,1	43670
BuKa3A	RU_UP_Sunghir3	Mbuti	0,224	0,004	55,1	82545
BuKa3A	SE_Meso_Motala12	Mbuti	0,216	0,004	53,9	74865
BuKa3A	TR_EpiPal_Pinarbasi	Mbuti	0,218	0,007	31,8	17462
BuKa3A	TR_Neo_Bar8	Mbuti	0,220	0,004	58,1	81905
BuKa3A	TR Neo Bon	Mbuti	0,219	0,004	56,9	78374
BuKa3C	AT_Gra_Krems I2483/4	Mbuti	0,258	0,006	42,3	26825
BuKa3C	BE_Aur_GoyetQ116-1	Mbuti	0,253	0,006	42,2	27700
BuKa3C	BE_Mag_GoyetQ2	Mbuti	0,234	0,006	36,9	24555
BuKa3C	BG_IUP_BB7-240	Mbuti	0,203	0,004	45,2	49534
BuKa3C	BG_IUP_BK_CC7-335	Mbuti	0,210	0,005	45,3	45880
BuKa3C	BG_IUP_BK_F6-620	Mbuti	0,194	0,004	48,3	76001
BuKa3C	BG_UP_BK-1653	Mbuti	0,233	0,004	52,0	66764
BuKa3C	CH_Meso_Bichon	Mbuti	0,220	0,004	62,3	178363
BuKa3C	CN_IUP_Tianyuan	Mbuti	0,199	0,005	43,3	43345
BuKa3C	CZ_Gra_Vestonice16	Mbuti	0,235	0,005	45,9	34597
BuKa3C	CZ_IUP_ZKU002	Mbuti	0,196	0,004	56,0	166815
BuKa3C	DE_Meso_BDB001	Mbuti	0,228	0,005	42,7	36575
BuKa3C	ES_Mag_ElMiron	Mbuti	0,240	0,006	39,5	26512
BuKa3C	ES_Meso_Canes	Mbuti	0,226	0,004	61,2	95557
BuKa3C	ES_Meso_Chan	Mbuti	0,221	0,004	61,4	121867
BuKa3C	ES_Meso_LaBrana	Mbuti	0,221	0,004	62,6	154393
BuKa3C	FR_Meso_PER503	Mbuti	0,218	0,005	44,6	47806
BuKa3C	GE_EpiPal_Satsurblia	Mbuti	0,215	0,004	60,8	122965
BuKa3C	HU_HG_KO1	Mbuti	0,220	0,003	63,6	176760
BuKa3C	IE_Meso_SRA62	Mbuti	0,218	0,003	62,5	179784
BuKa3C	IR_Neo_AH1	Mbuti	0,211	0,004	58,3	121256
BuKa3C	IT_EpiGra_Tagliente2	Mbuti	0,220	0,005	43,8	40054
BuKa3C	IT_EpiGra_Villabruna	Mbuti	0,231	0,005	47,1	44357
BuKa3C	IT_Meso_R15	Mbuti	0,225	0,003	66,5	172898
BuKa3C	JO_Neo_BAJ00	Mbuti	0,219	0,008	28,1	15476
BuKa3C	LU_Meso_Loschbour	Mbuti	0,221	0,004	62,7	179891
BuKa3C	LV_Meso_ZVEJ25	Mbuti	0,223	0,003	66,3	169204
BuKa3C	LV_Meso_ZVEJ32	Mbuti	0,221	0,004	58,2	109868
BuKa3C	RO_IUP_Oase1	Mbuti	0,203	0,006	33,9	20018
BuKa3C	RO_Meso_OC1	Mbuti	0,218	0,003	62,3	137418
BuKa3C	RO_Meso_SC2	Mbuti	0,221	0,003	64,0	161626
BuKa3C	RO_UP_Muierii	Mbuti	0,227	0,004	62,0	178949
BuKa3C	RU_IUP_Ust_Ishim	Mbuti	0,197	0,003	57,5	179888
BuKa3C	RU_MA1	Mbuti	0,214	0,004	60,4	135990
BuKa3C	RU_Meso_Karelia	Mbuti	0,217	0,004	59,6	148432
BuKa3C	RU_UP_Kostenki14	Mbuti	0,243	0,004	59 <i>,</i> 0	93744
BuKa3C	RU_UP_Sunghir3	Mbuti	0,228	0,004	63,2	178544
BuKa3C	SE_Meso_Motala12	Mbuti	0,217	0,004	61,0	162284
BuKa3C	TR_EpiPal_Pinarbasi	Mbuti	0,220	0,005	41,5	37960
BuKa3C	TR_Neo_Bar8	Mbuti	0,214	0,004	61,0	177423
BuKa3C	TR Neo Bon	Mbuti	0,210	0,003	63,1	169617

Table S3. Summary of outgroup f3 statistics in the form of f3(Mbuti; Ancient1, Ancient2)

Table S4. St W	mmary of f4 X (BuKa)	statistics in the form of f4(U Y	P, UP; BuKa3C, Mbuti) and f4( Z	UP,UP; CHG, f4	Mbuti) stderr	Zscore	snps
Mbuti	BuKa3A BuKa3A	BE_UP_GovetQ116-1 BE_UP_GovetQ116-1	RU_UP_Kostenki14 BG_UP_BK-1653	-0,00254	0,001461	-1,739	24840
Mbuti	BuKa3A	BE_UP_GovetQ116-1	RU_UP_Sunghir3	-0,004763	0,001471	-3,239	26470
Mbuti Mbuti	BuKa3A BuKa3A	BE_UP_GovetQ116-1 BE_UP_GovetQ116-1	RO_UP_Muierii CZ Gra Vestonice16	-0,001281 -0.001247	0,00138	-0,929	26454
Mbuti	BuKa3A	BE UP GoyetQ116-1	AT_Gra_Krems 12483/4	-0,000565	0,001857	-0,304	17342
Mbuti Mbuti	BuKa3A BuKa3A	BE_UP_GoyetQ116-1 BE_UP_GoyetQ116-1	BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620	-0,009175	0,00186	-4,932	23669
Mbuti	BuKa3A	BE_UP_GoyetQ116-1	CZ_IUP_ZKU002	-0,00587	0,001485	-3,953	25279
Mbuti Mbuti	BuKa3A BuKa3A	BE_UP_GovetQ116-1 BE_UP_GovetQ116-1	RO_IUP_Oase1 CN_IUP_Tianyuan	-0,004814	0,002415	-1,993	9400
Mbuti	BuKa3A	BE_UP_GoyetQ116-1	RU_IUP_Ust_Ishim	-0,008476	0,001535	-5,523	26471
Mbuti	BuKa3C	BE_UP_GoyetQ116-1	BG_UP_BK-1653	-0,002118	0,001142	-1,189	48237
Mbuti	BuKa3C BuKa3C	BE_UP_GovetQ116-1 BE_UP_GovetQ116-1	RU_UP_Sunghir3 RO_UP_Mujerij	-0,001432	0,001137	-1,26	55805
Mbuti	BuKa3C	BE_UP_GoyetQ116-1	CZ_Gra_Vestonice16	-0,001212	0,001343	-0,903	36138
Mbuti Mbuti	BuKa3C BuKa3C	BE_UP_GoyetQ116-1 BE_UP_GoyetQ116-1	AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335	0,001128	0,001345	0,838	36444 37035
Mbuti	BuKa3C	BE_UP_GoyetQ116-1	BG_IUP_BK_F6-620	-0,009363	0,001183	-7,915	49982
Mbuti	BuKa3C BuKa3C	BE_UP_GovetQ116-1 BE_UP_GovetQ116-1	RO_IUP_Oase1	-0,006905	0,001091	-6,328	19515
Mbuti	BuKa3C	BE_UP_GoyetQ116-1	CN_IUP_Tianyuan	-0,00921	0,001427	-6,455	38100
Mbuti	BuKa3A	RU_UP_Kostenki14	BE_UP_GoyetQ116-1	0,007287	0,001067	1,739	24840
Mbuti	BuKa3A	RU_UP_Kostenki14	BG_UP_BK-1653	-0,000577	0,000933	-0,618	64853
Mbuti	BuKa3A	RU_UP_Kostenki14	RO_UP_Muierii	-0,000085	0,000652	-0,131	114034
Mbuti Mbuti	BuKa3A BuKa3A	RU_UP_Kostenki14 RU_UP_Kostenki14	CZ_Gra_Vestonice16 AT Gra Krems I2483/4	0,001428	0,001181	1,209	34751 24273
Mbuti	BuKa3A	RU_UP_Kostenki14	BG_IUP_BK_CC7-335	-0,006373	0,001135	-5,616	44137
Mbuti Mbuti	BuKa3A BuKa3A	RU_UP_Kostenki14 RU_UP_Kostenki14	BG_IUP_BK_F6-620 CZ_IUP_ZKU002	-0,005574	0,000923	-6,04	72312
Mbuti	BuKa3A	RU_UP_Kostenki14	RO_IUP_Oase1	-0,002669	0,00156	-1,711	18897
Mbuti	BuKa3A BuKa3A	RU_UP_Kostenki14	RU_IUP_Ust_Ishim	-0,005504	0,0001284	-8,063	114128
Mbuti Mbuti	BuKa3C BuKa3C	RU_UP_Kostenki14 RU_UP_Kostenki14	BE_UP_GoyetQ116-1 BG_UP_BK-1653	-0,002118	0,001142	-1,855	52366 136458
Mbuti	BuKa3C	RU_UP_Kostenki14	RU_UP_Sunghir3	-0,001626	0,000586	-2,777	240037
Mbuti	BuKa3C BuKa3C	RU_UP_Kostenki14 RU_UP_Kostenki14	CZ_Gra_Vestonice16	-0,001698	0,000525	-3,235	73333
Mbuti	BuKa3C	RU_UP_Kostenki14	AT_Gra_Krems 12483/4	-0,000392	0,001201	-0,326	51291
Mbuti	BuKa3C BuKa3C	RU_UP_Kostenki14	BG_IUP_BK_F6-620	-0,008725	0,000741	-11,779	152251
Mbuti	BuKa3C BuKa3C	RU_UP_Kostenki14 RU_UP_Kostenki14	CZ_IUP_ZKU002 RO_IUP_Oase1	-0,005903	0,000567	-10,417	228051 39470
Mbuti	BuKa3C	RU_UP_Kostenki14	CN_IUP_Tianyuan	-0,009507	0,001032	-9,209	77474
Mbuti Mbuti	BuKa3C BuKa3A	RU UP Kostenki14 BG_UP_BK-1653	RU IUP Ust Ishim BE_UP_GoyetQ116-1	0,002636	0,000557	-11,864 1,678	240013 22818
Mbuti	BuKa3A	BG_UP_BK-1653	RU_UP_Kostenki14	0,000577	0,000933	0,618	64853
Mbuti	BuKa3A	BG_UP_BK-1653	RO_UP_Muierii	0,000155	0,000853	1,256	73076
Mbuti Mbuti	BuKa3A BuKa3A	BG_UP_BK-1653 BG_UP_BK-1653	CZ_Gra_Vestonice16 AT_Gra_Krems (2483/4	0,001845	0,001281	1,44	31235
Mbuti	BuKa3A	BG_UP_BK-1653	BG IUP BK CC7-335	-0,004859	0,001107	4,389	40378
Mbuti Mbuti	BuKa3A BuKa3A	BG_UP_BK-1653 BG_UP_BK-1653	BG_IUP_BK_F6-620 CZ_IUP_ZKU002	-0,005766	0,000984	-5,862	62250 69845
Mbuti	BuKa3A	BG_UP_BK-1653	RO_IUP_Oase1	-0,001878	0,001668	-1,125	17922
Mbuti	BuKa3A BuKa3A	BG_UP_BK-1653 BG_UP_BK-1653	RU_IUP_Lianyuan RU_IUP_Ust_Ishim	-u,004677 -0,005691	0,001371	-3,411	34910 73152
Mbuti Mbuti	BuKa3C BuKa3C	BG_UP_BK-1653 BG_UP_BK-1653	BE_UP_GoyetQ116-1 BU_UP_Kostenki14	0,001375	0,001156	1,189	48237
Mbuti	BuKa3C	BG_UP_BK-1653	RU_UP_Sunghir3	0,002225	0,000664	3,169 0,19	150458
Mbuti Mbuti	BuKa3C BuKa3C	BG_UP_BK-1653 BG_UP_BK-1653	RO_UP_Muierii CZ_Gra_Vestonice16	0,000843	0,000643	1,311	154049 66035
Mbuti	BuKa3C	BG_UP_BK-1653	AT_Gra_Krems 12483/4	0,002812	0,001191	2,362	47195
Mbuti Mbuti	BuKa3C BuKa3C	BG_UP_BK-1653 BG_UP_BK-1653	BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620	-0,003784 -0,006667	0,00088	-4,302 -8.57	84849 131156
Mbuti	BuKa3C	BG_UP_BK-1653 BG_UP_BK-1653	CZ_IUP_ZKU002 BO_IUP_Care1	-0,004791	0,00067	-7,149	147073
Mbuti	BuKa3C	BG_UP_BK-1653	CN_IUP_Tianyuan	-0,00429 -0,007143	0,001252	-3,428 -6,873	3/477 73725
Mbuti	BuKa3C	BG UP BK-1653 BU UP Supphir2	RU IUP Ust Ishim	-0,005425	0,000687	-7,901	154170
Mbuti	BuKa3A	RU_UP_Sunghir3	RU_UP_Kostenki14	0,0004763	0,000674	3,239	26470
Mbuti Mbuti	BuKa3A BuKa3A	RU_UP_Sunghir3 RU_UP_Sunghir3	BG_UP_BK-1653 RO UP Mujerij	-0,000155 0.000812	0,000853	-0,182	73147
Mbuti	BuKa3A	RU_UP_Sunghir3	CZ Gra Vestonice16	0,001876	0,001152	1,628	36075
Mbuti	BuKa3A BuKa3A	RU_UP_Sunghir3 RU_UP_Sunghir3	BG_IUP_BK_CC7-335	0,003953 -0,004341	0,001568	2,521	25857 48803
Mbuti Mbuti	BuKa3A BuKa3A	RU_UP_Sunghir3 RU_UP_Sunghir3	BG_IUP_BK_F6-620 CZ_IUP_ZKII002	-0,005228	0,000855	-6,111	84887 22040P
Mbuti	BuKa3A BuKa3A	RU_UP_Sunghir3	RO_IUP_Oase1	-0,002488	0,000498	-1,554	19981
Mbuti	BuKa3A BuKa3A	RU_UP_Sunghir3 BU_UP_Sunghir3	CN_IUP_Tianyuan RU_IUP_Ust_Ishim	-0,003756	0,001294	-2,904	39844 240819
Mbuti	BuKa3C	RU_UP_Sunghir3	BE_UP_GoyetQ116-1	0,001432	0,001137	1,26	55805
Mbuti Mbuti	BuKa3C BuKa3C	RU_UP_Sunghir3 RU_UP_Sunghir3	RU_UP_Kostenki14 BG_UP_BK-1653	0,001626	0,000586	2,777	240037
Mbuti	BuKa3C	RU_UP_Sunghir3 RU_UP_Sunghir3	RO_UP_Mulerii	-0,000212	0,000429	-0,496	509422
Mbuti	BuKa3C	RU_UP_Sunghir3	AT_Gra_Krems I2483/4	0,000378	0,000893	2,347	54538
Mbuti Mbuti	BuKa3C BuKa3C	RU_UP_Sunghir3 RU_UP_Sunghir3	BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620	-0,004175	0,00081 0,000695	-5,157 -9 0R1	102848
Mbuti	BuKa3C	RU_UP_Sunghir3	CZ_IUP_ZKU002	-0,004181	0,00044	-9,5	484935
Mbuti Mbuti	BuKa3C BuKa3C	RU_UP_Sunghir3 RU_UP_Sunghir3	RO_IUP_Oase1 CN_IUP_Tianyuan	-0,005024	0,001193 0,001006	-4,21	41729 84092
Mbuti	BuKa3C	RU UP Sunghir3	RU IUP Ust Ishim	-0,004232	0,000452	-9,363	509794
Mbuti	BuKa3A BuKa3A	RO_UP_Mulerii RO_UP_Mulerii	RU_UP_Kostenki14	0,001281	0,00138	0,929	114034
Mbuti	BuKa3A	RO_UP_Muierii RO_UR_Muierii	BG_UP_BK-1653	-0,001037	0,000825	-1,256	73076
Mbuti	BuKa3A	RO_UP_Muierii	CZ_Gra_Vestonice16	0,000655	0,001169	0,56	36051
Mbuti Mbuti	BuKa3A BuKa3A	RO_UP_Muierii RO_UP_Muierii	AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335	0,001312	0,001481	-4,474	25843 48738
Mbuti	BuKa3A	RO_UP_Mulerii	BG_IUP_BK_F6-620	-0,005967	0,0008	-7,461	84811
Mbuti	BuKa3A BuKa3A	RO_UP_Mulerii RO_UP_Mulerii	RO_IUP_Oase1	-0,003283	0,000484	-2,615	19958
Mbuti	BuKa3A	RO_UP_Muierii RO_UR_Muierii	CN_IUP_Tianyuan	-0,006136	0,0013	-4,721	39797
Mbuti	BuKa3C	RO_UP_Mulerii	BE_UP_GoyetQ116-1	0,00128	0,001091	1,173	55769
Mbuti Mbuti	BuKa3C BuKa3C	RO_UP_Muierii RO_UP_Muierii	RU_UP_Kostenki14 BG_UP_BK-1653	0,001698	0,000525	3,235	239822
Mbuti	BuKa3C	RO_UP_Muierii	RU_UP_Sunghir3	0,000212	0,000429	0,496	509422
Mbuti	BuKa3C	RO_UP_Mulerii	AT_Gra_Krems I2483/4	0,001816	0,001094	1,66	54498
Mbuti	BuKa3C	RO_UP_Muierii RO_UP_Muierii	BG_IUP_BK_CC7-335	-0,00487	0,000788	-6,177	102749
Mbuti	BuKa3C	RO_UP_Mulerii	CZ_IUP_ZKU002	-0,003872	0,000425	-9,101	484459
Mbuti Mbuti	BuKa3C BuKa3C	RO_UP_Muierii RO_UP_Muierii	RO_IUP_Oase1 CN_IUP_Tianyuan	-0,005853 -0,007917	0,001123	-5,212	41682 84001
Mbuti	BuKa3C	RO UP Mulerii	RU IUP Ust Ishim	-0,004036	0,000409	-9,879	509345
Mbuti	BuKa3A	CZ_Gra_Vestonice16	RU_UP_Kostenki14	-0,001247	0,001789	0,697 -1,209	34751
Mbuti Mbuti	BuKa3A BuKa3A	CZ_Gra_Vestonice16 CZ_Gra_Vestonice16	BG_UP_BK-1653 BU_UP_Sunghir3	-0,001845	0,001281	-1,44	31235
Mbuti	BuKa3A	CZ_Gra_Vestonice16	RO_UP_Muierii	-0,000655	0,001169	-0,56	36051
Mbuti	ouKa3A BuKa3A	CZ_Gra_Vestonice16	BG_IUP_BK_CC7-335	-0,000425 -0,007498	0,001688 0,001584	-0,252 -4,733	16736 23604
Mbuti	BuKa3A	CZ_Gra_Vestonice16	BG_IUP_BK_F6-620	-0,00671	0,001366	-4,912	32384
Mbuti	BuKa3A	CZ_Gra_Vestonice16	RO_IUP_Oase1	-0,003859	0,001251	-3,085	11880
Mbuti Mbuti	BuKa3A BuKa3A	CZ_Gra_Vestonice16 CZ_Gra_Vestonice16	CN_IUP_Tianyuan RU_IUP_Ust_Ishim	-0,006975 -0,006641	0,001713 0,001254	-4,072 -5,296	20720 36077
Mbuti	BuKa3C	CZ_Gra_Vestonice16	BE_UP_GoyetQ116-1	0,001212	0,001343	0,903	36138
Mbuti	BuKa3C	CZ_Gra_Vestonice16	BG_UP_BK-1653	-0,0002031	0,000912	-0,256	/3333 66035
Mbuti Mbuti	BuKa3C BuKa3C	CZ_Gra_Vestonice16 CZ_Gra_Vestonice16	RU_UP_Sunghir3 RO_UP_Muierii	0,000378	0,000893	0,423	76127
Mbuti	BuKa3C	CZ_Gra_Vestonice16	AT_Gra_Krems 12483/4	0,001222	0,001242	0,984	35443
Mbuti	BuKa3C BuKa3C	CZ_Gra_Vestonice16	BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620	-u,004738 -0,007059	0,001105	-4,289 -7,32	49850 68424
Mbuti Mbuti	BuKa3C BuKa3C	CZ_Gra_Vestonice16 CZ_Gra_Vestonice16	CZ_IUP_ZKU002 RO_IUP_Dase1	-0,004725	0,0009	-5,249	72071
Mbuti	BuKa3C	CZ_Gra_Vestonice16	CN_IUP_Tianyuan	-0,00875	0,001238	-7,071	43539
Mbuti Mbuti	BuKa3C BuKa3A	Lz Gra Vestonice16 AT_Gra_Krems I2483/4	KU IUP Ust Ishim BE_UP_GoyetQ116-1	-0,005682 0,000565	0,000945	-6,015	76112
Mbuti	BuKa3A	AT_Gra_Krems 12483/4	RU_UP_Kostenki14 BG_UP_RF-1652	-0,00263	0,001507	-1,745	24273
Mbuti	BuKa3A	AT_Gra_Krems 12483/4	RU_UP_Sunghir3	-0,002391	0,001568	-1,492	25857
Mbuti Mbuti	BuKa3A BuKa3A	AT_Gra_Krems 12483/4 AT_Gra_Krems 12483/4	RO_UP_Muierii CZ_Gra_Vestonice16	-0,001312 0,000475	0,001481 0,001689	-0,886	25843 16736
Mbuti	BuKa3A	AT_Gra_Krems I2483/4	BG IUP BK CC7-335	-0,008083	0,001957	-4,13	17313
Mbuti	BuKa3A BuKa3A	AT_Gra_Krems I2483/4 AT_Gra_Krems I2483/4	CZ_IUP_ZKU002	-u,008593 -0,005592	0,001701	-5,053 -3,603	23048 24709
Mbuti Mbuti	BuKa3A BuKa3A	AT_Gra_Krems 12483/4 AT_Gra_Krems 12483/4	RO_IUP_Oase1	-0,00288	0,002534	-1,137	9218
Mbuti	BuKa3A	AT_Gra_Krems 12483/4	RU_IUP_Ust_Ishim	-0,0073	0,001553	-4,702	25860
Mbuti Mbuti	BuKa3C BuKa3C	AT_Gra_Krems 12483/4 AT_Gra_Krems 12483/4	BE_UP_GoyetQ116-1 RU_UP_Kostenki14	-0,001128 0,00039?	0,001345	-0,838	36444 51291
Mbuti	BuKa3C	AT_Gra_Krems 12483/4	BG_UP_BK-1653	-0,002812	0,001191	-2,362	47195
Mbuti	BuKa3C	AT_Gra_Krems 12483/4	RO_UP_Muierii	-0,00262 -0,001816	0,001117	-2,347	54538 54498
Mbuti Mbuti	BuKa3C BuKa3C	AT Gra Krems 12483/4 AT Gra Krems 12483/4	CZ_Gra_Vestonice16 BG_IUP_BK_CC7-335	-0,001222	0,001242	-0,984	35443 36346
Mbuti	BuKa3C	AT_Gra_Krems 12483/4	BG_IUP_BK_F6-620	-0,009877	0,001269	-7,785	48830
Mbuti Mbuti	BuKa3C BuKa3C	AT_Gra_Krems 12483/4 AT_Gra_Krems 12483/4	CZ_IUP_ZKU002 RO_IUP_Oase1	-0,008081 -0,008865	0,001044 0,001838	-7,741	52032 19101
Mbuti	BuKa3C	AT Gra Krems 12483/4	CN_IUP_Tianyuan	-0,010747	0,001454	-7,389	37805
Mbuti	BuKa3A	BG_IUP_BK_CC7-335	BE_UP_GoyetQ116-1	0,009175	0,001178	-8,123 4,932	54530 17717
Mbuti	BuKa3A BuKa2A	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	RU_UP_Kostenki14 BG_UP_BK-1652	0,006373	0,001135	5,616	44137
Mbuti	BuKa3A	BG_IUP_BK_CC7-335	RU_UP_Sunghir3	0,004859	0,001107	4,389 4,234	40378 48803
Mbuti Mbuti	BuKa3A BuKa3A	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	KU_UP_Muierii CZ_Gra_Vestonice16	0,00461 0,007498	0,00103 0,001584	4,474	48738 23604
Mbuti	BuKa3A	BG_IUP_BK_CC7-335	AT_Gra_Krems 12483/4	0,008083	0,001957	4,13	17313
Mbuti	BuKa3A	BG_IUP_BK_CC7-335	CZ_IUP_ZKU002	0,000684	0,001022	-u,868 0,695	42913 46893
Mbuti Mbuti	BuKa3A BuKa3A	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	RO_IUP_Oase1 CN_IUP_Tianvuan	0,004535	0,001863	2,434	14039 26610
Mbuti	BuKa3A	BG_IUP_BK_CC7-335	RU_IUP_Ust_Ishim	-0,000229	0,001031	-0,222	48798
Mbuti Mbuti	BuKa3C BuKa3C	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	BE_UP_GoyetQ116-1 RU_UP_Kostenki14	0,005526	0,001272	4,346 8.269	37035 92939
Mbuti	BuKa3C	BG IUP BK CC7-335	BG_UP_BK-1653 BU_UP_Sunabir2	0,003784	0,00088	4,302	84849
Mbuti	BuKa3C	BG_IUP_BK_CC7-335	RO_UP_Mulerii	0,004175	0,00081	5,157 6,177	102848
Mbuti Mbuti	BuKa3C BuKa3C	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	CZ_Gra_Vestonice16 AT_Gra_Krems I2483/4	0,004738 0,007679	0,001105	4,289	49850 36346
Mbuti	BuKa3C	BG IUP BK CC7-335	BG IUP BK F6-620	-0,00175	0,000777	-2,252	90550
Mbuti	BuKa3C	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	RO_IUP_Oase1	-0,001363 -0,001365	0,000738	-1,846	98658 29113
Mbuti Mbuti	BuKa3C BuKa3C	BG_IUP_BK_CC7-335 BG_IUP_BK_CC7-335	LN_IUP_Tianyuan RU IUP_Ust_Ishim	-0,001955 -0,001417	0,001097	-1,782	55722 102839
Mouti	Bull 2A	BG IUP BK 56-620	BE UR CountOl16-1	0.009583	0.001598	5 996	23669

Mbuti	BuKa3A	BG_IUP_BK_F6-620		0.000074	0.000922	6.04	723
Mbuti	8-17-24	BC 1110 BY 56-620	RU_UP_Kostenki14	0,005766	0,000984	5.962	622
Mbuti	BuKa3A	BG_IUP_BK_F6-620	RU_UP_Sunghir3	0,005228	0,000855	6,111	848
Mbuti Mbuti	BuKa3A BuKa3A	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	CZ_Gra_Vestonice16	0,005967	0,0008	7,461 4,912	323
Mbuti Mbuti	BuKa3A BuKa3A	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	AT_Gra_Krems I2483/4 BG_IUP_BK_CC7-335	0,008593	0,001701	5,053	230
Mbuti	BuKa3A	BG_IUP_BK_F6-620	CZ_IUP_ZKU002	0,001168	0,000817	1,43	810
Mbuti Mbuti	BuKa3A BuKa3A	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	RO_IUP_Oase1 CN_IUP_Tianyuan	0,005093 0,000864	0,001624 0,001296	3,135 0,667	186
Mbuti	BuKa3A BuKa3C	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	RU_IUP_Ust_Ishim BF_UP_Govert0116-1	-0,000126	0,000844	-0,15	849
Mbuti	BuKa3C	BG_IUP_BK_F6-620	RU_UP_Kostenki14	0,008725	0,000741	11,779	1522
Mbuti Mbuti	BuKa3C BuKa3C	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	BG_UP_BK-1653 RU UP Sunghir3	0,006667	0,000778	8,57 9,081	1311
Mbuti	BuKa3C	BG_IUP_BK_F6-620	RO_UP_Muierii	0,006359	0,000675	9,421	1791
Mbuti Mbuti	BuKa3C BuKa3C	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	AT_Gra_Krems 12483/4	0,007059	0,000964	7,785	488
Mbuti	BuKa3C	BG_IUP_BK_F6-620	BG_IUP_BK_CC7-335	0,00175	0,000777	2,252	905
Mbuti	BuKa3C	BG_IUP_BK_F6-620	RO_IUP_Oase1	0,001156	0,0001218	0,949	389
Mbuti Mbuti	BuKa3C BuKa3C	BG_IUP_BK_F6-620 BG_IUP_BK_F6-620	CN_IUP_Tianyuan RU_IUP_Ust_Ishim	0,000688	0,001006	0,684	772
Mbuti	BuKa3A	CZ_IUP_ZKU002	BE_UP_GoyetQ116-1	0,00587	0,001485	3,953	252
Mbuti	BuKa3A BuKa3A	CZ_IUP_ZKU002	BG_UP_BK-1653	0,003765	0,000692	4,057	1085
Mbuti	BuKa3A	CZ_IUP_ZKU002	RU_UP_Sunghir3	0,002486	0,000498	4,994	2294
Mbuti	BuKa3A	CZ_IUP_ZKU002	CZ_Gra_Vestonice16	0,003859	0,001251	3,085	342
Mbuti Mbuti	BuKa3A BuKa3A	CZ_IUP_ZKU002 CZ_IUP_ZKU002	AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335	0,005592	0,001552	3,603	243
Mbuti	BuKa3A	CZ IUP ZKU002	BG IUP BK F6-620	-0,001168	0,000817	-1,43	810
Mbuti	BuKa3A	CZ_IUP_ZKU002	CN_IUP_Tianyuan	-0,000138	0,001303	-0,151	383
Mbuti Mbuti	BuKa3A BuKa3C	CZ_IUP_ZKU002	RU_IUP_Ust_Ishim BF_UP_Gover0116-1	-0,001558	0,000503	-3,1	2295
Mbuti	BuKa3C	CZ_IUP_ZKU002	RU_UP_Kostenki14	0,005903	0,000567	10,417	2280
Mbuti Mbuti	BuKa3C BuKa3C	CZ_IUP_ZKU002 CZ_IUP_ZKU002	BG_UP_BK-1653 RU_UP_Sunghir3	0,004791 0,004181	0,00067	7,149	4849
Mbuti	BuKa3C	CZ_IUP_ZKU002	RO_UP_Muierii	0,003872	0,000425	9,101	4844
Mbuti	BuKa3C	CZ_IUP_ZKU002	AT_Gra_Krems 12483/4	0,008081	0,001044	7,741	520
Mbuti Mbuti	BuKa3C BuKa3C	CZ_IUP_ZKU002 CZ_IUP_ZKU002	BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620	0,001363	0,000738	1,846	98
Mbuti	BuKa3C	CZ_IUP_ZKU002	RO_IUP_Oase1	0,000242	0,001093	0,221	40
Mbuti	BuKa3C BuKa3C	CZ_IUP_ZKU002	RU IUP Ust Ishim	0,000533	0,000957	-0,557	4841
Mbuti	BuKa3A	RO_IUP_Oase1	BE_UP_GoyetQ116-1	0,004814	0,002415	1,993	9
Mbuti	BuKa3A	RO_IUP_Oase1	BG_UP_BK-1653	0,001878	0,001668	1,125	17
Mbuti Mbuti	BuKa3A BuKa3A	RO_IUP_Oase1 RO_IUP_Oase1	RU_UP_Sunghir3 RO_UP_Mujerij	0,002482	0,001597	2,615	19
Mbuti	BuKa3A	RO_IUP_Oase1	CZ_Gra_Vestonice16	0,003439	0,002093	1,643	11
Mbuti Mbuti	BuKa3A BuKa3A	RO_IUP_Oase1 RO_IUP_Oase1	BG_IUP_BK_CC7-335	-0,00288	0,002534	-2,434	9.
Mbuti	BuKa3A	RO_IUP_Oase1	BG_IUP_BK_F6-620	-0,005093	0,001624	-3,135	18
Mbuti	BuKa3A	RO_IUP_Oase1	CN_IUP_Tianyuan	-0,00238	0,002034	-1,17	13
Mbuti	BuKa3A BuKa3C	RO_IUP_Oase1 RO_IUP_Oase1	BE_UP_GoyetQ116-1	0,007831	0,001631	4,221	19
Mbuti	BuKa3C	RO_IUP_Oase1	RU_UP_Kostenki14	0,008302	0,001219	6,809	39
Mbuti	BuKa3C	RO_IUP_Oase1	RU_UP_Sunghir3	0,005024	0,001193	4,21	41
Mbuti Mbuti	BuKa3C BuKa3C	RO_IUP_Oase1 RO_IUP_Oase1	CZ_Gra_Vestonice16	0,005853	0,001123	5,212 4,82	24
Mbuti	BuKa3C BuKa3C	RO_IUP_Oase1 RO_IUP_Oase1	AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335	0,008865	0,001838	4,823	19
Mbuti	BuKa3C	RO_IUP_Oase1	BG_IUP_BK_F6-620	-0,001156	0,001218	-0,949	38
Mbuti Mbuti	BuKa3C BuKa3C	RO_IUP_Oase1 RO_IUP_Oase1	CZ_IUP_ZKU002 CN_IUP_Tianyuan	-0,000242	0,001093	-0,221	40
Mbuti	BuKa3C	RO IUP Oase1	RU IUP Ust Ishim	-0,001508	0,001121	-1,345	41
Mbuti	BuKa3A	CN_IUP_Tianyuan	RU_UP_Kostenki14	0,005042	0,001264	4,333	36
Mbuti Mbuti	BuKa3A BuKa3A	CN_IUP_Tianyuan CN_IUP_Tianyuan	BG_UP_BK-1653 RU_UP_Sunghir3	0,004677 0,003756	0,001371 0,001294	3,411 2,904	34
Mbuti	BuKa3A	CN_IUP_Tianyuan	RO_UP_Muierii CZ_Gra_Vertenica16	0,006136	0,0013	4,721	39
Mbuti	BuKa3A	CN_IUP_Tianyuan	AT_Gra_Krems 12483/4	0,007558	0,001957	3,862	18
Mbuti Mbuti	BuKa3A BuKa3A	CN_IUP_Tianyuan CN_IUP_Tianyuan	BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620	-0,001036	0,001491 0,001296	-0,695 -0,667	26
Mbuti	BuKa3A	CN_IUP_Tianyuan	RO_IUP_Oase1	0,00238	0,002034	1,17	13
Mbuti	BuKa3A	CN_IUP_Tianyuan	RU_IUP_Ust_Ishim	-0,002001	0,001295	-1,544	39
Mbuti Mbuti	BuKa3C BuKa3C	CN_IUP_Tianyuan CN_IUP_Tianyuan	BE_UP_GoyetQ116-1 RU_UP_Kostenki14	0,00921	0,001427	6,455	38
Mbuti	BuKa3C	CN_IUP_Tianyuan	BG_UP_BK-1653	0,007143	0,001039	6,873	73
Mbuti	BuKa3C	CN_IUP_Tianyuan	RO_UP_Muierii	0,007917	0,000991	7,99	84
Mbuti Mbuti	BuKa3C BuKa3C	CN_IUP_Tianyuan CN_IUP_Tianyuan	CZ_Gra_Vestonice16 AT Gra Krems 12483/4	0,00875 0,010747	0,001238	7,071	43
Mbuti	BuKa3C	CN_IUP_Tianyuan	BG_IUP_BK_CC7-335	0,001955	0,001097	1,782	55
Mbuti	BuKa3C	CN_IUP_Tianyuan	RO_IUP_Oase1	0,001612	0,001519	1,061	27
Mbuti Mbuti	BuKa3C BuKa3C	CN_IUP_Tianyuan	RU_IUP_Ust_Ishim	0,001612	0,001519	0,306	84
Mbuti Mbuti	BuKa3A BuKa3A	RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim	BE_UP_GoyetQ116-1 BU_UP_Kostepki14	0,008476	0,001535	5,523	26
Mbuti	BuKa3A	RU_IUP_Ust_Ishim	BG_UP_BK-1653	0,005691	0,000854	6,662	73
Mbuti	BuKa3A BuKa3A	RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim	RU_UP_Sunghir3 RO_UP_Muierii	0,004056	0,000504	8,046	240
MDUti		011 1110 11 1 1 1	C7 Can Manhamian 16	0.0006641	0.0013E4	5,296	36
Mbuti Mbuti	BuKa3A BuKa3A	RU IUP Ust Ishim	AT Gra Krems 12483/4	0,008841	0.001254	4,702	25
Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A	RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim	AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335	0,000841 0,0073 0,000229	0,001234 0,001553 0,001031	4,702	25 48
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A	RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim RU_IUP_Ust_Ishim	AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620 RO_IUP_Oase1	0,008841 0,0073 0,000229 0,000126 0,003204	0,001234 0,001553 0,001031 0,000844 0,001631	4,702 0,222 0,15 1,965	25 48 84 19
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A	RU_IUP_Ust_Ishim           RU_IUP_Ust_Ishim           RU_IUP_Ust_Ishim           RU_IUP_Ust_Ishim           RU_IUP_Ust_Ishim           RU_IUP_Ust_Ishim           RU_IUP_Ust_Ishim	AT_Gra_Vestonice10 AT_Gra_Krems 12483/4 BG_IUP_BK_CC7-335 BG_IUP_BK_F6-620 RO_IUP_Oase1 RO_IUP_Oase1 ON_IUP_Tannian	0,000229 0,000126 0,003204 0,003204 0,003204	0,001234 0,001553 0,001031 0,000844 0,001631 0,001631	4,702 0,222 0,15 1,965 1,965 1,965	25 48 84 19 19
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C	RU_UUP_Ust_Ishim	L2_G13_VEX.011C218           AT_GTa_Krems 12483/4           BG_IUP_BK_CC7-335           BG_IUP_BK_F6-620           RO_IUP_Oase1           RO_IUP_Oase1           CN_IUP_Tianyuan           BE_UP_GoyetQ116-1	0,003241 0,0073 0,000229 0,000126 0,003204 0,003204 0,003201 0,007267	0,001234 0,001553 0,001031 0,000844 0,001631 0,001295 0,001295	4,702 0,222 0,15 1,965 1,965 1,544 6,814	25 48 84 19 19 39 55
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C	RU JUP Ust Ishim RU JUP Ust Ishim	LC offVELOBICIES           AT_Gra_Krems 12483/4           BG_IUP_BK_CC7-335           BG_IUP_BK_F6-620           RO_IUP_Oase1           CD_IUP_Oase1           CD_IUP_Oase1           CD_IUP_Oase1           RO_UP_Gose1           RU_UP_Kostenki16-1           RU_UP_Kstenki14           BG_UP_BK-1653	0,00364 0,0073 0,000229 0,000126 0,003204 0,003204 0,003204 0,003204 0,003204 0,003204 0,003204	0,001234 0,001553 0,001031 0,000844 0,001631 0,001631 0,001295 0,001067 0,000557 0,000687	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 7,901	25 48 84 19 19 39 55 240 154
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C BuKa3C BuKa3C	RU JUP Ust Ishim RU JUP Ust Ishim	L GI 2 VELORCE12 AT Gra Krems 12483/4 AG ULP BK CC7-335 BG ULP BK CC7-335 BG ULP Qase1 CO JUP Case1 CO JUP Case1 CO JUP Case1 CO JUP Case1 BG ULP BK-1653 RU UP Sunghir3 RU UP Sunghir3 RU UP Sunghir3	0,00841 0,0073 0,000229 0,000126 0,003204 0,003204 0,002001 0,007267 0,006609 0,005425 0,004232	0,001234 0,001553 0,001031 0,000844 0,001631 0,001631 0,001295 0,00167 0,000557 0,000657 0,000452 0,000452	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 7,901 9,363 9,879	25 48 84 19 39 55 240 154 509 509
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C	NU JUP Ust Ishim RU JUP Ust Ishim	C_ Gra_Vestolice194 AT Gra_Krems 12483/4 BG_UUP_BK_CC7-335 BG_UUP_BK_CC7-335 BG_UUP_BK_F6-620 RO_UUP_Oase1 RO_UUP_Oase1 RO_UUP_Oase1 RO_UUP_Case1 BC_UP_GravC116-1 RU_UP_Kostenki14 BG_UP_BK-1653 RU_UP_Sunghir3 RO_UP_Muterii CZ_Gra_Vestonice16 CZ_Gra_Vestonice16	0,000841 0,0073 0,000229 0,000126 0,003204 0,003204 0,003204 0,002001 0,007267 0,006609 0,005682 0,004232 0,004036 0,005682	0,001234 0,001553 0,001031 0,000844 0,001631 0,001631 0,001631 0,001095 0,0010657 0,000657 0,000657 0,000657 0,0006452 0,000452 0,0009452 0,0009452	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 7,901 9,363 9,879 6,015 8,153	255 488 844 19 19 39 55 240 154 509 509 509 509
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C	KU JUP Ust Ishim RU JUP Ust Ishim	L2 dis visibilitz dis AT Gr. Krem 12483/4 BG (JP BK (C7-335 BG (JP BK (F-620 RO (JP Case1 RO (J	0,006641 0,0073 0,000229 0,000126 0,003204 0,003204 0,003204 0,007267 0,006609 0,005425 0,004232 0,004232 0,004036 0,005682 0,0005625 0,000565 0,000565 0,000565 0,000565 0,00055 0,000	0,001254 0,001553 0,001031 0,000844 0,001631 0,001295 0,000167 0,000557 0,000687 0,000452 0,000405 0,000405 0,000409 0,000945	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 7,901 9,363 9,879 6,015 8,123 1,82	25 48 84 19 39 55 240 154 509 509 76 54 54
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C	LU         UP         LSHM           LU         UP         LSHM           RU         UP         LSHM	La Gas (astonica established) Hard Gas (com 2443)4 Hard Gas (com	0,006649 0,000126 0,000126 0,000201 0,000201 0,002001 0,002001 0,0005692 0,004232 0,004036 0,0005682 0,009571 0,0004699 0,005582 0,009571	0,001233 0,001533 0,001631 0,001631 0,001631 0,001631 0,001631 0,000557 0,000657 0,000657 0,000409 0,000945 0,000409 0,000945 0,0001178 0,000799	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 7,901 9,363 9,879 6,015 8,123 1,82 -1,461 1,345	25 48 84 19 19 39 55 240 154 509 76 54 509 76 54 102 179 41
Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C	HU UPU US I Bhim HU UPU US I Bhim	L2         Gar Lemmi 2443)/4           BG         JPL BK C27-335           BG         JPL BK C27-335           BG         JPL BK C27-335           BG         JPL BK C47-335           BG         JPL BK C47-335           BG         JPL BK C47-335           BG         JPL Gase1           BG         JPL Gase1           BG         JPL BK C463           BG         JPL BK C463           BG         JPL BK C463           BG         JPL BK C4620           BG         JPL BK C4623           BG         JPL BK C4620           BG         JPL BK C4620           BG         JPL BK C4620           BG         JPL BK C4620           BG         JPL Gase1           BO         JPL Gase1           BO         JPL Gase1	0,008941 0,0073 0,000126 0,008249 0,008240 0,008240 0,008200 0,007267 0,007267 0,005425 0,004232 0,005425 0,004232 0,005682 0,009571 0,001417 0,000356 0,001508 0,001508	0,001234 0,001533 0,001031 0,00084 0,001631 0,001631 0,001631 0,001067 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000451 0,000945	4,702 0,222 0,15 1,965 1,564 6,814 11,864 6,814 11,864 7,901 9,363 9,879 6,015 8,123 1,82 1,82 1,82 1,461 1,345 1,345 1,345	25 48 84 19 19 39 55 240 154 509 76 54 102 179 41 41 84
Mbuti Mbuti	Butka3A Butka3A Butka3A Butka3A Butka3A Butka3A Butka3A Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C Butka3C	LU         Up Graft, Bahm           LU         UP Graft, Bahm<	Tir Gas Veneto 12483/4           Gi UIP & KC-0-355           BG UIP & Covential           BG UIP & BK-1653           BG UIP & BK-1653           BG UIP & BK-1653           BG UIP & BK-1653           BG UIP & BK-1654           BG UIP Tangea           BG UIP Tangea	0,00384 0,0073 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229	0,001234 0,001533 0,001031 0,000844 0,001631 0,001631 0,001631 0,001057 0,000687 0,000687 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000557 0,0	4,702 0,222 1,965 1,965 1,965 1,965 1,965 1,965 9,879 6,015 8,123 1,822 1,345 1,345 1,345 1,345	25 48 84 19 19 39 55 240 559 509 76 54 102 179 41 41 84
Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C BuKa3C	To UP DO IT MANN TO UP DO IT MANN DO UP DO IT MANN TO UP	TJ Go, Xeres 124834           GL UP BK C7-335           BG, UP BK C7-335           BG, UP BK C7-6320           BG, UP BK C7-6335           BG, UP BK C7-6335           BG, UP BK C7-6320	0,008941 0,0073 0,000229 0,000229 0,003204 0,003204 0,003204 0,007267 0,006609 0,007267 0,006609 0,007425 0,004036 0,005512 0,009571 0,000557 0,000557 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,001508 0,00150 0,00050 0,00150 0,00150 0,00150 0,00150 0,00150 0,00150 0,00150 0,00150 0,00000 0,00150 0,000000 0,0000000 0,00000000 0,000000	0,001234 0,001533 0,001031 0,000831 0,001631 0,001631 0,001255 0,001631 0,001255 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,0001121 0,000124 0,000157 0,000577 0,000557 0,	4,702 0,222 0,15 1,965 1,965 1,544 6,814 1,864 9,861 9,863 9,879 6,015 8,823 1,82 1,845 1,345 1,345 1,345 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,366 2,367 2,	255 4884 849 199 199 555 559 509 766 549 1022 179 411 849 849 849 849 849 849 849 849 849 849
MButi Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C BuKA3C Bu	20 U UP Vol. 2004 20 U UP Vol. 2004 RU VOL	All Gas Green (1831);           All Gas Guern (1831);           Bis Guern (1831);	0,00841 0,0073 0,000229 0,000226 0,000226 0,000226 0,00020 0,003204 0,002267 0,004232 0,004232 0,004232 0,0045425 0,0045425 0,0045425 0,0045425 0,0045425 0,0045425 0,004542 0,000356 0,0000356 0,00000000000000000000000000000000000	0,001234 0,001533 0,001631 0,001631 0,001631 0,001631 0,001263 0,001067 0,000557 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,000452 0,00057 0	4,702 0,222 0,15 1,965 1,965 1,965 1,965 1,965 9,861 9,861 9,879 6,015 8,123 1,82 1,845 1,345 1,345 1,345 1,345 0,0698 -2,203	255 4884 844 844 849 199 199 199 555 540 199 509 509 509 509 509 509 509 509 1000 1000
Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C BuKa3C C C HG C HG C HG C HG	20 (JP 204 (Balance) 20 (JP 204 (Balance)	$\label{eq:2.1} \begin{array}{c} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\$	0,00841 0,0073 0,000229 0,000226 0,000226 0,002204 0,002204 0,002204 0,002207 0,005425 0,005425 0,005425 0,005425 0,005425 0,000545 0,000545 0,000545 0,000545 0,000545 0,00055	0,00153 0,00153 0,001631 0,001631 0,001631 0,001631 0,00163 0,00167 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000121 0,000121 0,000121 0,000121 0,000121 0,000121 0,000587 0,00058	4,702 0,222 0,15 1,965 1,965 1,965 4,1965 4,1965 4,1965 4,1965 4,1965 4,197 4,	255 4884 849 939 399 555 552 400 509 766 509 766 509 766 509 766 766 1022 1022 1022 1022 1022 1022 1022 10
Mbuti Mbuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BU	200 LIP 2004 (BMR) 200 LI	AT         Gas         Constr. 13433           BG         UP         BC (C-13)5           BG         UP         BC (C-13)5           BG         UP         BC (C-13)5           BG         UP         BC (D-13)5           BG         UP         BC (D-13)5           BD         UP         Const.           BD         DP         Const.           BD	0,00847 0,00023 0,00023 0,000229 0,000220 0,000220 0,000220 0,000200 0,0005425 0,000602 0,0005425 0,0004026 0,0005542 0,0004026 0,0005542 0,0004026 0,0005542 0,0004026 0,000557 1,0000957 1,000000000000000000000000000000000000	0,00153 0,00153 0,001631 0,001631 0,001631 0,001631 0,001631 0,001631 0,000537 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000587 0,000121 0,000121 0,000121 0,000121 0,000121 0,000945 0,000945 0,000945 0,000945 0,000945 0,000936 0,000945 0,00095 0,0005 0,0	4,702 0,222 0,15 1,965 1,965 1,965 1,965 8,19 9,879 6,015 8,123 1,864 1,864 1,864 1,864 1,864 1,845 1,845 1,245 1,	25548844888488848884888488488488488488488
Mibbiti Mibbiti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BUKA3C BU	200 (JP 2014) Biological State	1         Case (Journe) 1833/4           1         Case (Journe) 1833/4           10         Case (Journe) 1843/4           10         Law (Journe) 1843/4           11         Law (Journe) 1843/4           12         Law (Journe) 1843/4           12         Law (Journe) 1843/4           12         Law (Journe) 1843/4           12         Law (Journe) 1843/4           13         Law (Journe) 1843/4	0.00030 0.00023 0.00023 0.000226 0.000226 0.000226 0.000226 0.0005425 0.0005425 0.0005425 0.0005425 0.0005512 0.0005512 0.000551 0.000551 0.000551 0.000551 1 0.000551 1 0.000255 1 4 0.000256 1 4 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.000256 1 0.0005425 0.000557 1 0.000557 1 0.000256 1 0.000256 1 0.000256 1 0.000557 1 0.000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000256 1 0.0000000000000000000000000000000000	0,00133 0,00133 0,00131 0,00084 0,001631 0,001631 0,001631 0,001631 0,001631 0,001637 0,000857 0,000857 0,000857 0,000857 0,000857 0,000857 0,000857 0,000857 0,000857 0,000857 0,000121 0,000121 0,000121 0,000121 0,000962 0,000121 0,000962 0,000975 0,000962 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,000975 0,0000000000	4,702 0,222 0,15 1,965 1,564 6,814 6,814 6,814 6,814 6,814 1,1,864 1,2,601 8,122 1,823 1,82 1,823 1,82 1,845 0,306 <b>Zzcor</b> 0,089 2,203 0,089 3,278 3,383 3,383 3,383 3,383	255 488 49 399 555 509 509 509 509 509 509 509 509 5
Mibuti Mibuti	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKA3C BUKA3C BUKA3C BUKA3C BUKA3C BU	200 (JP 2014) Biblin 200 (JP 2014) Biblin	1         Gas Units (343).4           1         Gas Units (343).4           16         Gup B & C(-23).3           16         D/P & Gas.1           1         Gas Units (343).4           10         UP & Gas.1           10         D/P & Gas.1           10         UP & Gas.1           11         Gas Units (34).4           12         UP & Gas.1           13         UP & Gas.1           14         UP & Gas.1           15         UP & Gas.1           16         UP & Gas.1           17         Gas Units (36).3           18         UP & Gast.1           18         UP & Gast.1           19         UP Gast.1           10         UP Matrix           10         UP Matrix <t< td=""><td>0,00034 0,0073 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,00026 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,000000</td><td>0,001235 0,001235 0,00131 0,00084 0,00084 0,001631 0,001631 0,001631 0,001631 0,001631 0,001631 0,000857 0,000857 0,000857 0,000867 0,000857 0,000867 0,000867 0,000962 0,0000000 0,0000000000000000000000000</td><td>4,702 0,222 0,15 1,965 1,965 1,966 1,966 6,814 6,814 6,814 1,864 7,901 8,729 8,729 8,729 8,729 8,729 8,729 1,82 1,82 -0,306 <b>Zscore</b> -0,698 -2,203 -0,089 -3,383 -3,383 -3,383 -3,383 -3,383 -3,591 0,658</td><td>252 488 49 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9</td></t<>	0,00034 0,0073 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,00026 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,00000 0,000000	0,001235 0,001235 0,00131 0,00084 0,00084 0,001631 0,001631 0,001631 0,001631 0,001631 0,001631 0,000857 0,000857 0,000857 0,000867 0,000857 0,000867 0,000867 0,000962 0,0000000 0,0000000000000000000000000	4,702 0,222 0,15 1,965 1,965 1,966 1,966 6,814 6,814 6,814 1,864 7,901 8,729 8,729 8,729 8,729 8,729 8,729 1,82 1,82 -0,306 <b>Zscore</b> -0,698 -2,203 -0,089 -3,383 -3,383 -3,383 -3,383 -3,383 -3,591 0,658	252 488 49 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
Mobil Mobil	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKA3C Bu	200 UP 2014 Biblin Paul UP	1         Cast Sciences 124314           10         Cast Sciences 124314           10         Day BC (F-G3)           10         Day DC (S-G3)           11         Day DC (S-G3)           11         Day DC (S-G3)           11         Day DC (S-G3)           11         Day DC (S-G3)           12         DC (Day DC (S-G3))           13         DC (S-G4)           14         DC (S-G4)	0,00034 0,0073 0,00023 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,000229 0,00025 0,000025 0,00005 0,00005 0,00005 0,00005 0,00005 0,0005 0,0005 0,0005 0,0005 0,0005 0,0005	0,001392 0,001392 0,00131 0,00131 0,00131 0,00131 0,00131 0,001295 0,0000452	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 7,901 1,864 8,879 6,015 8,123 1,827 -1,461 1,8451,845	252 488 84 84 84 84 84 9 9 9 9 9 9 9 9 9 9
Miburi Mi	Bufk33A Bufk33A Bufk33A Bufk33A Bufk33A Bufk33A Bufk33A Bufk33C CHG CHG CHG CHG CHG CHG CHG CHG CHG CH	200 UP 2014 Biblin B0 UP 2014 Biblin R0 UP 2014	1         Gas Loren 1033/A           1         Gas Loren 1033/A           10         Gas Loren 1033/A           10         Dar L           11         Dar L           12         Dar L           13         Dar L           14         Dar Dominitia           14         Dar Dominitia           15         Dar Dominitia           16         Dar Dominitia           17         Gas Valencii           18         Dar Dominitia           10         Darominia	0.000124 0.00723 0.000125 0.000126 0.000126 0.000126 0.000126 0.000126 0.000126 0.000126 0.000126 0.000126 0.000127 0.0006609 0.000562 0.000422 0.000422 0.000422 0.000422 0.000422 0.000422 0.000150 0.000050 0.00000000	0.001353 0.001353 0.001341 0.001461 0.001461 0.001461 0.001461 0.001461 0.000452 0.000452 0.000452 0.000452 0.000452 0.000452 0.000452 0.000452 0.000452 0.000452 0.000452 0.0001121 0.000145 0.000145 0.000145 0.000145 0.000145 0.000145 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.000045 0.0000	4,702 0,222 0,15 1,965 1,965 1,946 6,814 11,864 9,867 9,867 9,879 9,867 9,879 9,867 9,879 9,867 9,879 9,867 9,879 9,867 9,879 9,867 9,879 9,867 1,827 0,009 2,200	255 488 849 199 199 555 555 509 509 509 509 509 509 509 5
Miburi Mi	BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3A BuKa3C BuKA3C BuKA3C BuKA3C Bu	200 (JP 204 (Balan) 200 (JP 204 (Balan)) 200 (JP 204 (Bala)) 200 (JP 204 (Bala)) 200 (JP 204	1         Gas Unerror 1033/4           1         Gas Unerror 1033/4           16         Gup B & GC 2035           16         U/P Gass1           1         Gas V & Gas	0.00073 0.00073 0.000126 0.000204 0.000204 0.000204 0.000204 0.0005425 0.0005425 0.0005425 0.0005425 0.0005425 0.0005425 0.0005425 0.0005425 0.000551 0.000552 6.000551 6.000055 6.0005	0.001353 0.001353 0.001031 0.0001631 0.0001631 0.001631 0.001631 0.0001631 0.000057 0.000052 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000452 0.0000326 0.000036 0.0000036 0.0000036 0.0000036 0.00000050 0.0000050 0.0000050 0.0000050 0.00000000	4,702 0,222 0,15 1,965 1,965 1,544 6,814 11,864 9,863 9,879 6,015 8,123 1,827 0,605 1,827 0,605 1,827 0,605 1,827 0,203 0,007 0,00000000	255 4884 849 849 19 19 19 19 19 55 55 55 55 50 95 90 90 90 90 90 90 90 90 90 90 90 90 90
Mibuti Mibuti	BuKa3A           BuKa3C           CHG	100 UP 004 (BMR) 100 UP 004 (BMR) RU UP 104 (BMR) RU UP 004 (BMR) RU U	1         Cost Correct 1831/4           10         Up B (C-13)/5           10         Up B (Z-63)           10         Up C (C-13)/5           11         Up C (C-13)/5           11         Up C (C-13)/5           11         Up C (C-13)/5           12         Up C (C-13)/5           13         Up C (C-13)/5           14         Up C (C-13)/5           14         Up C (C-13)/5           14         Up C (C-13)/5	0.00073 0.00073 0.000273 0.000274 0.000276 0.000276 0.000267 0.0005425 0.0005571 0.0005571 0.0005571 0.0005571 0.0005571 0.0005571 0.0005571 0.0005571 0.000557 4 0.000557 4 0.000557 4 0.000557 0.000356 0.000356 0.000356 0.000054 0.000054 0.000557 0.0000557 0.000557 0.000557 0.000557 0.000557 0.0005	0.0015c3 0.00015c3 0.000084 0.001031 0.001631 0.001631 0.0001631 0.0001631 0.000050 0.000050 0.000050 0.000050 0.000040 0.000040 0.000040 0.000040 0.000120 0.000120 0.0001361 0.0001361 0.0001361 0.0001361 0.000340 0.0001361 0.000340 0.000340 0.000040 0.0000040 0.0000040 0.00000000	4,702 0,222 0,15 1,965 1,965 1,965 1,965 1,965 1,965 8,122 9,879 6,015 8,122 1,82 1,82 1,82 1,82 1,82 1,82 1,8	255 488 844 849 199 199 2400 509 509 509 509 509 509 509 509 509 5
Miburi Mi	Bufc33A           Bufc33C           Bufc3C           Bufc3C           Bufc3C           Bufc3C           Bufc3C           Bufc3C           Bufc3	200 UP 2014 Biblin B0 UP 2014	1         Ga         Constr. 1333.4           0.5         UP 86.7         CO.335           0.5         UP 87.7         CO.335           0.5         UP 87.7         CO.335           0.5         UP 87.7         CO.335           0.5         UP 0.7         CO.335           0.5         UP 0.7         CO.335           0.5         UP 0.7         CO.335           0.6         UP 0.7         CO.335           0.7         UP 1.7         CO.335           0.8         UP 0.7         CO.335           0.7         UP 1.7         Co.335           0.7         UP 0.7         Co.335           0.7         UP 0.7         Co.335           0.7         Co.32         Co.325           0.7         Co.32         Co.325           0.7         Co.32         Co.325           0.7         Co.325         Co.325	0.00073 0.000726 0.000126 0.000126 0.000126 0.000126 0.000126 0.000126 0.000126 0.0005425 0.0066425 0.0066425 0.0066571 0.00056425 0.0066571 0.00056425 0.0006571 0.000567 0.000571 0.000571 0.000571 0.000571 0.000126 0.0000126 0.00000000000000000000000000000000000	0.0001553 0.0000161 0.0000161 0.0000161 0.0000161 0.0000161 0.0000161 0.0000161 0.0000051 0.0000057 0.000057 0.0000057 0.0000057 0.0000000000	4,702 0,222 0,15 1,965 1,965 1,965 1,965 1,965 1,965 1,965 8,923 1,826 8,923 1,826 0,965 8,123 1,82 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 8,123 1,82 0,965 1,965 1,965 8,123 1,82 0,965 1,965	255 4884 849 849 855 555 555 508 849 849 849 849 849 849 849 849 849 84
Miburi Mi	Buda3A Buda3A Buda3A Buda3A Buda3A Buda3A Buda3C Bu	200 (JP 2014) Biblin 200 (JP 2014) Biblin	$\begin{tabular}{l l l l l l l l l l l l l l l l l l l $	0.00073 0.00072 0.00022 0.0	0.001552 0.001011 0.00004 0.001011 0.00004 0.001011 0.001011 0.001014 0.001014 0.001014 0.00000000	4,702 0,222 0,15 1,965 1,965 1,965 1,965 1,965 1,965 1,965 1,97 9,879 9,799 9,879 9,970 9,970 9,270 9,	2992 4884 8493 9995 5555 5097 766 5097 766 5097 766 5097 766 5097 766 5097 766 102 102 102 102 102 102 102 102 102 102
Mitteri Mitter	Buta3A Bu	100 UP 041 (MAR) 100 UP 041 (	$\label{eq:constraint} $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$$	0.00073 0.00072 0.000726 0.00076 0	0.00152 0.001513 0.00054 0.001611 0.00064 0.001615 0.000657 0.00057 0.000057 0.0000	$\begin{array}{c} 4,702\\ 4,702\\ 0,212\\ 0,$	2992 4884 849 399 555 509 509 766 509 766 509 766 509 766 509 766 509 766 509 766 102 102 102 102 102 102 102 102 102 102
Mittari Mittar	Buda3A Buda3A Buda3A Buda3A Buda3A Buda3C Bu	200 UP 201 Binn BU BU B	1         Cas Common 1983/44           1         Cas Common 1983/44           0         Cas Common 1984/44           0         Cas Common 1984/44           1         Cas Common 1984/44           2         Cas C	0.0000713 0.0000729 0.000024 0.000024 0.000024 0.000024 0.000024 0.000004000000400000000	0.00155. 0.001011 0.000041 0.000041 0.001011 0.000041 0.001125 0.000055 0.000055 0.000055 0.000055 0.000055 0.000055 0.000055 0.000055 0.000055 0.000055 0.000005 0.000005 0.00000500000000	4702 4702	2992 2992 2992 2992 2400 240 24
Mibuti Mi	Budala Colo Colo Colo Colo Colo Colo Colo C	200 (JP 2014) Biblin 200 (JP 2014) Biblin	1         Gas Units           2         Gas Units           2         Gas Units           3         Gas Units           4         Gas Units           5         Gas Units           6         Units           7         Gas Units           8         Units           8	0.000279 0.000279 0.000224 0.00024 0.00004 0.00004 0.00004 0.00	0.000512 0.0	4,702,022 0,222 0,153 1,564	29929292929292929292929292929292929292
Million Millio	Buda3A Buda3A Buda3A Buda3A Buda3A Buda3A Buda3C Bu	200 UP 2014 Biblin B0 UP 2014 Biblin R0 UP 2014 B	1         Construction           0         Construction           0         Dep Dep C-FASD	0.00219 0.00219 0.00224 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.0024 0.	0.00155: 0.000151: 0.00084: 0.001121: 0.00084: 0.000125: 0.00005: 0.00005: 0.00	4,702 4,702 4,702 4,015 4,	292924 4884 844 84884 844 848 844 858 859 859 859 859 859 859 859 859 859
Million Millio	Buda3A Buda3A Buda3A Buda3A Buda3A Buda3A Buda3C Bu	200 UP 2014 Biblin B01 UP 2014 Biblin B1	1         Case (1994).           1         Case (1994).           10         Der (1994).           10         Der (1994).           10         Der (1994).           10         UP (1994).           10         UP (1994).           11         UP (1994).           12         UP (1994).           13         UP (1994).           14         UP (1994).           14         UP (1994).           14         UP (1994).           15         UP (1994).           14         UP (1994).           15         UP (1994).           16         UP (1994).           16         UP (1994).           16         UP (1994).           17         Cos (1994).           18         UP (1994).           19         UP (1994).           10         UP (1994).           10         UP (1994).           11         UP (1994).           11         UP (1994).           11         UP (1994).           11         UP (1994).           12         UP (1994).           14         UP (1994).           14 <td>0.00019-00000000000000000000000000000000</td> <td>0.00015- 0.00016- 0.00011- 0.00004- 0.00011- 0.00004- 0.000004- 0.000004- 0.000004- 0.000004-</td> <td>4,702 4,</td> <td>292924 4884 4884 4884 4884 4884 4884 488</td>	0.00019-00000000000000000000000000000000	0.00015- 0.00016- 0.00011- 0.00004- 0.00011- 0.00004- 0.000004- 0.000004- 0.000004- 0.000004-	4,702 4,	292924 4884 4884 4884 4884 4884 4884 488
Malani Ma	Budala         Budala           Child         Budala           Child         Budala           Child         Budala           Child         Science           Child         Science           Child         Science           Child         Science           Child         Science           Child	200 (JP 2014) Biblin 200 (JP 2014) Biblin	1         Gas Common 10341/A           1         Gas Common 10341/A           10         Dep UP & GC 2035           10         DP Content           10         DP Content     <	0.000129 0.0001	0.00153 0.00161 0.000001 0.000001 0.00000000	4,702 (2) 2,222 (2) 1,506 (2)	29292 29292 29292 2400 2007 200
Michael Michae	BudalA Bu	200 UP 2014 BMm B0 UP	1         Construction           0         Construction           0         UP         Construction           0         UP <td< td=""><td>0,00719 0,00719 0,00712 0,0071</td><td>0.0015-0 0.0016-0 0.0010-0 0.0010-0 0.0010-0 0.0010-0 0.0010-0 0.0000-0 0.0</td><td>4,702 4,</td><td>29292 29292 29292 2404 2007 200</td></td<>	0,00719 0,00719 0,00712 0,0071	0.0015-0 0.0016-0 0.0010-0 0.0010-0 0.0010-0 0.0010-0 0.0010-0 0.0000-0 0.0	4,702 4,	29292 29292 29292 2404 2007 200
Maturi Ma	ButchA           Bu	200 UP 301 BMB BU UP 301 BMB B	1         Ga         Users 1333/4           0         Users 1343/4         Sec. 1313           0         UP         BC (UP & C-1315)           0         UP         Down           1         D         Down           1         D         Down           1         D         Down           2         Down         Down           2         Down         Down           2         Down         Down           2         Down         Down           3         Down         Down           3         Down         Down           4	0,00023 0,0	0.00152. 0.001011 0.000081 0.000081 0.000081 0.000081 0.000082 0.00082 0.000080 0.000080 0.000080 0.000080 0.000080 0.000080 0.000080 0.00	4,702 (2) 4,702 (2) 1,106 (2)	29292 29
Manual Ma	ButchA           Bu	200 UP 301 BMm B0 UP 301 BMm B	1         Gas Comero 1034/4           1         Gas Comero 1034/4           10         De UP B (C-1035)           10         De UP B (C-1035)           10         De UP B (C-1035)           10         DP Const.           10         DE (D-1034)           11         Z           10         DE (D-1034)           11         Z           11         AF (D-1034)           12         DE (D-1034)           13         DE (D-1034)           14         DE (D-1034)	0,0073 0,0072	0.00152. 0.001011 0.00004 0.000010 0.000010 0.000000 0.000000 0.000000 0.000000 0.000000	4,702 (2) 2,222 (2) 1,202 (2)	29292 29292 29292 29292 2020 20
Manual Ma	Budah Budah	200 UP 2014 BMm B0 UP 2014 BMm B1 UP	1         Construction	0,0001 0,0001	0.00155. 0.001011. 0.000014. 0.00000	4,702 (2) (2) (2) (2) (2) (2) (2) (2) (2) (2	2524 2525 2480 2480 2480 2490 2400 2400 2400 2400 2555 2555 2555 2577 2577 2595
Manual Ma	Botala         Botala           Butala         Butala           Olio         Olio	200 UP 301 BMB BU UP 301 BMB BU UP 302 BMB B	1         Construction           0         Construction           1         Construction	0,00073 0,00073 0,00072 0,0	0.0015-0 0.0015-0 0.0016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.0000000-0 0.000000-0 0.000000-0 0.000000-0 0.000000-0 0.000000-	4,702 (2) (2) (2) (2) (2) (2) (2) (2) (2) (2	29292 29292 2400 2007 200
Manual Ma	Bucksh         Bucksh           Bucksh	200 UP 301 (BMR) 200 UP 301 (	1         Gas Uners 1333/4           1         Gas Uners 1333/4           16         Gu UP & GC 1335           16         D, UP & Gas 1           1         Gas UP & GC 1335           16         D, UP & Gas 1           17         Gas UP & Gas 1           18         D, UP & Gas 1           19         D, UP & Gas 1           10         UP & Gas 1           10         UP & Gas 1           10         UP & Gas 1           11         D, UP & Gas 1           12         UP & Gas 1           13         UP & Gas 1           14         Gas UP & Bai 1633           15         UP & Gas 1           16         UP & Matrini 163           17         Gas Rem 1283/4           18         UP & Gas 1           10         UP & Sant 1           11         UP & Sant 1           12         UP & Sant 1           13         UP & Sant 1           14	0,00719 0,00729 0,0	0.0015-0 0.0016-0 0.0016-0 0.00016-0 0.00016-0 0.00016-0 0.00016-0 0.00005-0	4,002 4,002 4,002 4,002 4,00 4,00 4,00 4	2525 240 240 240 240 240 240 240 240
Millerid Millerid Misseli Millerid Mill	Budah Budah	200 UP 2014 BMB BU UP 2014 BM	1         Gas         Users         103.44           0.5         Users         103.44         103.45           0.5         UP         0.6         104         0.6           0.5         UP         0.6         104         0.6         104         0.6           0.5         UP         0.6 <td>0,00073 0,00073 0,00073 0,00073 0,00075 0,0</td> <td>0.00115- 0.00115- 0.00116- 0.000016- 0.0000000- 0.0000000- 0.0000000- 0.00000000</td> <td></td> <td><math display="block">\begin{array}{c} 2592\\ 2592\\ 360\\ 360\\ 360\\ 360\\ 360\\ 360\\ 360\\ 360</math></td>	0,00073 0,00073 0,00073 0,00073 0,00075 0,0	0.00115- 0.00115- 0.00116- 0.000016- 0.0000000- 0.0000000- 0.0000000- 0.00000000		$\begin{array}{c} 2592\\ 2592\\ 360\\ 360\\ 360\\ 360\\ 360\\ 360\\ 360\\ 360$
Millerid Mil	Botala         Botala           Botala	200 UP 301 BMB BU UP 301 BMB BU UP 305 BMB BU UP 301 BMB DU UP 301 BMB DU UP 301 BMB DU UP 301 BMB BU DE 301 BMB BU UP 301 BMB BU DE 301 BMB BU UP 301 BMB BU DE 301 BMB BU DE 301 BMB BU UP 301 BMB BU DE 301 BMB BU DE 301 BMB BU DE 301 BMB BU UP	1         Ga         Construction           1         Construction         Construction           1         Construction <td>0,000229 0,00029 0,00009 0,000009 0,000000 0,000000 0,000000 0,000000 0,000000 0,00</td> <td>0.00112-00000000000000000000000000000000</td> <td>4,702 (2) 4,702 (2) 1,506 (2)</td> <td>2552 884 884 884 884 884 884 885 555 55</td>	0,000229 0,00029 0,00009 0,000009 0,000000 0,000000 0,000000 0,000000 0,000000 0,00	0.00112-00000000000000000000000000000000	4,702 (2) 4,702 (2) 1,506 (2)	2552 884 884 884 884 884 884 885 555 55
Milleri Miller	Budah Budah	200 UP 2014 BMm BU UP 2014 BM	1         Construction           1         Construction           10         Description           10         Description           10         Description           10         Description           10         Description           10         Description           11         Description           12         Description           13         Description           14         Description           15         Description           16         Description           17         Description           18         Description           18         Description           18         Description           18         Description	0.0001 0.0001	0.00115- 0.00125- 0.00126- 0.00016- 0.000016- 0.000016- 0.000016- 0.00016- 0.00016- 0.00016- 0.00016- 0.00016- 0.00016- 0.00016- 0.00016- 0.00016- 0.00016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.0000000- 0.0000000- 0.000000- 0.000000- 0.000000- 0.000000- 0.0000000- 0.000000- 0.000000- 0.000000- 0.00000000	4,702 4,702 4,702 4,702 4,70 4,70 4,70 4,70 4,70 4,70 4,70 4,70	$\begin{array}{c} 2592\\ 2592\\ 3502\\$
Milleri Miller	Botaba         Botaba           Butaba         Butaba           Butaba         Colo           Colo         Colo      C	200 (JP 2014 Bible BU (JP 2014	1         Construction           0         Construction           1         Construction           Construction           C	0,00073 0,00073 0,00072 0,0	0.0015-0 0.0015-0 0.0016-0 0.000016-0 0.0000000000000000000000000000000000	4,702 4,702 1,150 4,	2525 2525 264 265 265 265 265 265 265 265 265 265 265
Milleri Miller	Butaba         Butaba           Butaba         Conce           Conce         Conce	200 UP 304 (2004) 2010 UP	1         Gas Corres 1243/4           0         Gas Corres 1243/4           0         Gas Dup B & CF-030           0         Gup B & CF-030	0,00719 0,00729 0,0	0.0015-0 0.0015-0 0.00101-0 0.00000-0 0.00001-0 0.000001-0 0.000001-0 0.000000-0 0.000000-0 0.000000-0 0.0000000-0 0.000000-0 0.000000-0 0.000000-0 0.000000-0 0.00000000	4,702 (2) 4,702 (2) 1,506 (2)	2 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
	Budah Budah	200 UP 2014 BMB BU UP 2014 BM	1         Construction           1         Construction           10         Construction           11         Construction           12         Construction           13         Construction           14         Construction           15         Construction           16         Construction           16         Construction           16         Construction           16         Construction           16         Construction           16         Construction           17         Construction           18         Construction           18         Construction           18         Construction           18         Construction           18         Construction           18         Construction           19         Construction           19         Construction           19         Cons	0,0001 0,0001	0.00115- 0.00115- 0.00101- 0.00004- 0.000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.000000000- 0.0000000- 0.0000000- 0.00000000		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Millardi Mil	Botala         Botala           Butala         Butala           Butala	200 UP 301 Bink BU BU B	1         Case (1994)           1         Case (1994)           10         Der (1994)           11         Der (1994)           12         Der (1994)           13         Der (1994)           14         Der (1994)           14         Der (1994)           15         Der (1994)           14         Der (1994)           15         Der (1994)           16         Der (1994)           17         Der (1994)           18         Der (1994)           19         Der (1994)           10         Der (1994)           11         Der (1994)           12         Der (1994)           13         Der (1994)           14         Der (1994)           15	0,000239 0,0000	0.00115- 0.00116- 0.00101- 0.00004- 0.00016- 0.00016- 0.00016- 0.00004- 0.0	4,002 4,002 10,002 11,000 15,000	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	Butch         Butch           Butch <td>200 UP 301 (2004) 200 UP 301 (2</td> <td>1         Gas Corres 1333.4           1         Gas Corres 1343.4           1         Gas UpP &amp; GC-1315.           16         UpP &amp; GAS-1           1         Gas Dup &amp; G</td> <td>0,00719 0,00729 0,0</td> <td>0.0015-0 0.0015-0 0.0016-0 0.00016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.0000016-0 0.000016-0 0.000016-0 0.000000-0 0.00000000-0 0.00000</td> <td></td> <td>29292 29</td>	200 UP 301 (2004) 200 UP 301 (2	1         Gas Corres 1333.4           1         Gas Corres 1343.4           1         Gas UpP & GC-1315.           16         UpP & GAS-1           1         Gas Dup & G	0,00719 0,00729 0,0	0.0015-0 0.0015-0 0.0016-0 0.00016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.000016-0 0.0000016-0 0.000016-0 0.000016-0 0.000000-0 0.00000000-0 0.00000		29292 29
	Botaba         Botaba           Butaba         Butaba           Butaba	200 UP 2014 BMB BU UP 2014 BM	1         Construction	0,00073 0,00073 0,00073 0,00074 0,00075 0,0	0.00115- 0.00115- 0.00116- 0.00016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.000016- 0.00	4,022 4,024	29292 29292 29292 29292 29292 2020 2
	Botala         Botala           Butala         Butala           Butala	200 UP 301 Bink BU BU B	1         Case (1994)           1         Case (1994)           10         Der (1994)           11         Der (1994)           12         Der (1994)           13         Der (1994)           14         Der (1994)           15         Der (1994)           14         Der (1994)           15         Der (1994)           14         Der (1994)           15         Der (1994)           16         Der (1994)           17         Der (1994)           18         Der (1994)           19         Der (1994)           10         Der (1994)           10         Der (1994)           11         Der (1994)           12         Der (1994)           13         Der (1994)           14	0,000739 0,000739 0,000729 0,0007	0.00115- 0.00116- 0.00101- 0.00004- 0.00016- 0.00016- 0.00016- 0.00016- 0.00004- 0.0	4,702 (2) 2,221 (2) 2,221 (2) 3,251 (2) 3,561 (2)	2 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2
Malani Ma	Butch         Butch           String         String	200 UP 301 (2004) 200 UP 301 (2	1         Construction           1         Construction           10         Description           11         Description           12         Description           13         Description           14         Description           15         Description           16         Description           17         Description           18         Description           18         Description	0.00013 0.00013 0.00012 0.0	0.00115- 0.00115- 0.00101- 0.00004- 0.000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0	4,702 4,702 4,702 1,212 1,	$\begin{array}{c} 29292\\ 29292\\ 384\\ 488\\ 488\\ 488\\ 488\\ 488\\ 488\\ 488$
	Botala         Botala           Butala         Butala           Butala	200 UP 2014 Biblin BU UP 2014 Biblin RU UP 2014 Biblin BU UP 2014 B	1         Construction           0         Construction           1         Construction	0,00073 0,00073 0,00072 0,0	0.00112- 0.00112- 0.00110- 0.00014- 0.000014- 0.0000014- 0.0000014- 0.000014- 0.000014- 0.000	4,702 4,702 4,702 1,155 4,154 4,155 4,	2 9 2 9 2 9 2 9 2 9 2 9 2 9 2 9 2 9 2 9
	Botala         Botala           Botala	200 UP 301 Bible BU UP 301 Bib	1         Construction           1         Construction           10         UP Construction           10         UP Construction           10         UP Construction           11         UP Construction           12         UP Construction           13         UP Construction           14         Construction           15         UP Construction           16         UP Construction           16         UP Construction           16         UP Construction           17         Construction           18         UP Construction           19         UP Construction           10         UP Construction <td>0.000239 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.0000</td> <td>0.00015-0.000000-0.000000-0.000000-0.0000-0.00000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0</td> <td>4,002 4,002 10,002 11,000 15,000</td> <td>29292 29292 29292 29404 29402 29404 29402 29404 29402 29404 29402 29404 29</td>	0.000239 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.000039 0.0000	0.00015-0.000000-0.000000-0.000000-0.0000-0.00000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0.0000-0	4,002 4,002 10,002 11,000 15,000	29292 29292 29292 29404 29402 29404 29402 29404 29402 29404 29402 29404 29
	Budah Budah	200 UP 2014 Biblin BU UP	1         Construction	0.0001 0.0001	0.00115- 0.00115- 0.00101- 0.000014- 0.0000014- 0.000014- 0.000014- 0.000014- 0.000014- 0.000014- 0.000014- 0.000014- 0.000014- 0.0000014- 0.0000014- 0.0000014- 0.0000014- 0.00000000000000000000000000000000000	4,702 4,	2 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2
	Botaba         Botaba           Butaba         Butaba           Butaba	200 UP 2014 Biblin BU UP 2014 B	1         Construction	0,00073 0,00073 0,00072 0,0	0.00115- 0.00115- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.00116- 0.000016- 0.00016- 0.0000016- 0.000016- 0.0000016- 0.0000016- 0.0000016- 0.000000000000- 0.0000000- 0.000000000	4,702 4,702 1,105 4,	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	Botala         Botala           Botala	200 UP 301 Bible BU UP 301 Bib	1         Construction	0,00023 0,0	0.00115- 0.00116- 0.00101- 0.00004- 0.00010- 0.00004- 0.0	4,702 4,702 1,105 4,	255 266 267 268 269 269 269 269 269 269 269 269
	Budah         Budah           Budah <td>200 UP 2014 Bible BU UP 2014</td> <td>1         Construction           1         Construction</td> <td></td> <td>0.00115- 0.00101- 0.00101- 0.00000- 0.00000- 0.0</td> <td>4,702 4,</td> <td>2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3</td>	200 UP 2014 Bible BU UP 2014	1         Construction		0.00115- 0.00101- 0.00101- 0.00000- 0.00000- 0.0	4,702 4,	2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3
Million I Million I Millio	Botaba         Botaba           Botaba	200 UP 2014 Biblin Bibl	1         Construction	0,00021 0,00022 0,0	0.00112- 0.0012- 0.0012- 0.0012- 0.0012- 0.0012- 0.0012- 0.0012- 0.0012- 0.0012- 0.000	4,002 4,002 10,000	2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3
	Botala         Botala           Botala	200 UP 301 Bible BU UP 301 Bib	1         Gas           1 <t< td=""><td>0.000739 0.0007</td><td>0.00015-00000000000000000000000000000000</td><td>4,002 4,002 4,002 4,002 4,00 4,00 4,00 4</td><td>2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2</td></t<>	0.000739 0.0007	0.00015-00000000000000000000000000000000	4,002 4,002 4,002 4,002 4,00 4,00 4,00 4	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

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					Oa	se1	, ,		Oase1_Maske	d_Neanderta	
w	Х	Y	Z	f4	stderr	Zscore	snps	f4	stderr	Zscore	snps
Mbuti	BuKa3A	RO_IUP_Oase1	BE_UP_GoyetQ116-1	0,004814	0,002415	1,993	9400	0,004263	0,002649	1,61	8229
Mbuti	BuKa3A	RO_IUP_Oase1	RU_UP_Kostenki14	0,002669	0,00156	1,71	18897	0,000746	0,001659	0,45	16524
Mbuti	BuKa3A	RO_IUP_Oase1	BG_UP_BK-1653	0,001878	0,001668	1,126	17922	0,000584	0,001802	0,324	15668
Mbuti	BuKa3A	RO_IUP_Oase1	RU_UP_Sunghir3	0,002482	0,001597	1,554	19981	0,001298	0,001689	0,769	17462
Mbuti	BuKa3A	RO_IUP_Oase1	RO_UP_Muierii	0,004038	0,001544	2,615	19958	0,003993	0,00166	2,405	17448
Mbuti	BuKa3A	RO_IUP_Oase1	CZ_Gra_Vestonice16	0,003439	0,002093	1,643	11880	0,002742	0,002232	1,228	10455
Mbuti	BuKa3A	RO_IUP_Oase1	AT_Gra_Krems I2483/4	0,00288	0,002533	1,137	9218	0,002414	0,002754	0,876	8079
Mbuti	BuKa3A	RO_IUP_Oase1	BG_IUP_BK_CC7-335	-0,004535	0,001863	-2,434	14039	-0,005726	0,001976	-2,898	12298
Mbuti	BuKa3A	RO_IUP_Oase1	BG_IUP_BK_F6-620	-0,005093	0,001624	-3,135	18648	-0,006029	0,001725	-3,495	16283
Mbuti	BuKa3A	RO_IUP_Oase1	BG_IUP_BB7-240	-0,002641	0,001806	-1,462	15131	-0,003567	0,001963	-1,817	13233
Mbuti	BuKa3A	RO_IUP_Oase1	CZ_IUP_ZKU002	-0,000196	0,001503	-0,131	19200	-0,001215	0,00164	-0,741	16779
Mbuti	BuKa3A	RO_IUP_Oase1	CN_IUP_Tianyuan	-0,00238	0,002034	-1,17	13294	-0,003114	0,002176	-1,431	11635
Mbuti	BuKa3A	RO_IUP_Oase1	RU_IUP_Ust_Ishim	-0,003204	0,001631	-1,964	19971	-0,003911	0,001779	-2,199	17454
Mbuti	BuKa3C	RO_IUP_Oase1	BE_UP_GoyetQ116-1	0,007831	0,001855	4,221	19515	0,00682	0,001988	3,43	17053
Mbuti	BuKa3C	RO_IUP_Oase1	RU_UP_Kostenki14	0,008302	0,001219	6,809	39470	0,007923	0,001316	6,02	34400
Mbuti	BuKa3C	RO_IUP_Oase1	BG_UP_BK-1653	0,00429	0,001252	3,428	37477	0,004145	0,001316	3,15	32655
Mbuti	BuKa3C	RO_IUP_Oase1	RU_UP_Sunghir3	0,005024	0,001193	4,21	41729	0,00485	0,001215	3,992	36323
Mbuti	BuKa3C	RO_IUP_Oase1	RO_UP_Mulerii	0,005853	0,001123	5,212	41682	0,005456	0,001211	4,505	36285
Mbuti	BUKa3C	RO_IUP_Oase1	C2_Gra_Vestonice16	0,007364	0,001528	4,82	24955	0,007378	0,001636	4,509	21846
Nibuti	BuKa3C	RO_IUP_Oase1	A1_Gra_krems 12483/4	0,008865	0,001838	4,823	19101	0,008224	0,001939	4,24	16/14
Mbuti	BUKa3C	RO_IUP_Oase1	BG_IUP_BK_CC7-335	0,001365	0,001304	1,047	29113	0,000404	0,001409	0,287	25431
Nibuti	BuKa3C	RO_IUP_Oase1	BG_IUP_BK_F6-620	-0,001156	0,001218	-0,949	38953	-0,001943	0,001288	-1,508	33911
IVIDUTI Mbuti	BuKa3C	RO_IUP_Uase1		-0,001291	0,001002	-0,993	31045	-0,002678	0.00119	-1,918	2/560
Mbu+	BuKa2C	RO UR Occol		-0,000242	0,001093	-0,221	27700	-0,001214	0,00110	-1,029	24613 24252
Mbuti	Bukaac		RIL IIID List Johim	-0,001012	0,001319	-1.001	27799 A1712	-0,00253	0,001004	-1,452	24333
Mbuti		Bukase	BE LIP Gover0116 1	0.0001208	0,001121	-1,545 0 216	41/13	-0,00203/ 0,000203	0,001183	-2,22ð 0 100	17052
Mbuti		Bukaac	BE Mag CovotO2	0,000384	0,0017/8	0,210	12630	0,000382	0,001921	0,133	13645
Mbuti		Bukaac	ES Mag ElMiron	-0.001213	0,00178	-0.685	19751	-0.001243	0,001951	-0.38	17208
Mhuti	RO ILIP Oscal	RuKaRC	R[] [[IP  ]ct  chim	-0,001214	0.001102	-0,000	41712	-0,000724	0,001300	-0,30	36303
Mbuti	RO ILIP Oaso1	Bukaac	ΔT Gra Kreme 12/182//	0.003379	0.001153	1 970	19101	0.002333	0.001273	1 7/1	1671/
Mbuti	RO IUP Oase1	BuKaRC	RU UP Kostenki14	-0.001510	0.001032	-1 402	39470	-0.001434	0.001168	-1 228	34400
Mhuti	RO IUP Oase1	BuKa3C	BG LIP RK-1653	-0.000752	0.001136	-0.667	37477	-0.000559	0.001226	-0.456	32655
Mbuti	RO_IUP_Oase1	BuKa3C	CZ Gra Vestonice16	-0.001584	0.001429	-1 108	24955	-0.001462	0.001220	-0.973	21846
Mbuti	RO_IUP_Oase1	BuKa3C		-0.001384	0.001425	-1 288	40007	-0.001402	0.001217	-1.098	34813
Mbuti	RO_IUP_Oase1	BuKa3C		-0.000407	0.001233	-0.33	33136	-0.000087	0.00134	-0.065	28867
Mbuti	RO_IUP_Oase1	BuKa3C	CN IIIP Tianyuan	-0,000407	0.001255	-1 905	27799	-0,000007	0.001565	-0,005	24353
Mbuti	RO_IUP_Oase1	BuKa3C	RO UP Mujerij	-0.000857	0.001095	-0.782	41682	-0.000848	0.001197	-0 708	36285
Mbuti	RO_IUP_Oase1	BuKa3C	BU UP Sunghir3	-0.001143	0.00108	-1.058	41729	-0.000265	0.001159	-0.228	36323
Mbuti	RO_IUP_Oase1	BuKa3C	IT EpiGra Tagliente2	-0.004404	0.002276	-1.935	9700	-0.004822	0.002438	-1.978	8495
Mbuti	RO_IUP_Oase1	BuKa3C	IT_EpiGra_Villabruna	0.001342	0.001304	1.029	30396	0.001853	0.001379	1.344	26575
Mbuti	RO IUP Oase1	BuKa3C	ES Meso Chan	-0.00129	0.001249	-1.033	33460	-0.000446	0.001336	-0.334	29263
Mbuti	RO IUP Oase1	BuKa3C	RU Meso Karelia	0.001821	0.001202	1.515	36298	0.001377	0.001321	1.042	31552
Mbuti	RO IUP Oase1	BuKa3C	CH Meso Bichon	0,000634	0,001165	0,544	41679	0,000573	0,001259	0,455	36276
Mbuti	RO IUP Oase1	BuKa3C	LU Meso Loschbour	0,000206	0,001065	0,194	41731	0,000937	0,001131	0,828	36321
Mbuti	RO IUP Oase1	BuKa3C	ES Meso Chan	-0,00129	0,001249	-1,033	33460	-0,000446	0,001336	-0,334	29263
Mbuti	RO IUP Oase1	BuKa3C	IR Neo AH1	0,000161	0,001229	0,131	31280	0,000143	0,001314	0,109	27211
Mbuti	RO_IUP_Oase1	BuKa3C	TR_Neo_Bon	-0,000261	0,00112	-0,233	40059	-0,000083	0,001195	-0,07	34888
Mbuti	RO_IUP_Oase1	BuKa3C	RO_Meso_OC1	0,000381	0,001313	0,29	31343	0,000723	0,001438	0,503	27349
Mbuti	RO_IUP_Oase1	BuKa3C	SE_Meso_Motala12	0,000205	0,001148	0,179	38061	0,000135	0,001252	0,108	33132
Mbuti	RO_IUP_Oase1	BuKa3C	GE_EpiGra_Satsurblia	0,000048	0,00127	0,038	29292	-0,00035	0,001367	-0,256	25489
Mbuti	RO_IUP_Oase1	BuKa3C	GE_Meso_Kotias	0,001438	0,001082	1,329	41480	0,001478	0,001173	1,26	36099
Mbuti	RO_IUP_Oase1	BuKa3C	BG_IUP_BB7-240	-0,000248	0,00137	-0,181	31645	-0,000555	0,00144	-0,386	27560
Mbuti	RO_IUP_Oase1	BuKa3C	BG_IUP_BK_CC7-335	0,002104	0,001438	1,463	29113	0,002692	0,001527	1,763	25431
Mbuti	RO IUP Oase1	BuKa3C	BG IUP BK F6-620	-0,001037	0,001178	-0,88	38953	-0,000274	0,001265	-0,217	33911
Mbuti	RO_IUP_Oase1	BuKa3A	BE_UP_GoyetQ116-1	-0,000759	0,002352	-0,323	9400	-0,000851	0,002526	-0,337	8229
Mbuti	RO_IUP_Oase1	BuKa3A	BE_Mag_GoyetQ2	-0,000248	0,002648	-0,094	7526	-0,000551	0,002859	-0,193	6597
Mbuti	RO_IUP_Oase1	BuKa3A	ES_Mag_ElMiron	0,000731	0,002477	0,295	9557	0,001259	0,002717	0,464	8403
Mbuti	RO_IUP_Oase1	BuKa3A	RU_IUP_Ust_Ishim	-0,001511	0,001602	-0,943	19971	-0,001902	0,001782	-1,068	17454
Mbuti	RO_IUP_Oase1	BuKa3A	AT_Gra_Krems I2483/4	0,00043	0,002514	0,171	9218	-0,00001	0,002797	-0,004	8079
Mbuti	RO_IUP_Oase1	BuKa3A	RU_UP_Kostenki14	-0,002993	0,001584	-1,89	18897	-0,002984	0,001739	-1,716	16524
Mbuti	RO_IUP_Oase1	BuKa3A	BG_UP_BK-1653	-0,002749	0,001641	-1,676	17922	-0,003804	0,001835	-2,073	15668
Mbuti	RO_IUP_Oase1	BuKa3A	CZ_Gra_Vestonice16	0,000609	0,002105	0,289	11880	0,001693	0,002333	0,726	10455
Mbuti	RO_IUP_Oase1	BuKa3A	CZ_IUP_ZKU002	-0,001673	0,001584	-1,056	19200	-0,00184	0,001702	-1,081	16779
Mbuti	RO_IUP_Oase1	BuKa3A	RU_MA1	0,001801	0,001733	1,039	15944	0,002149	0,001861	1,155	13951
Mbuti	RO_IUP_Oase1	BuKa3A	CN_IUP_Tianyuan	-0,002376	0,002097	-1,133	13294	-0,00252	0,002279	-1,106	11635
Mbuti	RO_IUP_Oase1	BuKa3A	RO_UP_Muierii	-0,000461	0,001482	-0,311	19958	-0,000176	0,001629	-0,108	17448
Mbuti	RO_IUP_Oase1	BuKa3A	RU_UP_Sunghir3	0,00058	0,001533	0,378	19981	0,000626	0,001694	0,37	17462
Mbuti	KO_IUP_Oase1	BuKa3A	IT_EpiGra_Tagliente2	0,006318	0,003002	2,105	4706	0,004606	0,003375	1,365	4132
Mbuti	KO_IUP_Oase1	BuKa3A	IT_EpiGra_Villabruna	0,001695	0,001803	0,94	14561	0,001791	0,001922	0,932	12765
Mbuti	KO_IUP_Oase1	BuKa3A	ES_Meso_Chan	0,000496	0,001759	0,282	15987	0,000342	0,001912	0,179	14045
Mbuti	KU_IUP_Oase1	BuKa3A	KU_Meso_Karelia	0,00244	0,001634	1,494	17381	0,00152	0,001763	0,862	15189
Mbuti	KU_IUP_Oase1	BuKa3A	CH_Meso_Bichon	0,00042	0,00148	0,284	19934	0,000154	0,001625	0,095	17426
Mbuti	KO_IUP_Oase1	BuKa3A	LU_Meso_Loschbour	-0,000604	0,001561	-0,387	19982	-0,000751	0,001703	-0,441	17463
Mbuti	KU_IUP_Oase1	BuKa3A	ES_Meso_Chan	0,000496	0,001759	0,282	15987	0,000342	0,001912	0,179	14045
Mbuti	KO_IUP_Oase1	BuKa3A	IK_Neo_AH1	-0,00015	0,001629	-0,092	15015	-0,00037	0,001769	-0,209	13166
IVIDUTI	RO_IUP_Oase1	Buka3A	IK_Neo_Bon	-0,000/23	0,001650	-0,463	19121	-0,001358	0,001700	-0,804	10/19
IVIDUTI		BuKa3A	KU_IVIESO_UC1	0,000107	0,001658	0,3//	10222	-0,000029	0,001769	-0,016	15015
Nibuti	KU_IUP_Oase1	BuKa3A	SE_IVIESO_Motala12	-0,000197	0,001642	-0,12	18232	-0,00101	0,001768	-0,5/1	15915
IVIDUTI	RO_IUP_Oase1	Buka3A	GE_EpiGra_Satsurblia	0,00073	0,001/36	0,42	14116	0,000005	0,001901	0,003	12337
IVIDUTI		BuKa3A	GE_IVIESO_KOTIAS	-0,000845	0,00176	-0,601	15131	-0,00102	0,001000	-U,6//	12222
IVIDUTI		BUKa3A	BG_IUP_BB/-240	-0,001157	0,001027	-0,65/	15131	-0,000693	0,001923	-0,36	13233
		BukasA		-0,0005	0,001937	-0,258	10040	-0,000264	0,002106	-0,125	16282
ITUQIVI	IND IOP Dasel	виказА	DU IUP BK F6-620	-0,002832	0,001039	-1,/28	10048	-0,00324	0,001801	-1,/98	10283

#### Table S6. Summary of library counts

Table S6.	Summary	of library counts										
Sample	Library typ	Total merged Reads	Mapped Rea	%Mapped Rea	No Duplica	% Duplica	Q20	%Q20	no_indel	Bp_covered	no_indel	Bp_covered
D. 16-24	SS	434067516	1363797	0,31%	1308612	4,05%	968913	74,04%	949222	34646603	1 (15,000	F 995.007
БиказА	DS	386553501	1077374	0,28%	958509	11,03%	668375	69,73%	660757	24117631	1,010+000	5,00E+007
BuKa3C	DS	307786326	4228673	1,37%	4196156	11,24%	3134038	74,69%	3124721	115614677	3,12E+006	1,16E+008

Table S7. References for mitochondrial sequences

	Haplogroup	Date*	Location	Reference
Yoruba	L3	modern	West Africa	AF347014.1
BK_BB7-240	Ν	44690	Bulgaria	Hublin, et al.4
BK_CC7-335	Ν	45120	Bulgaria	Hublin, et al. <sup>4</sup>
BK_CC7-2289	R	43690	Bulgaria	Hublin, et al. <sup>4</sup>
BK_F6-620	М	43110	Bulgaria	Hublin, et al.4
BK_1653	U8	34950	Bulgaria	Hublin, et al. <sup>4</sup>
BuKa3A	Nl	35770	Crimea	this study
BuKa3C	U	36830	Crimea	this study
Cioclovinal	U	32660	Romania	Fu, et al. <sup>26</sup>
Fumane2	R	39805	Italy	Benazzi, et al.44
Goyet2878-21	U5	26662	Belgium	Fu, et al. <sup>26</sup>
GoyetQ116-1	М	35210	Belgium	Fu, et al. <sup>26</sup>
GoyetQ376-19	U2	27515	Belgium	Fu, et al. <sup>26</sup>
GoyetQ376-3	М	33540	Belgium	Fu, et al. <sup>26</sup>
GoyetQ53-1	U2	27975	Belgium	Fu, <i>et al</i> . <sup>26</sup>
GoyetQ55-2	U2	27520	Belgium	Fu, et al. <sup>26</sup>
GoyetQ56-16	U2	26320	Belgium	Fu, et al. <sup>26</sup>
Kostenki14	U2	38050	Russia	Seguin-Orlando, et al.7
KremsWA	U5	31020	Austria	Teschler-Nikola, et al. <sup>22</sup>
LaRochette	М	27592	France	Posth, et al. <sup>11</sup>
Muieriil	U6	35204	Romania	Hervella, et al.45
Nla	Nla	NA	NA	N1a canonical
Nlb	Nlb	NA	NA	N1b canonical
Natufian9	N1	10800	Isreal	Lazaridis, et al.46
Oasel	Ν	39580	Romania	Fu, et al. <sup>37</sup>
Paglicci108	U2'3'4'7'8'9	28396	Italy	Fu, et al. <sup>26</sup>
Paglicci133	U8c	32260	Italy	Fu, et al. <sup>26</sup>
Salkhit	Ν	34425	Mongolia	Massilani, et al.47
SAT29	Ν	28543 †	Georgia	Gelabart, et al.48
Sunghir1	U8	33270	Russia	Sikora, et al. <sup>40</sup>
Sunghir2	U2	34610	Russia	Sikora, et al. <sup>40</sup>
Sunghir3	U2	34520	Russia	Sikora, et al. <sup>40</sup>
Sunghir4	U2	34320	Russia	Sikora, et al. <sup>40</sup>
Tianyuan	R	39570	China	Fu, et al. <sup>28</sup>
TKH-1	Ν	6978	Lybia	Vai, et al. <sup>49</sup>
Ust-Ishim	R	45020	Siberia	Fu, et al. <sup>5</sup>
Věstonice13	U8	31140	Czechia	Fu, et al. <sup>26</sup>
Věstonice14	U5	30870	Czechia	Fu, <i>et al</i> . <sup>26</sup>
Věstonice16	U5	31250	Czechia	Fu, <i>et al</i> . <sup>26</sup>
Věstonice43	U5	31150	Czechia	Fu, <i>et al</i> . <sup>26</sup>
Zlatý Kůň	Ν	42036 †	Romania	Prüfer, et al. <sup>3</sup>

\*median value (cal BP) of dates from reference. †median value from mtDNA tip dating.

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## **Chapter II**

## Genomics of the European Neolithization Process Paralleled by Fine-Scale Population Differentiation

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The Neolithic expansion from the Balkans to the Paris Basin along the continental route was a relatively slow process that took over 1,000 years. This left ample time for regional differentiation of both genomes and cultures. While some of the regional characteristics have been analyzed genetically in Central Europe, there is a lack of data for northern France. Therefore, we wanted to fill the empty space on the map and investigate the genomics of the neolithization process in this area at high resolution. We focused on the Paris Basin and sampled 168 individuals from the Early, Middle and Late Neolithic. Fine-scale analysis of newly generated genome data allowed us to shed light on fundamental populational processes, such as migration and admixture. The interpretation of the obtained genomic results in light of archaeological data, which is still ongoing, will modify our view of the neolithization process in western Europe.

### **Results & Discussion**

We report the genomic analysis of 109 newly sequenced ancient individuals from 20 sites in the geographically defined Paris Basin including the present-day Picardy, Champagne and Nord-Pas-de-Calais regions of northern France. We also enriched the sample of Neolithic Iberian shotgun genomes with a new genome of a Late Neolithic individual. All the individuals studied here are associated with Neolithic cultures spanning a period from 5100 to 2500 BCE except one Mesolithic individual dating to ~6200 BCE (Fig. 1a, b). The majority of the sites are located along the Aisne Valley in Picardy and correspond to the remains of Neolithic villages dating between 5100 and 4900 BCE and associated with the final phase of the Linearbandkeramik (LBK) culture in Western Europe, formerly knowns as the "Rubané Récent du Bassin Parisien"- RRBP, and at present as terminal LBK<sup>1</sup>. We also analyzed data obtained from three individuals from the site of Saint-Martin-sur-le-Pré in the Marne Valley Southeast of Reims. We also sequenced and analyzed individuals from post-LBK periods in the Aisne Valley including the Blicquy/Villeneuve-Saint-Germain (BVSG) culture dating between 4900-4700 BCE, as well as from later periods associated with the Cerny culture, the Michelsberg culture (Michelsberger Kultur - MK) and the post-Michelsberg period (post-MK) approximately dating to 4700-4300 BCE, 4250- 3700 BCE and 3600-3,00 BCE, respectively<sup>2-</sup> 4

We further included seven individuals, dating between 4126 and 3866 calBCE, from the Middle Neolithic II site of Escalles "Mont d'Hubert" from the most Western extension of the Paris Basin in the Flanders region (Cap Blanc Nez) with its particular "Escalles" culture. One analyzed individual was buried in the Middle Neolithic III "Balloy" culture site at Haut-de-Launois, Pont-sur-Seine in the Aube department Southeast of Paris and dated to  $4715 \pm 40$  BP (GrA-47169) (3641-3380BCE). Another one originates from the site of Mairy "Les Hautes Chanvières", a Middle Neolithic III site close to Sedan in the Ardennes located at the tipping point between the Rhine zone and the Western area of the "Michelsberg" culture and dating to 4770 ±45 BP (3631-3372BCE). Finally, we analyzed 18 individuals from two hypogea at Chouilly « la Grifaine » in the Marne Valley dating to between 3400-3300 and 2900-2800 BCE, i.e., during the Late Neolithic (Table S1). The Iberian individual from Camino de las Yeseras in the Madrid region dates to the 3rd millennium BCE. We generated genomic data from these 110 ancient individuals by shotgun sequencing resulting in a coverage range from 0.1 to 4.2 X with a median of 0.6 X genomic coverage. 78 individuals with a coverage higher than 0.3 X were imputed and phased together with publicly available ancient genomes generated by shotgun sequencing (Table S1, S3) based on the high accuracy performance for common alleles (MAF > 5%) reported by Rubinacci et al. Lower coverage genomes and those that had been genotyped using sequence capture with the 1240k SNP array were treated separately and considered as pseudo-haploid genomes (See Materials and Methods).

#### Uniparental Markers and Kinship

We determined the uniparental markers in all individuals. The mitochondrial haplogroups comprise the diversity of haplogroups that were previously reported in Neolithic individuals from France, i.e., H, J, K, N, T, U (Table S1)<sup>5–8</sup>. Similarly, Y haplogroup diversity of these newly reported Neolithic individuals comprise the common Neolithic and Mesolithic haplogroups C1a2, G2a2, H2, I2a1a, I2a1b, J2a1a, R1b. We encountered one exceptional case of I1 in a Late Neolithic individual from the Chouilly hypogeum F11, which is a haplogroup commonly found in present-day Northern European populations<sup>9</sup> and to our knowledge reported only once in an LBKT Neolithic site in Hungary<sup>10</sup>. The Y chromosome sequences from both the newly generated and the previously published genomes were placed into the reference Y chromosome phylogeny (Fig S1)<sup>11</sup>.



## Figure 1. Spatiotemporal distribution and genetic relatedness of the analyzed Neolithic individuals

a, Map showing geographical locations of archaeological sites analyzed in this study. The Aisne valley is shown in the inset at higher resolution.
b, Chronological timeline of the individuals grouped by archaeological cultures and geographical regions in northern France.
c, Genetic relatedness among analyzed individuals. Cotterman coefficients (k2, k1, and k0) of pairs of related individuals estimated by NgsRelate indicating probabilities of sharing 2, 1 or 0 autosomal alleles that are identical-by-descent.

In order to provide insights about the burial practices and social interactions within and between Neolithic sites and to exclude closely related individuals from downstream population analyses, we estimated the pairwise kinship coefficients for autosomes and X chromosomes of all individuals (Table S2). We calculated Cotterman coefficients (k0, k1, k2), i.e., the genome fraction between two individuals sharing 0, 1 and 2 alleles in the identity-by-descent (IBD) approach, using NgsRelate<sup>12</sup> on imputed genomes. This analysis allowed us to infer the kin relationships between related individuals in comparison with previously reported pedigree simulations (Fig. 1c)<sup>13</sup>. We report two pairs of twins, BVT609 – BVT610 and BLF148-BLF149, in the sites of Berry-au-Bac "Le Vieux Tordoir" (BVT) and Bucy-le-Long " La Fosselle" (BLF),
respectively (Fig 1c.). To increase the genomic information from these individuals, the raw data of the twins were merged as if they were different genomic libraries of the same individuals. With the support of the uniparental haplogroups and the anthropological age of death estimation as well as the Cotterman coefficient distribution we infer a family including a mother, MDV208, and her two children, adult female MDV233 and juvenile male MDV213, that were buried in LBK burials in close vicinity in the site Menneville "Derrière le Village" (MDV)<sup>14,15</sup> as the parent offspring pairs share a single allele in the IBD analysis at each position and the siblings are positioned in the middle of the ternary diagram (Fig. 1c). However, we do not detect any degree of kinship from other individuals that were buried in close vicinity to this family. There are two other pairs of sisters that can be deduced from their position in the ternary diagram and their mitochondrial haplogroups. The pair MDV93.2, an adult female, and MDV93.3, a female infant, was buried together in Menneville "Derrière le Village". Strikingly, another pair of adult sisters were found to be buried in different sites roughly 30 km apart, one in Maizy "Les Grands Aisements" (MGA45) and one in Bucy-le-Long "La Héronnière" (BLF91) illustrating connections between LBK villages and suggesting some female mobility. We found also various inter- and intra-site second to third degrees of kinship that can be deduced from the distribution of k0 and k1 values. One notable case is a pair from the LBK site Saint-Martinsur-le-Pré, a male SMP471 and a female SMP451. These individuals shared the mitochondrial haplogroup and were inferred based on the autosomal and X-chromosomal kinship values to have third- and second-degree kin relations (Table S2). These results indicate that they were half siblings sharing the same mother.

#### Mesolithic hunter-gatherers and Neolithic farmers in western Europe

Previous studies that compared the various aspects of individuals from Early Neolithic populations and their contributions to the populations of later periods in Western Europe relied only on genomes from LBK sites in Central Europe or made assumptions directly based on post-LBK populations in Western Europe<sup>7,8,16</sup>. The conclusions drawn, however, might be misleading since they did not take into account the genome evolution of the westwards moving LBK groups leading to genetic differentiation. Instead, genetic differences between the northern and southern Neolithic genomes were explained exclusively by varying hunter-gatherer

proportions<sup>7,17,18</sup>. It is questionable, however, that the moving LBK groups did only evolve through admixture. Genomic data from populations in Northwestern Europe, and in particular the Paris Basin, and a higher resolution analysis were needed to better inform the biological and social evolution during the LBK and the following Neolithic periods.

The newly produced genomes from Early Neolithic individuals from the territory of present-day France, in particular from the Paris Basin were deemed to fill this gap and to increase the resolution of the analysis. We excluded the genomes of related individuals as well as low coverage genomes and analyzed the remaining 269 imputed and phased Mesolithic and Neolithic genomes via ChromoPainterv2/fineSTRUCTURE analysis<sup>19</sup> comprising 65 new genomes being produced in the present study. This analysis was followed by principal component analysis (PCA) performed on the linked coancestry matrix (Fig. 2a). Huntergatherers and farmers are separated by PC1 (right and left, respectively) whereas PC2 separates hunter-gatherer ancestries in a way roughly correlated with geography. We further focused our investigation on the differences in the genetic structure between the various hunter-gatherer genomes from both Mesolithic and Neolithic contexts applying the same pipeline (Fig. S2). The ensuing fineSTRUCTURE dendrogram reveals an east-to-west cline (Fig. S2a). In western Europe, the hunter-gatherer genomes are divided into two clusters corresponding to the presence of the previously well-defined dual ancestries associated with either the Magdalenian or the Epi-Gravettian cultures<sup>20</sup>. The Epi-Gravettian ancestry, which was found in the early post LGM individuals from northern Italy, Tagliente and Villabruna dating back to respectively ~17 and ~14 kya<sup>20,21</sup>, is represented in the present dataset by the genomes of slightly later individuals from the Bichon and Kendrick's Caves (Bichon and Kendrick, both ~13,7 kya)<sup>22,23</sup>. The Magdalenian ancestry, which was previously found in Spain (El Miron, ~19 kya)) and Belgium (Goyet Q2, ~15 kya)<sup>20,24</sup>, is represented by the earliest individual from Gough's Cave (Gough, ~14,8 kya)<sup>23</sup>. The fineSTRUCTURE dendrogram separates these two earliest individuals with Epi-Gravettian ancestry from the later western European Mesolithic individuals. The newly reported Mesolithic individual CCF711 from Cuiry-lès Chaudardes in the Aisne Valley (Fig. 1a,b) is both genetically and geographically closest to the cluster of Mesolithic hunter-gatherers from present-day France, Great Britain, and Luxembourg who all are close to the highly related Mesolithic hunter-gatherers from Italy, altogether associated with the earlier Bichon and Kendrick individuals (Fig. 2b). This cluster attests to the presence of genetic ancestry of the earlier Epi-Gravettian cultures in western Europe and thus genetic

continuity until the Mesolithic. However, this "Epi-Gravettian" group is distinct from the Mesolithic individuals from Iberia that have retained the genetic ancestry associated with Magdalenian hunter-gatherers, here represented by the Gough's Cave individual<sup>23,24</sup>.



#### Figure 2. Fine-scale structure of Neolithic populations in Europe.

**a**, Principal Component Analysis (PCA) based on ChromoPainter haplotypic coancestry matrix calculated on the whole dataset including both farmer and hunter-gatherer genomes. The fraction of variance explained by PC1 and PC2 is, respectively, 64.9% and 9.1%. Empty symbols indicate hunter-gatherer genomes. Diamonds with black outlines indicate Neolithic individuals from northern France reported here. **b**, PCA plot as in Fig. 2a but showing individuals colored by their hunter-gatherer ancestry proportions estimated by

SOURCEFIND. The hunter-gatherer genomes are represented as in Fig. 2A. **c**, PCA based on ChromoPainter haplotypic coancestry matrix calculated on a subset of individuals excluding hunter-gatherer and outlier farmer genomes with high hunter-gatherer ancestry (>~35%). The later Neolithic individuals from British Isles are excluded from the dataset in order to reduce the effect of clustering formed by the extreme haplotype sharing (see Figure S4). The fraction of variance explained by PC1 and PC3 is, respectively, 38,9% and 2,8% (PC2: 5.5%, see Fig. S5). **d**, PCA plot as in Fig. 2c but showing individuals colored by their hunter-gatherer ancestry proportions estimated by SOURCEFIND. Names of the individuals referred to in the text are indicated. The black outlines indicate newly reported genomes. Two-letter country codes according to the International Organization for Standardization (ISO) are used in the group labels. (FR: France, AT: Austria, DE: Germany, ES: Spain, PT: Portugal, IT: Italy, GB: Great Britain (-E :England, -S: Scotland), IE: Ireland, GR: Greece, HR: Croatia, HU: Hungary, BG: Bulgaria, RS: Serbia, TR: Turkey, CZ: Czechia, PO: Poland, SE: Sweden, RO: Romania, NO: Norway, LV: Latvia, LU: Luxembourg, CH: Switzerland)

It has been shown that the Last Glacial Maximum (LGM) had a detrimental effect on the diversity of European hunter-gatherer populations, that the resulting bottleneck was followed by population expansions and that diversity and population size in farmer populations was higher in the Holocene<sup>25-28</sup>. To assess the recent demographic history of the ancestral population of the Mesolithic individual from the Paris Basin, CCF711, together with other Mesolithic groups, we calculated the distribution of runs of homozygosity (ROH) segments based on their total number of segments and their cumulative lengths. To render this estimation more robust and to decrease the number of false-positive homozygous segments, we restricted our analyses to segments longer than 1 centimorgan (cM). The ratio of cumulative length and number of ROH segments shows larger proportions of ROHs in Mesolithic individuals from western Europe compared to contemporary southeastern individuals (Fig. S3a). This suggests a higher "background relatedness" in the west due to possibly smaller recent population sizes. CCF711, however, has shorter cumulative ROHs compared to the other western Mesolithic individuals with Epi-Gravettian ancestry described above, to which he shows both genetic and geographical proximity. When the shorter ROH segments between 1 to 2 cM are excluded, the ROH proportion for this individual is drastically decreased indicating a lack of segments larger than 2 cM (Fig. S3b). This shift detected after exclusion of the ROH segments between 1 to 2 cM suggests that CCF711 originated from a population that was relatively larger compared to those of other western Mesolithic individuals. We predicted the pigmentation pattern of Mesolithic and Neolithic individuals in the imputed dataset through genotyping using the forensic HIrisplex-S assay<sup>29</sup>. The Mesolithic hunter-gatherer from the Aisne Valley, CCF711, probably had phenotypic traits similar to Loschbour, the closest neighbor of CCF711 both

genetically and geographically, with blue eyes, dark black to brown hair and intermediate skin color (Table S7). This is in contrast to other Mesolithic hunter gatherers who probably had dark to black skin such the Mesolithic individuals from the British Isles<sup>16,30</sup>.

The first farmers of western Europe – Genomic differences between the two Neolithic migration routes into Europe

The comparison of hunter-gatherers and European Neolithic farmers reveals the various levels of hunter-gatherer ancestries to be the main source of differentiation between European Neolithic farmers along PC1 as visible when the proportions of HG ancestry in the genomes is represented (Fig. 2b). PC2 also separates the Neolithic farmer groups from the Marmara (TR), Aegean (GR), the Balkans (BG, RS, HR), and Central Europe (DE, HU, PO) from those of the British Isles. Individuals from other regions are distributed between these two poles in a manner that is not related to their geographic origin (Fig 2a). Genomes from the Iberian Peninsula (ES, PT) and northern Europe (PO, SE) cluster together while those from the northern France LBK individuals (FR\_N\_5100\_4900\_LBK) are widely spread and appear to encompass the whole European Neolithic variability, as visible along PC2. Furthermore, some of these northern France LBK individuals are similar to Southern Mediterranean Neolithic individuals associated with the Impressa-Cardial (ICC) culture. This uncovers strong links between LBK groups in the Paris Basin and ICC groups from the Western Mediterranean.

Since this differentiation of Neolithic farmer does not follow their hunter-gatherer proportions, we aimed at better characterizing it by performing the PCA in the absence of hunter-gatherer-rich genomes ( $>\sim35\%$ ) (Fig. 2c, d, S4b). PC1 separates Neolithic farmers according to the combination of the extent of hunter-gatherer ancestry and an approximate east-to-west cline (Fig. 2c, d). PC3 separates the Neolithic farmers with hunter-gatherer ancestry according to a south-to-north cline (Iberian Peninsula and British Isles, respectively). The corresponding genetic differentiation seems to have started with the beginning of the Neolithic migrations since the earliest ICC groups in Italy have already diverged from the Balkan Neolithic population (See Fig. S4-5 for alternative PCA representations). The correlation

between the position of individuals on this PCA plot and their geographical locations reveals the progression of the genetic differentiation of Neolithic farmers as they move along the two European migration routes in Europe. In the PCA, the genomes on the right side correspond to the original Aegean Neolithic population before the separation into two main groups. Individuals of group I associated with the ICC moved from east-to-west (right-to-left in the PCA plot) over the Mediterranean via Italy (intermediate positions on the PCA plot) ending on the Iberian Peninsula (lower left corner). Genomes of the individuals belonging to the Neolithic group II moving northward through the Balkans and to the following LBK groups moving westward spread on the PCA plot to the upper left corner with central European individuals from Poland occupying an intermediate position. From these results we can conclude that the migrating groups on both routes diverged from the same source population in the southern Balkans as they moved into Europe and admixed with hunter-gatherers. The LBK population in the Paris Basin has a heterogenous distribution on the PCA testifying the early Neolithization of Europe as a transition period during which the farmer populations differentiated. Indeed, the presence of both eastern and western ancestries in the earliest farmer group of the Paris Basin highlights the ongoing formation of a local ancestry signature in this founder population. The spread along PCA of the later Neolithic individuals from the Paris Basin is more restricted as it is the case for the other western European individuals. Along PC3, they occupy an intermediate position between the Iberian Peninsula/southern France and the British Isles. In conclusion, our results show the ChromoPainterv2/fineSTRUCTURE-based PCA to be powerful enough to uncover the genomic differences between the southern ICC and the northern LBK groups.



Figure 3. Demographic history of Early Neolithic European populations.

**a**, Runs of Homozygosity (ROH) computed for Early European farmers. The ratio of cumulative length and number of ROH segments longer than 1 centi-Morgan (cM) was used to estimate the inbreeding and background population relatedness for assessing the recent demographic history of individuals. The names of individuals referred to in the text are indicated. **b**, Past effective population size changes inferred by MSMC2. Six haplotypes per Early Neolithic or Mesolithic population were used for the estimations.

To assess the recent demographic history of Mesolithic and Early Neolithic farmer groups, we calculated the distribution of ROH segments based on their total number of segments and their cumulative lengths, restricting the analyses to segments longer than 1 centimorgan (cM) (see above). We find that the distribution of ROH segments in the LBK population from the Paris Basin varies considerably with values that are on average higher than those of the LBK individuals from Germany (Fig. 3a). This suggests that the Paris Basin was colonized by smaller groups compared to those in central Europe causing a loss of genetic diversity that occurred independently of the extent of hunter-gatherer ancestry (Fig. S6). Individual MDV13-I is exceptional in that it shows a high number of long ROH segments, which are signals of recent consanguinity (Fig. 3a). To infer past effective population size changes in Early Neolithic groups, we used Multiple Sequentially Markovian Coalescent (MSMC2), a method based on a pairwise hidden Markov model (HMM) approach, for the estimation of coalescent rates<sup>31</sup>. We used six haplotypes per population consisting of the individuals with the highest coverage to minimize the impact of imputation errors. The MSMC2 results show population size fluctuations over the last 50 kya (Fig. 3b), similar to those previously reported for Eurasia<sup>32</sup>. We observe a differentiation of the population dynamics between the Mesolithic and Neolithic populations

with the former experiencing only reduced post-LGM expansion and then conserving a small population size during the first half of the Holocene. The lower effective population size estimated for the western Mesolithic populations is in agreement with the differences in the ROH segment distribution between these forager and farmer groups (Fig. 3a, Fig. S3a). The population size of the southeastern Mesolithic/Epipaleolithic populations, however, increases after ~18 kya suggesting that the population dynamics in Western and Southeastern Mesolithic hunter-gatherer populations were different (Fig. 3b). This result is in agreement with the ROH size distribution in the different populations (Fig. S3a). The ancestral Neolithic farmer populations started to expand right after the LGM, earlier than what was previously reported<sup>28</sup>, a trend that was never reversed up to now in most of Europe. In the most recent phase, 7-4 kya, the population size of the various Early Neolithic populations all over Europe steadily increases except in the LBK population of the Aisne Valley, whose size decreases. This decrease is corroborated by the higher proportion of ROH observed in this population (Fig. 3).



#### Figure 4. Evolution of hunter-gatherer ancestry in Neolithic Europeans.

**a**, Proportion of hunter-gatherer ancestry calculated per individual by two-way admixture modelling of qpAdm. The individuals were grouped by location, archaeological context and dates. The names of individuals referred to in the text are indicated and newly reported genomes are boxed. **b**, top: Admixture dates and 95% confidence intervals (in black) inferred

with fastGLOBETROTTER and mean radiocarbon dating values of the individuals. bottom: Density curve of inferred dates. The black line indicates the cumulative distribution computed from all genomes whereas the colored density plots correspond to individuals grouped as ICC, LBK and post LBK/ICC as indicated on the figure. The LBK outlier MDV571-7 that has an ancestry related to the Mediterranean expansion route and an admixture date shared with three other ICC was included in the ICC group for density plot calculation.

Although the archaeological evidence for the interaction between early migrating LBK farmers and autochthonous foragers is limited<sup>33</sup>, genetic data provided clear evidence for their admixture<sup>17</sup>. To reconstruct the admixture history between early European farmers and autochthonous forager groups, we inferred the admixture dates using fastGLOBETROTTER, a robust method relying on phased haplotypes<sup>34</sup>. The archaeological contexts in the LBK villages from which the analyzed individuals originate are well characterized and precisely dated based on both stylistic criteria on the pottery and radiocarbon dates. The villages in the Aisne Valley were occupied during a relatively short period of ~150 years between 5100 to 4900 BCE, i.e., for ~5 generations. Based on this narrow, reliable time frame, we inferred the dates for the admixed individuals regardless of the presence of radiocarbon dating information to have occurred in their ancestors between 9 to 33 generations before their birth corresponding to an average value of 21 generations (Table S5). Based on these data and assuming 28 years per generation, we can propose that the major admixture wave occurred on average between 5600-5400 BCE, i.e., at the time of the emergence of the LBK in Transdanubia and its early expansion into Central Europe. For the radiocarbon-dated individuals we plotted the inferred admixture dates with 95% CI obtained from a jack-knifing resampling method together with the calibrated mean age of the samples (Fig. 4b). The most recent number of generations is detected in the LBK individual SMP4738 dating to 5100 cal BCE, for whom we demonstrate elevated hunter-gatherer ancestry (Fig. 2b, 4a), indicating admixture dates between 5400-5300 cal BCE. This suggests that the admixture occurred in the ancestors of SMP4738 before they arrived in the Paris Basin. When all early European Neolithic individuals are compared, the LBK individuals from France and Germany indicate an approximate admixture date range corresponding to the early LBK expansion.

ICC individuals from Spain and Italy display diverse and recent admixture events. However, admixture dates estimated for R6, a Neolithic ICC individual from Central Italy dated to 5242 - 5177 cal BCE <sup>35</sup> with the highest hunter-gatherer ancestry of all ICC genomes available,  $\sim 20\%$ , (Table S4), is in the range of 5923 - 6132 calBCE, i.e., earlier than what was estimated for LBK individuals. This is in line with ICC expansions having started around 500 years earlier in the central Mediterranean<sup>33</sup>, i.e., contemporaneous with the admixture date estimated for this individual. A similar range of admixture dates was estimated for Neolithic individuals from Sicily and Sardinia (Fig. 4b). Furthermore, recently reported admixture dates of Neolithic groups from continental Italy and Sardinia<sup>36</sup> and southwestern France<sup>18</sup> by a method relying on the ancestry covariance pattern between the test genome (pseudo-haploid in this case) and those of two source populations coincide with these earlier admixture dates inferred herein for ICC individuals. A striking case is the woman MDV571-7, buried in the ditch enclosure of the LBK site of Menneville "Derrière le Village" in the Aisne Valley, that probably died from a blow to her head. The inferred admixture date is around 33 generations before her birth (95% CI: 28-36) around 5975 - 6102 calBCE (Fig. 4b). This range fully overlaps with the dates inferred from the Italian ICC individual R6. Moreover, MDV571-7 clusters together with the ICC individuals from Italy and Spain indicating similar genetic ancestry as the members of the Mediterranean expansion (Fig. 2c). Interestingly, the ROH distribution profile of MDV571-7 diverges slightly from the profile of the other LBK individuals of the Aisne Valley, further supporting the interpretation of a different origin of her ancestry (Fig. 3a). These different genetic lines of evidence suggest that MDV571-7 has a different origin than the other LBK individuals in the Aisne Valley. Using a method adapted to 1.2 million SNP array and pseudo-haploid data<sup>26</sup>, higher ROH proportions for individuals from southern France and smaller effective population sizes compared to continental expansion route have been reported which supports the hypothesis of farming expansion via the Mediterranean route taking place in smaller-sized groups<sup>18</sup>. Therefore, it seems legitimate to hypothesize that MDV571-7 or her ancestors came from an ICC-associated context in southern Europe. This is the first reported genetic evidence of interaction between LBK and ICC groups. This individual probably had been killed and then was buried with various wild and domestic animals suggesting that she occupied a particular position in the village, possibly related to her origin.

To obtain a global view of the distribution of the admixture dates of the various genomes analyzed here, we plotted density curves of these dates together with their uncertainty distribution. When all Neolithic individuals are considered, three major admixture waves are visible centered around 5500, 4900 and 3800 BCE. Since these individuals correspond to different migrations routes and/or cultural affiliations and span a large time period, we divided them in three groups corresponding to the two European Neolithic migration routes, the central European/LBK route and the Mediterranean/ICC route, as well as a third group corresponding to later Neolithic periods. This allowed us to achieve better resolution of the timing of admixture. The ICC-associated individuals show two admixture waves , one corresponding to the early wave discussed above, including MDV571-7, and a second wave centered around 5500 BCE. The LBK individuals also experienced to two major admixture waves but occurring at distinct times, one centered around 5600 BCE, the second around 5400 BCE. The post-LBK individuals also show two peaks that will be discussed later.

We further investigated the genomic distribution of hunter-gatherer segments in admixed Neolithic genomes. We inferred local ancestry based on ELAI that uses a two-layer HMM for learning local haplotype structures <sup>37</sup>. The inferred local ancestry pattern per admixed individual was plotted as an ancestry karyogram to visualize the genomic segments of huntergatherer or Early European farmer (EEF) ancestry (Fig 5, Fig S9-10). The "outlier" LBK individual SMP4738 has an elevated hunter-gatherer ancestry (~45%) associated with a more recent admixture date (95% CI: 8–10 generations), carries longer genomic segments of huntergatherer origin compared to another LBK individual from the Paris Basin, BLF148-9, with limited hunter-gatherer ancestry (~6%) and a similar number of admixture generations (95% CI: 8–15) (Fig 5a). The differences in the distribution of long segments indicate a gene flow event in the ancestors of SMP4738 that is potentially more recent than the inferred number of generations for the major admixture event that occurred at a similar date than for other individual with smaller segment sizes. This suggests that recent gene flow events leading to a few long haplotype blocks do not contribute as much to admixture date estimation with fastGLOBETROTTER than many shorter haplotype blocks do.



# Figure 5. Genomic distribution of hunter-gatherer segments in Neolithic farmer genomes

Karyogram showing local ancestry pattern inferred with ELAI for admixed Neolithic individuals. The genomic regions with mean local ancestry dosages higher than 90% for either hunter-gatherers (HG) or Early European farmers (EEF) are shown in purple or orange, respectively. The grey color, NA, indicates the regions with less reliable local ancestry inference (<90%). Ancestry karyograms with different admixture histories in Early Neolithic (a) and Late Neolithic (b) farmers from the Paris Basin. See Figure S9 and S10 for karyograms of other Neolithic individuals.

The inference of local ancestry segments in admixed individuals allowed us to analyze the background hunter-gatherer ancestry and investigate the potential source for gene flow into Early Neolithic farmers. To do so, we extracted the hunter-gatherer segments present in admixed Neolithic genomes and constructed for each individual a new "semi-diploid" genome. The underlying procedure is that positions on segments inferred to originate from hunter-gatherers on only one haplotype are pseudo-diploidized whereas those inferred to originate from hunter-gatherers on both haplotypes remain in the diploid state. The reconstituted partial genomes were analyzed separately together with hunter-gatherer genomes filtered to keep only shared positions. The ChromoPainterv2/fineSTRUCTURE pipeline was used to produce coancestry matrices. The resulting PCA plots allowed us to characterize the hunter-gatherer ancestry in Neolithic farmers. To explore the accuracy of this approach, we analyzed the hunter-gatherer ancestries of early farmers from either the continental/LBK or

Mediterranean/ICC expansions. Strikingly, we see a notable clustering between the huntergatherer ancestries of some individuals and local hunter-gatherers (Fig S8). The approach used is powerful enough to detect different signals of local admixture in different regions of Europe. An early Neolithic individual from Hungary (NE1), for instance, has HG ancestry that clusters closely to a local hunter-gatherer from Hungary (Fig. S8d). Likewise, a Cardial individual from southern Spain, Mur (5296-5076 cal BCE), is found to be the product of a local admixture between Cardial farmers and Iberian hunter-gatherers (Fig S8e). Not all Neolithic farmers could be associated, however, to a single, previously described, source of hunter-gatherer ancestry. For example, the hunter-gatherer ancestry of another Cardial farmer from northeastern Spain, CB13 (5469-5327 calBCE), who lived around 200 years earlier than the Cardial individual from Mur, does not appear to be similarly close to Iberian Mesolithic individuals (Fig. S8f), extending previous observations at lower resolution<sup>38</sup>. CB13 occupies a position on the PCA suggesting a dual influence of western and Iberian hunter-gatherer ancestry (Fig. S8f). We detect a hunter-gatherer ancestry with a close proximity to western European Mesolithic individuals in two Italian ICC individuals, R6 and R17 (Fig. S8a-b). The ICC individuals cluster together on the whole genome PCA despite their hunter-gatherer ancestries originating from different sources since (Fig. 2). This suggests that the main source for the differentiation between western European Neolithic farmers are not different hunter-gatherer ancestries. When this approach was applied to the LBK individuals from the Paris Basin, we detected various hunter-gatherer ancestry affinities (Fig. S7). The aforementioned SMP4738 individual, a carrier of elevated hunter-gatherer ancestry and large segments, presumably originating from recent admixture events, clusters with western European forager groups and is close to the earlier CCF711 Mesolithic individual from the same region (Fig. S7a), thus indicating a recent admixture event with local individuals with high hunter-gatherer ancestry. Interestingly, MDV571-7, who displayed ICC-like genetic ancestry, carried hunter-gatherer ancestry with closer proximity to the Iberian Mesolithic individuals than observed for most of the other Paris Basin Neolithic individuals. Another LBK individual, MDV188-4-89, has also hunter-gatherer ancestry that shows proximity to Iberian Mesolithic individuals (Fig. 7e). This individual, in contrast to MDV571-7, does not show genomic proximity to southern ICC individuals (Fig. 2c) providing additional evidence that the whole genome differentiation of western Neolithic individuals detected by the ChromoPainter PCA is not solely driven by differences in the source of HG ancestry. The complex geographical distribution of Magdalenian ancestry, which has so far been found in Iberian Mesolithic individuals (Fig. S2), is yet to be fully characterized to obtain a better understanding of its presence in farmer genomes of later periods. When the huntergatherer ancestry in a given Neolithic individual occupies an intermediate position between currently described hunter-gatherer populations, we cannot establish whether this putative mixed ancestry corresponds to unsampled hunter-gatherer populations or if this composite ancestry resulted from mating between Neolithic farmers with diverse sources of huntergatherer ancestries. Intuitively, this latter interpretation appears more parsimonious. Our detection of differences in the timing of the major waves of HG admixture, as well as in the sources of these HG ancestry in the Neolithic farmers migrating in Europe along the continental and Mediterranean routes indicates geographical and temporal differences in the interactions between the migrating Neolithic farmers and the local Mesolithic hunter-gatherers. These differences contributed to the phylogeographical shaping of the early European genome even though the diversity of these admixture patterns does not appear to be the sole generator of genetic differentiation. Indeed, genetic drift during migration is likely playing an important role in this differentiation that cannot be simply correlated to HG ancestry in many cases.

#### Post-LBK populations of Northern France

After the end of the LBK around 4900 BCE, the expansion of farming and new Neolithic cultures continued to spread within Europe<sup>33</sup>. In northern France, this process seems to be accompanied by new waves of admixture with hunter-gatherers. We could detect two main admixture waves in post-LBK western Europeans, one centered around 4900 BCE and one centered around 3800 BCE (Fig. 4b). In parallel, we did not detect Middle Neolithic farmers with little or no HG ancestry, while genomes with elevated levels of HG ancestry can be found in these later periods (Fig. 4a). This argues that individuals with high HG ancestry still existed during this later period even though the Mesolithic lifestyle is not detected anymore at this time in this area. The genomes of the individuals associated with post-LBK cultures in the Aisne Valley, including BVSG (Blicquy-Villeneuve-Saint-Germain), Cerny, Michelsberg and post-Michelsberg, cluster with the preceding LBK farmers, which argues for population continuity (Fig. 2c). The early Neolithic culture of BVSG spreading from the Paris Basin west and north and dating back from 4900/4850 to 4700/4650 BCE, is archaeologically considered as a continuation of the former LBK culture with some distinct features<sup>1</sup>. The inferred HG admixture dates for the two contextually-dated BVSG individuals with the highest genome

coverage range between 5100 – 5600 BCE, overlapping with the dates inferred for the preceding LBK individuals (Table S5). In the following periods, a more recent date of HG admixture ranging from 4600-5100 BCE is estimated for the individuals from France Cerny, Michelsberg and post-Michelsberg culture, as well as for the Early Neolithic from England (Fig. 4b). Thus the admixture process between farmers and foragers continued during the westward expansion of farming, in agreement with archaeological evidence that supports interactions with preexisting Mesolithic groups<sup>39</sup>.



## Figure 6. Population history of 4<sup>th</sup> millennium BCE Paris Basin individuals with high hunter-gatherer ancestry

**a**, Past effective population size changes inferred with MSMC2. Four haplotypes per population were used for Beaurieux les Grèves (BLG) as well as for the reference Mesolithic and Early Neolithic groups. **b**, ROH computed for BLG, Mont-Aimé and Mesolithic individuals. The ratio of cumulative length and number of ROH segments longer than 1 cM was used to estimate the inbreeding and background population relatedness to assess the recent demographic history. **c**, PCA based on ChromoPainter haplotypic coancestry matrix calculated on hunter-gatherer genomes and on extracted hunter-gatherer segments from BLG and Mont-Aimé individuals. The fraction of variance explained by PC1 and PC2 are, respectively, 63,8% and 9,6%.

#### Hunter-Gatherers of Western Europe in the 4th Millennium BCE

In western Europe the hunter-gatherer ancestry gradually increased up to 30% from early to later Neolithic periods, if one neglects a few "outlier" Early Neolithic individuals like SMP4738 and the Cardial farmers from Southern France<sup>7</sup>, shown to carry traces of recent admixture with forager groups (Fig 4b). There are, however, some special cases of highly elevated levels of forager ancestry detected in the 4th millennium BCE, such as the roughly contemporaneous individuals from the Blätterhöhle and Tangermünde sites in western and northern Germany, respectively<sup>7,17</sup>. The Blätterhöhle had two occupation periods dating back to roughly 9000 BCE and the 4th millennium BCE, corresponding to the Mesolithic and Neolithic periods, respectively. The genomes of the four individuals from the Neolithic phase had been shown previously to contain elevated hunter-gatherer ancestry around 70% for one individual, and between 50-40% for the remaining three (Lipson et al., 2017). We report four individuals from northern France, three from the Aisne Valley dated between 3400 - 3600 BCE from the site of Beaurieux "les Grèves" (BLG), and one from Mairy in the Ardennes, who display extremely elevated hunter-gatherer ancestries ranging from 48 to 83% (Fig 1,2a-b, 4a, Table S4). A similar ancestry proportion of  $\sim 60\%$  was previously reported for individual 2H11, from one of the hypogea of Mont-Aimé in the Paris Basin dated between 3350- 3100 calBCE (Table S4, Seguin-Orlando et al., 2021). Using fastGLOBETROTTER we inferred a strikingly recent admixture date of 4016-3774 BCE and 3945-3714 BCE for the two individuals from BLG247 with the highest genome coverage (Fig 4b, Table S6). We estimated a very similar range of admixture dates, between 4035 - 3822 BCE, for the ~200 year-younger individual 2H11 from the Mont-Aimé that carried a high hunter-gatherer ancestry proportion whereas individual 2H10 yielded an admixture dating range similar to the post-LBK Neolithic individuals from the Aisne Valley (Fig. 4b). Furthermore, the recently reported admixture dates of one Blätterhöhle individual based on the ancestry covariance pattern are in the range between 3944-3720 BCE<sup>36</sup>, which coincides with the inferred admixture dates for the individuals from Beaurieux "les Grèves" and Mont-Aimé in the Paris Basin. When the genomic distributions of ancestral segments in contemporary post-Michelsberg individuals are compared, the differences in size and number of hunter-gatherer segments are striking (Fig. 5b). CCF315-1, whose admixture date was estimated to ~5000 BCE within the first post LBK/ICC admixture wave (Fig. 4b, Table S6), has much smaller hunter-gatherer segments compared to BLG247-1 (Fig. 5b) and 2H11 (Fig. S10f). This allows us to hypothesize that, during the early 4th millennium BCE, individuals who had preserved their hunter-gatherer genomes since the Mesolithic period started to receive gene flow from Neolithic farmers. This phenomenon implies interactions between groups with distinct ancestries that have not been detected by archaeological approaches in this region at this period, presumably due to the lack of distinctive cultural features. In the case of the Blätterhöhle individuals, stable isotope analyses showed two types of diet for different individuals, one being a typical Mesolithic diet with a preference for freshwater fish, the other being a typical Neolithic diet with a preference for terrestrial resources including domestic animals and crops<sup>40</sup>. The protein-based diet coming from freshwater fish was preferred by the individual with the highest hunter-gatherer ancestry, while the others had a typical Neolithic diet. These roughly contemporary individuals might therefore be witnesses of the admixture process followed by acculturation of the hunter gatherers. The special case of Beaurieux "les Grèves", where all three excavated individuals showed highly elevated hunter-gatherer ancestries, indicates that their hunter-gatherer ancestry was not further diluted. This means that the members of these groups continued their lives as a distinct community with preferential intra-group mating behavior even if admixture events with Neolithic farmers took place several generations before. Interestingly, a similar range of admixture dates were inferred for later Neolithic individuals in Germany and Sweden (Fig. 4b). The Wartberg group from central Germany also shows elevated levels of hunter-gatherer ancestry (Fig. 2a-b, Fig 4a), indicating that the segregation of groups with distinct ancestry and preferential intra-community mating behavior was not uncommon during this period. This segregation behavior may be based on communication barriers, since Mesolithic huntergatherers and Neolithic farmers did not speak the same language, as observed also for presentday populations<sup>41</sup>, as well as on other cultural attributes that are specific for each community.

To further investigate the population history at Beaurieux "les Grèves" we used MSMC2 with four haplotypes to analyze the two BLG genomes with the highest hunter-gatherer ancestry together with different Mesolithic and Early Neolithic genomes (Fig 6a). The estimation of the dynamics over the last million of years of the ancestral population of the two BLG individuals reveals that it evolved in parallel to other Mesolithic populations. This gives support to our interpretation that these individuals were genetically hunter-gatherers who received recent gene flow from Neolithic farmers. At the post-LGM period starting from ~18 kya, the size of the ancestral population of the BLG247 ancestral group increased to the same degree as the southeastern Mesolithic population (Fig 6a). This apparent population increase may simply be the consequence of the admixture with Neolithic farmer ancestry that increases mechanically the heterozygosity.

We calculated the ROH distribution of the BLG247 and Mesolithic individuals to assess their recent demographic history (Fig. 6b). The ROH distribution of cumulative length and the total segment number have similar values in the two BLG individuals with high hunter-gatherer ancestry and some southeastern Mesolithic individuals, the latter showing relatively fewer and smaller ROH segments compared to Western Mesolithic individuals. Interestingly, the calculations for BLG247-3, who carries ~48% hunter- gatherer ancestry, indicate extremely low ROH numbers similar to Central European LBK individuals. Although the admixture dates propose a common origin for BLG individuals, there is a striking difference in the ROH distribution of BLG247-3 compared to the other two BLG individuals, whose ROH values are closer to those of western Mesolithic individuals. This may result from a recent admixture event with farmers with high Neolithic ancestry that abolished most ROH originating from the HG lineages. Lastly, we performed the same local ancestry inference-based method described above on the two high coverage BLG247 individuals together with the Mont-Aimé 2H11 individual by merging the genomic segments from hunter-gatherer ancestry as described previously.. The hunter-gatherer fraction of these genomes show genetic proximity to hunter-gatherers from the west, not to the more western hunter gatherers but rather to the earlier Mesolithic individual from Bad Dürrenberg, eastern Germany, dated to around 6,600 BCE, or to hunter-gatherers further to the east (Fig. 6c). Indeed, the Bad Dürrenberg Mesolithic genome is similar to more

western Mesolithic genomes, represented by the Aisne Valley CCF711 and the Bichon, Loschbour, and Cheddar individuals, but is nevertheless distinct as it shows some proximity with a Polish Mesolithic individual N22 (Fig. 6c and S2b). It is striking that the SMP4738 with high HG ancestry, dated around 5100 BCE, seems to have received a large part of this ancestry from individuals similar to the local Mesolithic individual CCF711, dated around 6,200 BCE, while 1,700 years later, in the same area, the contributing hunter gatherer ancestry is closer to what was found more eastward. This suggests that the populations that have preserved their Mesolithic ancestry for almost 2,000 years after the arrival of Neolithic farmers and persisted with little admixture during the 4th millennium BCE may originate from Central Europe. These populations may as well have contributed to the high hunter gatherer ancestry found in the Blätterhöhle and Tangermünde individuals that show similar timing and extent of admixture as the BLG247 individuals. Since the former originate from Central Europe such an ancestry is less intriguing. In the pigmentation pattern test using HIrisPlex-S, the BLG247 individuals were positive for the genetic markers associated with lighter skin pigmentation and blue eyes while most of the other Neolithic individuals analyzed carried the SNPs associated with brown eyes, dark brown to black hair and intermediate to dark skin (Table S7).

#### The Late Neolithic in northern France

We analyzed several Late Neolithic genomes from northern France. The study of a family burial from Bréviandes in the Aube region close to Troyes, Champagne, is reported separately since it concerns the arrival of the steppe ancestry in northern France (Parasayan et al., in preparation). We also analyzed burials from two hypogea at Chouilly « la Grifaine » in the Marne Valley south of Reims dating to between 3400-3300 and 2900-2800 BCE, i.e., during the Late Neolithic (Table S1). The cemetery that includes these and other hypogea was in use over ~900 years. The genomes of the slightly older hypogeum F10 with burials covering the period between 3400-2800 BCE, cluster with the Neolithic genomes from northern France while the genomes of the slightly younger hypogeum F11 with burials dated between 3400-2500 BCE cluster with Neolithic genomes from southern France and the Iberian Peninsula (Fig. 2c, S4b, S11, S12). This suggests that two different populations were inhumated at this location, the more recent one having a different origin. This is in line with our findings from Bréviandes

since we detected southern Neolithic ancestry in northern France during the 3rd millennium BCE as well as patterns of mobility for some individuals. Another line of evidence supporting a different origin for these two hypogea is provided by the dates of admixture with HG inferred by fastGLOBETROTTER. The number of generations estimated for hypogeum F10 ( $39\pm15$  generations; Table S5) is smaller than for hypogeum F11 ( $97\pm28$  generations; Table S5), which also supports different source populations for these two hypogea, in agreement with our aforementioned observation of an earlier date of admixture with HGs for Neolithic farmers who migrated along the Mediterranean route than for those who migrated along the Danubian route.

#### The genetics behind the spread of farming into the British Isles

Farming spread into the British Isles with a delay of ~1000 years. The mechanisms of the spread are still elusive despite being frequently addressed by both archaeology and genetics. Possible migration routes were proposed based on archaeological evidence<sup>42,43</sup> as well as possible source populations of the migrating groups<sup>7,16,30,44,45</sup>. Most of these genetic studies concluded that the Neolithic individuals from the British Isles are descendants of Mediterranean farmers. Coming from Iberia, these farmers would have reached northern France and the British Isles via the Atlantic seaboard. These conclusions were reached through various methods based on the formal analyses of both independent SNPs and haplotypes from Neolithic farmer genomes from Germany, as the representatives of the central European expansion route, and those from the Iberian Peninsula and/or southern France. The strength of these conclusions, however, was limited owing to the lack of Neolithic genomes from northern France. The present study fills this gap since it provides both a large number of Neolithic genomes from northern France and the high resolution of haplotype-based methods enabling us to differentiate with an unprecedented precision northern and southern Neolithic groups. In addition to the Aisne Valley, we analyzed a population from the Middle Neolithic site of Escalles "Mont d'Hubert", Pas-de-Calais, the Flanders region of Northern France, close to the "Cap blanc Nez" southwest of Calais, dated to 4230-3879 BCE. Not only is this the closest continental site to the British coast analyzed paleogenomically, just in view of present-day Dover, but the corresponding genomes also form a distinct and tight cluster with the Neolithic populations from the British

Isles to the exclusion of all other Neolithic genomes (Fig 2, Fig S4). This pattern is striking in both PCAs whether they include hunter-gatherers or not (Fig. 2a and c). The latter PCA has a higher resolution of Neolithic genomes broadening only slightly the Escalles-British cluster (Fig. 2c and Fig. S4b). Thus, the genomes from Escalles and the British Isles cluster together regardless of the sample size. To explore further the possibility of a continental European origin for the cluster formed by Escalles and British Isles individuals, we successively excluded from the dataset either one of these two related groups to minimize the effect of affinity induced by a large number of individuals with similar ancestry. Both analyses yielded the same result: the two groups cluster with the Aisne Valley Neolithic genomes when only one of them is present (Fig. S11). In all these analyses, the genetic affinity between the Neolithic individuals of the British Isles and the descendants of the Mediterranean farmers is lower than with the individuals from northeastern France. This demonstrates both the genetic affinity between the British group and the continental Neolithic farmers in northern France and the affinity between the Neolithic groups in northern France. Therefore, we propose the Middle Neolithic population in the Flanders region to be the source population of the Neolithic farmers who colonized England. This hypothesis is also consistent with the close geographic proximity between the coast of Flanders and the coast of southeast England. Nevertheless, the possibility remains that an unsampled group from more northern areas could be the source population, in particular in light of the strong sea currents of the Channel between the "Cap Blanc Nez" (Calais) and Dover that may constitute an obstacle for navigation.

To extend our analyses and include the much larger published dataset generated via insolution hybridization capture methods using the 1240k SNP array, we had to use less powerful analysis methods than the haplotype-based methods on phased shotgun genomes used above. We performed MDS analyses calculated on distance matrices coming from the inverted pairwise outgroup f3-statistics. To minimize the effect of allelic biases in the 1240k enrichment dataset and enable a better, less biased co-analysis of shotgun and 1240k capture data, we called the allelic positions in capture and shotgun genomes using a restricted SNP set of ~460,000 positions with the least capture-induced reference biases<sup>46</sup>. Moreover, to prevent any bias that could result from excessive relatedness caused by known methodological artefacts of the capture protocol<sup>46</sup>, we used a single captured population at a time to compare it with our well-covered shotgun genome set. Although, expectedly, a method based on unlinked genetic loci cannot provide a resolution as high as the haplotype-based method, our MDS results still enable us to identify successfully the clusters formed by populations from the British Isles and Escalles (Fig. S12-14). In this way we could test whether there are any other capture-genotyped populations that behave in a similar way as the Escalles group. First, we demonstrate that Early Neolithic capture-genotyped genomes from Britain and Germany cluster together with the corresponding populations generated via shotgun sequencing (Fig. S12a, b). We also included into these analyses capture-genotyped populations from France (Fig. S13), Iberia and Italy (Fig. S14). All these capture-genotyped populations cluster with their corresponding shotgun genotyped populations. These different MDS analyses thus reveal that the well-covered shotgun genomes in our set are representative of the Neolithic European genome diversity known from the sequence capture analyses. Furthermore, our analyses reveal that no other ancient population, whose genomic data are so far published, shows a level of genetic affinity with the Neolithic genomes of the British Isles as important as the Neolithic population from Escalles. We cannot exclude completely, however, a scenario where the formation of the genetic structure detected in Escalles would also involve some low-level gene flow from a Mediterranean-related Neolithic population into a northern Neolithic population, even though the affinity of the Escalles population with the Aisne valley population is clearly visible in the absence of the closer British Isles populations and the affinity of this British Isles population with the Mediterranean population is always much lower than it is with the Northern French Neolithic population, even when the Escalles population is not considered (Fig S11). Thus the previously proposed strong contribution from Mediterranean populations to the Neolithic population on the British Isles was due to the poor representation of the Neolithic population from northern France. Our analysis reveals the progressive evolution of the genome structure of the Neolithic population that occurred during the westward trans-European migration and further evolved in northern France. Moreover, it uncovers the combined effects on the shaping of the source population structure of the early Neolithic colonizers of the British Isles: these are (i) migration-induced genetic drift, (ii) admixture with local hunter-gatherer populations at various time periods and geographic locations and (iii) interactions of the Danubian/LBK and the Mediterranean/ICC Neolithic populations that met in northern France. Thus, we propose the Escalles population or a genetically close population living in this area to have crossed the Channel and spread in the British Isles.

### Material & Methods

#### **DNA extraction and Library Construction**

Ancient DNA work was carried out in a high containment laboratory as described<sup>47</sup>. The dense pyramidal parts of the petrous bones were isolated using a flame-sterilized diamond-disc of a Dremel. Bone pieces were then ground to fine powder in a 6775 Freezer/Mill®Spex SamplePrep in liquid nitrogen as described previously<sup>47</sup>. About 100 mg of bone powder were washed three times for 15 min. each with 1 ml 0.5 M sodium phosphate buffer at pH 8.0 Each sample was rinsed with 1 ml TT buffer made of 10 mM Tris HCl pH 8.0 and 0.1% Tween 20 One ml extraction buffer (0.5 M EDTA pH 8.0, 0.05% Tween 20, 250 µg/ml Proteinase K, and 0.14 M β-mercaptoethanol) was added to each sample and incubated on a rotating wheel for  $\sim$ 30 hours at 37°C. After this first incubation, the samples were centrifuged at 6000 × g for 1 minute. The supernatant was removed and kept for purification. Another 1 ml extraction buffer was added to the pellet and after resuspension, incubated for another 30 hours on a rotating wheel at 37°C. After this second incubation step, all samples were centrifuged at 6000×g for 1 minute. The supernatants from both incubation periods were pooled together in 2 ml tubes, mixed well and then centrifuged at maximum speed for 2 minutes. One ml of the supernatant was used for the following purification step using 5M40 binding buffer (5M Guanidine HCl, 40% isopropanol, 120 mM Sodium Acetate (NaAc) pH 5.2, 0.05% Tween 20;. 1 ml of each sample extract was purified with  $\sim 10$  ml 5M40 binding buffer through Qiagen columns under vacuum, rinsed twice with 1 ml Buffer PE (Qiagen) and eluted with twice 30 µl of TET buffer (10 mM Tris-HCl pH 8.0, 1 mM EDTA, 0.05% Tween 20) following l Libraries were constructed using 6 µl of extract and the NEBNext Ultra II DNA Library Prep Kit for Illumina (NEB, Ipswich, MA, USA) after a pretreatment with USER enzyme mix (NEB, Ipswich, MA, USA) as described by the manufacturer. An unindexed Y-shaped adapter was ligated, the ligated libraries were first amplified for 8 cycles with the Illumina Rd1 and Rd2 sequencing primers, then 20% of the library was further amplified for 12 cycles with Illumina unique dual indexed adapter primers. The libraries were purified using 1.3 volume of SPRI beads (Macherey-Nagel<sup>TM</sup> NucleoMag<sup>TM</sup> NGS Clean-up and Size Select) for two successive rounds of purification.

#### **Processing of Sequencing Data**

All data processing steps were performed using shell instructions and in-house written scripts. The raw output of Illumina sequencers was in the BCL format. Because of the high number of in-house barcodes used, we performed the initial demultiplexing and fastq conversion using bcl2fastq (Illumina) on the laboratory server. Sequence quality was assessed using FastQC<sup>48</sup>. Paired-end reads were merged and trimmed for adapters using leeHom<sup>49</sup>. Reads larger than 28 bp were selected using awk and mapped onto the Human Reference Genome hs37d5 using BWA (Burrows-Wheeler Aligner) aln version 0.7.17<sup>50</sup> with a seed length of 18. Aligned sequences in BAM format were processed with Samtools v.1.9<sup>51</sup> to create index files and flagstat reports, and to select and sort mapped reads. Picard tools (http://broadinstitute.github.io/picard/) was used to remove duplicates. Multiple libraries were merged by Samtools v.1.9 before, followed by filtering the mapping quality (-q 20). Damage patterns were analyzed using mapDamage v.2.2.1 followed by end-clipping using BamUtil (https://genome.sph.umich.edu/wiki/BamUtil:\_trimBam). According to the damage pattern, three to four bases at the ends of each read were clipped for the UDG-treated libraries and 10 bases for non-UDG treated libraries. Five Mbuti genome sequences (SRR1157019, SRR1157021, SRR1157023, SRR1157024, and SRR1157055) were mapped onto the hs37d5 human genome using bwa mem deduplicated and filtered for a mapping quality higher than 30.

#### Sex Identification, Uniparental Haplogroups and Contamination Estimation

To determine the sex of each individual, chromosome counts were performed using index statistics (idxstats) of Samtools on bam files by using exclusively the reads with mapping quality higher than 20 to prevent confusing effects of repetitive regions. Then the ratio of the proportion of read counts normalized to chromosome length for both the X and Y, normalized for each to the average of the autosomal proportion was used. (Table S1). Mitochondrial variants were called using bcftools mpileup (options -B -q30 -Q30) and call (option –ploidy GRCh37) for all individuals. The output mtDNA vcf file was used as input to run HaploGrouper <sup>52</sup> following the example provided online (https://gitlab.com/bio\_anth\_decode/haploGrouper) (Table S1). The chipped bam files of male individuals were used as inputs to determine Y haplogroups by

placing alleles onto reference phylogenies using pathPhynder<sup>11</sup> following the example provided online (https://github.com/ruidlpm/pathPhynder/tree/master/tutorial) (Table S1). The clipped bam files were used as the inputs to run Haplocheck<sup>53</sup> and ANGSD<sup>54</sup> software to estimate contamination on the basis of mtDNA for all individuals and X chromosome for male individuals, respectively (Table S1).

#### **Genotype Calling and Dataset Preparation**

We followed two different genotyping approaches, which are genotype imputation and pseudo-haploid calling, in order to prevent the possible false positive calls that could come from direct diploid genotyping due to low coverage of the majority of ancient samples. To generate an imputed and phased dataset, GLIMPSE (v.1.1.1)<sup>55</sup> was used for imputing the ancient genomes, namely 78 individuals from the current study and 206 publicly available ancient individuals (Table S3). We followed the procedure described in the online Glimpse tutorial (https://odelaneau.github.io/GLIMPSE/tutorial\_hg19.html), using Genotype Likelihoods (GL) computed with Bcftools (mpileup -I -E, call -Aim parameters) using the 1000 Genomes Project phase 3 reference panel excluding the indels. We filtered out from the imputed genomes the positions that have a MAF lower than 5% in the 1000G reference panel. Then, we applied a further filtration of Genotype Posterior Probability (GP) lower than 0.99 and genotype missingness rate of 0 for downstream analyses. We use the autosomal sites in the 1240k SNP capture<sup>56</sup> to select 1240k SNPs that were used for calling, with Samtools mpileup and the pileupCaller pipeline (https://github.com/stschiff/sequenceTools), the bam files resulting from either shotgun sequencing or in-solution target capture. To minimize the effect of allelic biases in the 1240k enrichment dataset and enable a better, less biased co-analysis of shotgun and 1240k capture data, we called the allelic positions in capture and shotgun genomes on a restricted SNP set of ~460,000 positions (460k) with the least bias toward enriched positions<sup>46</sup>.

# Estimation of Kinship, Pigmentation Profile and Runs of Homozygosity (ROH)

We inferred the relatedness between individuals coming from different Neolithic sites described in the current study using NgsRelate<sup>12</sup>. We used a mixed group of 250 ancient European individuals covering the periods of the Early to Late Neolithic to provide a distribution of ancestral proportions in the background allele frequency similar to that found in Neolithic sites analyzed in this study. For hunter-gatherers including admixed individuals with the hunter-gatherer ancestry  $>\sim 50\%$  we prepared another set of 30 individuals to prevent the bias that can be introduced by elevated levels of hunter-gatherer ancestry. The NgsRelate analysis was performed using as input vcf files containing the filtered imputed genotypes of these 250 and 30 individuals. The estimated kinship (theta) and Cotterman (k0, k1, k2) coefficients of Neolithic individuals reported in this study (Fig. 1c, Table S2) were compared to the ideal values obtained using simulations by Yaka et al., 2021. The kinship relationships described in the text were determined by these analyses, the uniparental haplogroups (mitogenomes and Y chromosomes), the genetic sex and the estimation of the anthropological age at death (Table S1).

In order to predict the pigmentation profile of the newly reported individuals, we used HIrisplex-S<sup>29</sup> and the imputed genotypes (Table S7). After filtration of GP and missing variants, described above, plink v1.9<sup>57</sup> was used in order to identify the proportions of runs of homozygosity in ancient genomes (Fig. 3a, S3) with the following parameters;

--homozyg --homozyg-density 50 --homozyg-gap 100 --homozyg-kb 500 --homozyg-snp 50 --homozyg-window-het 1 --homozyg-window-snp 50 --homozyg-window-threshold 0.05

The physical positions estimated by plink was converted to genetic positions using the genetic maps built for hg19.

#### **Population Genetic Analyses**

We ran ChromoPainter/fineSTRUCTURE<sup>19</sup> on the imputed and phased data using different sets of all individuals (Fig. 2a), excluding hunter-gatherer rich genomes (Fig. 2c), as described in the text, or using only hunter-gatherers (Fig S2)<sup>58</sup>. After estimation of switch and mutation rates using 10 expectation-maximization (EM) iterations, each haplotype was painted using all the other haplotypes (-a 0 0). We applied fineSTRUCTURE's Markov chain Monte Carlo (MCMC) model on the resulting coancestry matrices with 3,000,000 burn-in and 2,000,000 sampling iterations. After the extraction of the maximum observed posterior probability state and 100,000 hill-climbing iterations, the tree was inferred by using the maximum concordance state as it is used in the PoBI study<sup>58</sup>. To obtain input files for SOURCEFIND v259 and fastGLOBETROTTER34 we ran ChromoPainter v2 with 10 iterations of EM to infer parameters on chromosomes 1, 8, 15 and 22. Then, the copy vector and painting samples files were generated for the 22 autosomes by using the inferred parameters and the ancestral groups, EEF (Bar31, Bar8, LEPE48-2, LEPE52-1, Nea2, Nea3, Klein7, I0707, I0745, I0709, I0708, I2521) and HG (CCF711, Loschbour, Cheddar, Bichon, SRA62, Chan, LaBrana, KO1, I5236, VLASA32, VLASA7, N22, BDB001), as donor populations to paint recipient individuals. An individual-based dataset was prepared including only test individual together with EEF and HG groups. This allowed us to keep only shared genomic positions between tested individuals and ancestral groups after GP and missingness filtrations without any loss of data due to unshared positions between tested individuals. We ran fastGLOBETROTTER to infer the admixture dates on each individual dataset by using HG and EEF ancestral populations as both donor and surrogate populations followed by a jackknife resampling step as implemented in the software in order to calculate the confidence intervals (Fig. 4b, Table S5-6). These CIs were calculated using the delete-mj jackknife variance estimator formula of Busing et al.<sup>60</sup>. Density curves were computed using admixture dates calculated from the number of inferred generations per autosome of individuals that were estimated by the jackknife resampling step of fastGLOBETROTTER.

We inferred effective population sizes of Neolithic and Mesolithic populations using MSMC2<sup>31</sup>. The input files for two or three diploid individuals were generated from quality filtered imputed and phased genomes using the generate\_multihetsep.py script from MSMC-tools (https://github.com/stschiff/msmc-tools) and masked for high mappability regions per chromosome downloaded from (https://github.com/wangke16/MSMC-IM/tree/master/masks). MSMC2 was run on multihetsep.txt input files with four and six

haplotypes using (msmc2 -t11 -I 0,1,2,3 -s -o pop.4haps.msmc2.txt pop.4haps.chr{1..22}.multihetsep.txt) and msmc2 -t11 -I 0,1,2,3,4,5 -s -o pop.6haps.msmc2.txt pop.6haps.chr{1..22}.multihetsep.txt), respectively (Fig. 3b, 6a).

Populations represented with 6 haplotypes are

France-Aisne LBK : BLF148-9, MDV233, MDV93.2 ; Germany LBK : LBK, Dil16, Ess7 ; Austria LBK : Asp6, Klein7, I5069 ; Italian ICC : R9, R3, R2 ; Serbia Starcevo : I4918, STAR1, VC3-2 ; Western Mesolithic : CCF711, Loschbour, Cheddar ; Southeastern Mesolithic : VLASA32, VLASA7, I5236

Populations represented with 4 haplotypes are

France-Aisne LBK : BLG247-1, BLG247-2 ; France-Aisne LBK : BLF148-9, MDV93.2 ; Germany LBK : Herx, LBK ; Greece Early Neolithic : Nea2, Nea3 ; Western Mesolithic : CCF711, Loschbour ; Southeastern Mesolithic: VLASA32, VLASA7 ; Ireland Mesolithic: SRA62, KGH6 ; Iberia Mesolithic: Chan, LaBrana

Local ancestry inference was performed using ELAI<sup>37</sup> on the individual datasets as described above for fastGLOBETROTTER. Admixed target individual and source populations, EEF and HG, were extracted from each dataset as vcf files and then manually converted into phased BIMBAM format that is described in the ELAI user manual (https://github.com/haplotype/elai). ELAI was run on each admixed individual per chromosome as follows;

elai -g EEF.chr1.geno -p 10 -g HG.chr1.geno -p 11 -g admixed.chr1.geno -p 1 -pos admixed.chr1.pos -C 2 -c 10 -mg #generation.

Output mean local ancestry files (ps21) from ELAI were used in order to plot ancestry karyograms for admixed individuals (Fig. 5, Fig S9-10). Both HG and EEF segments of admixed individuals that are defined by local ancestry dosages > 90% were manually converted into breakpoint file format awk for described in using haptools (https://haptools.readthedocs.io/en/latest/formats/breakpoints.html). Then, we used karyogram to plot these breakpoints files as ancestry karyograms haptools (https://haptools.readthedocs.io/en/latest/commands/karyogram.html). The regions < 90% mean local ancestry dosages are indicated as NA.

The same mean local ancestry files (ps21) were filtered keeping the positions with HG ancestry dosage > 90% per haplotype. These HG positions were extracted from each test individual as both diploid and haploid segments and these haploid segments were manually pseudo-diploidized using awk to reconstruct a "semi-diploid" genome from the hunter-gatherer segments of admixed individuals. These reconstructed segments were merged with hunter-gatherer genomes and only shared positions were kept. Each resulting dataset were individually analyzed with ChromoPainterv2/fineSTRUCTURE pipeline as described above (Fig S7-8). Only the hunter-gatherer-segments coming from individuals with elevated ancestries for BLG247-1, BLG247-3 and 2H11 were merged in a single dataset as their high ancestry proportions (See Fig 5b, 9e ,10f) resulting in many shared regions allowed us to analyze them simultaneously (Fig. 6c).

Admixture modelling and outgroup-f3 statistics were computed using qpAdm<sup>61</sup> and qp3Pop programs from the ADMIXTOOLS package (version 5.0)<sup>62</sup> for individuals coming from both shotgun sequencing and in-solution target capture data. We used Mbuti, Ust'-Ishim<sup>63</sup>, Kostenki14<sup>64</sup>, Sunghir3 <sup>65</sup>, Karelia<sup>66</sup>, Latvian hunter-gatherers<sup>67</sup>, and Iranian Neolithic <sup>20</sup> genomes as the reference groups to calculate admixture proportions for the same EEF and HG source populations in the 1240k SNP set (Fig. 4a, Table S4). The outgroup-f3 statistics were calculated in a pairwise manner in the form of f3(Mbuti; ind1, ind2) with 460k SNP. Distance matrices coming from inverted pairwise values (1-f3) were used to compute Multi-Dimensional Scaling (MDS) analysis (cmdscale package in R) (Fig. S12-14).

## **Supplementary Materials**



#### Figure S1. Y chromosome phylogeny of modern and ancient individuals.

Ancient sequences of newly reported and previously published individuals were placed into reference Y chromosome phylogenies with pathPhynder using the best-path workflow. The major haplogroups of male individuals analyzed herein are indicated.





**a**, fineSTRUCTURE clustering dendrogram based on the same coancestry matrix. When compared to Fig. 2a, Late Paleolithic hunter-gatherers from Britain, Gough and Kendrick, were added. In order to better define various ancestral source populations found during the Mesolithic, we also included two recently reported into our analysis. **b**, PCA based on the ChromoPainter haplotypic coancestry matrix calculated on the dataset including only hunter-gatherer genomes with the addition of Late Glacial Paleolithic genomes from Gough and Kendrick's caves in Britain dating to approximately 14,8 and 13,7 kya, respectively. The fraction of variance explained by PC1 and PC2 is, respectively, 55.2% and 13.6%.



Figure S3. ROH computed for hunter-gatherer individuals. The ratio of cumulative length and number of ROH segments longer than 1 cM (a) and 2 cM (b).



# Figure S4. The impact of sample size change of the British Isles Neolithic populations on the fine-scale genetic affinities.

**a,** PCA based on ChromoPainter haplotypic coancestry matrix calculated on the dataset used in the analysis shown in Figure 2a without the later Neolithic individuals from the British Isles. The fraction of variance explained by PC1 and PC2 is, respectively, 70.4% and 6.6%. **b,** PCA based on ChromoPainter haplotypic coancestry matrix calculated on a subset of individuals excluding hunter-gatherer and outlier farmer genomes with high hunter-gatherer ancestry similar to that shown in Figure 2c but including the later Neolithic individuals from the British Isles. The fraction of variance explained by PC1 and PC2 is, respectively, 39.3% and 5.2%.



#### Figure S5. PCA based on ChromoPainter haplotypic coancestry matrix

**calculated on the same dataset as Figure 2D.** The individuals are colored by group labels (a) or hunter-gatherer ancestry proportions (b). The fraction of variance explained by PC1 and PC2 is, respectively, 38.9% and 5.5%.

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#### Figure S6. ROH computed for Early Neolithic individuals.

**a**, ROH plot as in Fig. 3a but showing individuals colored by their hunter-gatherer ancestry proportions estimated by SOURCEFIND. **b**, ROH plot as in Fig. S6a but excluding the individual with highest hunter-gatherer ancestry, SMP4738, to better visualize the ancestry proportions of other individuals.



**Figure S7. Diversity of hunter-gatherer ancestries in LBK individuals from the Paris Basin.** PCA based on different ChromoPainter haplotypic coancestry matrices on hunter-gatherer genomes and on extracted hunter-gatherer segments from Neolithic individuals. Each matrix includes only one Neolithic individual due to the uniqueness of the genomic positions of hunter-gatherer segments found in each Neolithic genome. The fractions of variance explained by PC1 and PC2 are, respectively, 60-65% and 10-15%.


Figure S8. Diversity of hunter-gatherer ancestries in Early Neolithic individuals from different parts of Europe.



**Figure S9. Genomic distribution of hunter-gatherer segments in Neolithic farmer genomes from the Paris Basin.** Legend is as in Figure 5.



**Figure S10. Genomic distribution of hunter-gatherer segments in previously published Neolithic farmer genomes from Europe.** Legend is as in Figure 5.



# Figure S11. Origins of the British Isles/Escalles population in continental Europe.

PCA based on ChromoPainter haplotypic coancestry matrices calculated on the Neolithic dataset excluding either the British Isles (a) or the Escalles (b) genomes. See Figure 2d for comparison. The fractions of variance explained by PC1 and PC2 are, respectively,  $\sim 40\%$  and  $\sim 6\%$  in both PCA.



**Figure S12. Multidimensional scaling (MDS) including both shotgun and capture genomes using a pseudo-haploidized 1240k SNP set.** MDS calculated using the pairwise genetic distance matrix coming from inverted outgroup-f3 values (1-f3) in the form of f3(Mbuti; Neolithic1, Neolithic2). Each distance matrix includes only one representative of the population whose genome segments were obtained using hybridization capture. See Figures S12-S13. Neolithic populations from England (a) and Germany (b) are clustering with contemporary Neolithic genomes obtained via shotgun sequencing.



**Figure S13. Multidimensional scaling (MDS) including both shotgun and capture genomes from France using a pseudo-haploidized 1240k SNP set.** Legend as in Fig. S12.



Figure S14. Multidimensional scaling (MDS) including both shotgun and capture genomes from Mediterranean Europe using a pseudo-haploidized 1240k SNP set. Legend as in Fig. S12.

CHOUF11P78122 CHOUF11P7822 CHOUF11P8C32	CHOU9745	CHOU9743 CHOU9744	CHOU9742	0HQU0000	CHOU9737	01006008	0HOU3935	CHOU7237	CHOU3923	PS 51	81G247-3 Main42349	BLG247-2	OCT 112	007315-1	BLRGS	CCT99	002488	8U67	BLP10	ES@7	ESC/201	ESO87	ESOI2	ESC10188	BU91	SNP4738	SNP471	BFN369	BFN373	BFM320	667181	00:006	007345	8UH417	8U92	8U54	BLF53	8150	802.345	815348	MAC66	8 CM130	BCP 196	BVT609	8VT605-2 8VT607	BV7586	NGA45	C6H12	910/01W	M0V242	MDV233 MDV234	M0v208 M0v213	M0V195	M0v214	M0V192	M0V144	M0V131	MDV93.3 MDV272	MDV93.2	MDV571-7	N0V563-4	MDV561-1	MDV13-1	M0V249	M0/317	M0V248	M0V189-2.2 M0V254	MDV188-6.3	MDV188-6.2	00711	Cli addure C
0HOU Choulily (Marne) 0HOU Choulily (Marne) 0HOU Choulily (Marne)	010U Chouilly (Marne) 010U Chouilly (Marne)	0100 Choully (Marne)	CHOU Chouilly (Marne)	0100 Chouilly (Marne)	OHOU Chouilly (Marne)	OHOU Chouilly (Marne)	010U Chouilly (Marne) 010U Chouilly (Marne)	010U Chouilly (Marne)	010U Chouilly (Marne) 010U Chouilly (Marne)	PSS Haut de Launois	Abiny Tec Hautee Chandeleres	BLG Beaurieux-Cuiry	CCT Cuiry-les-Chaudardes	COF Cuiry-Ids-Chaudardes	BLP Beaufeux	COT Cuiry-les-Chaudardes	COS Cuint-like-Chandonies	BLP Beautieux	BLP Beaufeux	ESC Mont d'Hubert	ESC Mont d'Hubert	ESC Mont d'Hubert	ESC Mont of Hubert	ESC Mont d'Hubert	MAC Missy-sur-Alsne	SMP Saint-Martin-sur-le-Pré	SMP Saint-Martin-sur-le-Pré	GMD Calue Martineau JacOrd	BFM Bucy-le-Long	BFM Bucy-le-Long	BFT Bucy-le-Long	COF Cuiry-les-Chaudardes	COF Ouiry-les-Chaudardes	BLH Bucy-le-Long	BLF Bucy-le-Long	BLF Bucy-le-Long	BLF Bucy-le-Long	BLS Bucy-le-Long	BLF Bucy-le-Long	BLF Bucy-le-Long	NWC Mssy-sur-Aisne	BCM Berry-au-Bac	BVT Berry-au-Bac BCP Berry-au-Bac	BVT Berry-au-Bac	BVT Berry-au-Bac BVT Berry-au-Bac	BVT Berry-au-Bac	NGA Mazy	CGH Chassemy	MDV Menneville	MOV Menneville	MDV Menneville	MOV Menneville	MDV Menneville	MDV Menneville	MOV Menneville	MDV Menneville	MDV Menneville	MDV Mennevile	MOV Menneville	NDV Menneville	NOV Nemewile	MDV Menneville	MOV Menneville	MOV Menneville	MOV Menneville	MDV Menneville	MOV Menneville	MOV Menneville	NOV Menneville	CO <sup>T</sup> Cuiry-les-Chaudardes	Site cose Site 1
Hypogeum F 11 (H11) Hypogeum F 11 (H11) Hypogeum F 11 (H11)	Hypogeum F11 (H11) Hypogeum F11 (H11)	Hypogeum F11 (H11)	Hypogeum F11 (H11) Humonum F11 (H11)	Hypogeum F11 (H11) Hypogeum F11 (H11)	Hypogeum F11 (H11)	Hypogeum F30 (H10)	Hypogeum F 30 (H10) Hypogeum F 30 (H10)	Hypogeum F30 (H10)	Hypogeum F30 (H10) Hypogeum F30 (H10)	Pont-sur-Seine	les Gravelines	les Gravelines	le Champ Tortu	les Fontinettes	la Plaine	le Champ Tortu	les Gravelines	la Plaine	la Plaine	Escalles	Escalles	Escalles	Escalles	Escalles	la Plaine le Culot			le Fond du Marais	le Fond du Marais	le Fond du Marais	la Fosse Tourise	les Fontinettes	les Fontinettes	la Miccensière	la Fosselle	la Fosselle la Encolle	la Fosselle	la Fosselle	la Fosselle	la Fosselle	la Croix Maigret	la Croix Maignet	le Vieux Tardar le Cheminde la Pécher	le Weux Tordor	le Vieux Tardar le Vieux Tardar	le Vieux Tardar	les Grands Asements	le Grand Horle	Derrière le Village	Dentère le Village	Derrière le Village Derrière le Village	Derrière le Village Derrière le Village	Derrière le Village	Derrière le Village Derrière le Village	Derrière le Village	Derrière le Village Derrière le Village	Derrière le Village	Derrière le Village	Derrière le Village	Derrière le Village Derrière le Village	Derrière le Village	Denière le Village	Derrière le Village	Derrière le Village	Derrière le Village Derrière le Village	Derrière le Village	Derrière le Village	Derrière le Village	Derrière le Vitage	les Fontinettes	73610
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FR N 3400 2900 Choully H11 FR N 3400 2900 Choully H11	FR N 3400 2900 Choully H11 FR N 3400 2900 Choully H11	FR N 3400 2900 Choully H11 FR N 3400 2900 Choully H11	FR N 3400 2900 Choully H11	FR N 3400 2900 Choully H11 FR N 3400 2900 Choully H11	FR_N_3400_2900_Choully_H11	FR_N_3400_2900_Choully_H20	FR_N_3400_2900_Choully_H30 FR_N_3400_2900_Choully_H30	FR N 3400 2900 Choully H30	FR N 3400 2900 Choully H30 FR N 3400 2900 Choully H30	FR N 3600 3400 Post NK	FR N 3600 3400 Post NK	FR_N_3600_3400_Rost_NK	FR_N_3600_3400_Rost_NK	FR_N_3600_3400_Rost_NK	FR N 3600 3400 Rost NK	FR N 4250 3700 MK	FR N 4250 3700 NR	FR N 4250 3700 MK	FR_N_4250_3700_MK 52	FR_N_4250_3700_Esc	FR N 4250 3700 Esc	FR N 4700 4300 Gerny FR N 4700 4300 Gerny	FR_N_\$100_4900_LBK	FR_N_\$100_4900_UBK	FR_N_4900_4700_VSG	FR N 4900 4700 VSG	FR N 4900 4700 VSG	FR N 4900 4700 VSG	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR_N_5100_4900_UBK	FR N 5100 4900 LBK	FR_N_5100_4900_LBK	FR_N_5100_4900_LBK	FR_N_\$100_4900_LBK	FR N 5100 4900 LBK	FR_N_S100_4900_UBK	FR N 5100 4900 LBK	FR_N_5100_4900_LBK	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR_N_S100_4900_UBK	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR_N_\$100_4900_UBK	FR_N_S100_4900_LBK	FR_N_5100_4900_LBK	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR_N_5100_4900_LBK	FR N 5100 4900 LBK	FR_N_5100_4900_LBK	FR_N_5100_4900_U8K	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR N 5100 4900 LBK	FR_N_5100_4900_LBK	FR N 5100 4900 LBK	FR_N_\$100_4900_U8K	FR N 5100 4900 LBK	FR_N_5100_4900_LBK	FR_N_5100_4900_LBK	FR_N_5100_4900_LBK	FR_N_5100_4900_UBK	FR N Mesolithic	Construction of the second sec			
3400 2500 BCE 3400 2500 BCE	3400-2500 BCE 3400-2500 BCE	3400-2300 BCE	3400-2500 BCE	3400-2300 BCE	3400-2500 BCE	3400 3200 805	3400-3300 BCE 3300-3000 BCE	3400-3100 BCE	4350 ± 30 BP (3081-2901 cal8 (E) 3400-3300 BCE	4755 ±408P(3629-3373 cal8CI)	4645 ± 35 89 (3516-3365 cal8 02) 4730 +45 89 / 3641, 3500 cal8 02)	4645 ± 35 8P (3516-3365 cuBCE) 4650 ± 30 8P (3516-3365 cuBCE)	4785 ± 40 BP (3545-3383 calB (E)	4800 ± 45 BP (3651-3382 calB CE)	4710 ± 45 8P (3530-3371 cal8 (E)	5040±40 8P(3954-3711 cal8 0E)	490 ± 90 BP (3945-3657 GBCR)	5010 ± 45 8P (3947-3656 cal8 (E)	75±40 8P (4239-3985 cit BCE); 5375						5775 ± 45 8P (4724-4498 cul8 0E) 5480 ± 55 8P (4449-4176 cul8 0E)	6160 ±40 8 P (5236-4996 calls CE)	6035 ±35 BP (5004-4840 calBCE)	50(0 ±40 00/#045.4775, col0.00)				5960 ± 50 BP (4986-4719 cal8 02)																											6110 ± 30 BP (\$209-4939 calBCE)	6125±358P(5209-4951 cill8Ct)	6155 ± 30 8P (\$210-5008 cal8 02)	6350 ± 30 BP (5211-5010 calB 02)		6310 ± 30 8P (5324-5219 cal8 0E)	6130 ± 30 8P (\$207-4990 call6 0E)	6030 ± 30 8P (5193-4938 call8 0E)	6055 ± 30 8P (\$033-4850 cal8 (£)	60/0 ± 30 8P (3201-4849 Ghove)	(308)	7400 ± 60 8P(6400 - 6086 calBCE)	Careto and Anno and
F U811 M K1a411	F U301 M K1a4a1	F Kla	F HWD	M H1e1a	M H1	F HVOu	M H1	F J201a2a	F K1bla	M T25	M T258	M HS	M J1c1b	F Klalbl	e F HIT	M USo2b	F K183	M Nialala2	M H1	M Kla_T295C	F K1a4a1	F K1a4a1	M T2b	M X25	M H4a1	F K1a	M U811	F Kla	M H1	F H77	M K1a	M T2c1d	F J1c	M T2b	F Kla4a1	F K1a2	F Tla	M H77	F X25/d	F U8b1b1	F T2c1d3a	F 11c3	F US01	F US01	F H1	M K1b3a1	M K1a	M Kla	M 11c2	X X	F J2a1a1a M K1a4a1	F J2alala M J2alala	M HV0a	M H1	M N13131	F USb2b3	M J1c1	F K1b1a1	F K1b1a1	F HV04	M K143	F HVOu	F U8015	M USa'b	F H1	M K1a2	M H77 F U812	F Klalbl	F K1a2	M USb1b2	A Bardian samanur Vana
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0,9	0,4	0,0	3,1	0,2	0,3	6,6	0,2	0,t	0,5	0,3	3,7	3,0 1,0	10,2	1,5	0,7	0,2	10	0,2	0,4	1,3	1,3	0,5	0,9	0,6	0.3	8,0	0,6	0,7	0,3	1,1 0,2	0,2	3c 1,1	0,1	1,2	0,1	1,1	0,4	0,2	0,3	2,1	0,2	0,1	1,6	1,6	0,2	0,2	0,2	0,7	0,3	6,0	1,7 1	1,3 1,0	0,7	0,8	la 0,2	0.80	1a 0,7	9,0 1,1	1,6	0,6 8,0	0,1	0,7	0,6	0,2	0,3	0,4	0,1	1,1	1,0	4,2	and the second se
3rd or 4th degree to CHOU9741				3rd or 4th degree to CHOUF 11P78 122			3rd or 4th degree to CHOU8047					2nd degree to BLG 3/1-1	And Annual 11 (01/2) ANNU					An a set of set	3rd or 4th degree to 88,869	and solutions on stranger	Jud durance for ES (E2)7	3rd dignee to ESC791					2d degree to SMP451 (half sibling, same mother)	Ad daamaa to GAIDATT (half sibilian sama mothas)						281 diagrade to MisrAH5 (paster)		2nd degree to 8LF53; 3rd degree to 8LF70	Ad degree to BLFS4 and BLF70	Indidama to Bil 553 and MINUIAB Indidamas to Bil 554	100100 0 0 0000	winof 8EF149			twin of BVT009	twin of BVT610			151 OH(NRE 10 SLIVE1 (ASTER)	for descent as the third descent			st degree to MDV213, MDV208 (daugther of MDV208, sister of MDV213); 2nd degree to MDV195	1st degree to MDV203, MDV233 (mother of both); 2nd degree to MDV135 1st degree to MDV203, MDV233 (son of MDV203, brather of MDV233); 3nd degree to MDV 295	2nd degree to MDV208; 3rd degree to MDV213, MDV233					1st ongjete to ARDV93.2 (asser)	1st degree to MDV93.3 (sister)								2nd degree to 8LF53				Antino
NA	NA	NA	NA NA	NA	NA	NA	NA	NA	NA	NA	NA NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA 1	NA	NN	NA	NN	NA	NA	NA	NA NA	NA	NN NN	NA	NA NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA NA	NA	NA	NA	NA	NA	NA	NA	
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														4444	204.0	0,7084	3600.0		0,708						0,708			0,7087		0,7078	0,7087			0,7084	0,7106		0,1002	CBUE O		0,7099	0,7097	0,7077	0,7097 101	0,7077		0,7079	0,7102	0,7081		o i o i	0,7077	0,7093		0,7104				0,7103	0,7082			4,444	7700	-	0,7082	0,7092	Idi 0,7084			+	
petrous	petrous	petrous	petrous	petrous	petrous	petrous	petrous	petrous	petrous	petrous	petrous R	petrous R	petrosal right	petrosal left	petrosal left	petrosal right	petrous netrocal right	petrosal right							petrosi right	petrous	petrous	petrosal left	petrosal left	petrosal right	petrosal right	temporal R, lower part	petrous L	petrous tragment K	temporal R lower part	petrous R	petrous L	petrous fragment R	petrous L	temporal L, lower part	temporal L, lower part	petrous R	temporal L, petrous and dorsal part temporal R lower part	temporal R	temporal L	Souli	Storil	Souli	petrous R	Soull	petrous fragment L	Seuli temporal L lower part	petrous fragment R	small petrous fragment R petrous fragment L	petrous L	petrous R petrous fragment R	temporal R lower part	Soull	Souli	Seul	cartilage	petrous fragment R	petrous R national financiant B	petrous R	Seul	Souli	Souli	or n	Slovil	left petrous	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
F1601F11/P7/81.2/US208 F1601F11/P7/82.2/US208	F 3501 F11 P34/03/US202 F 3501 F11/P6/01 3/US208-Ko22	F1601 F11 P8/61.2/US208	F1601 F11 P5/On3/US208	F1601 F11 P8/04.3/US212	F1601 F11 P8/A1.3/US208	F10/924/G9/US130	F 30/P25/F3/US130 F 30/P15/F11/US118	F1601F10P24/US130	F1601 F10 P15/H10/US118 F1601 F10 P23/G9/30/US130											EMH-F-II ST 445 M16 (6	ENH-F-II ST 445 M16 05	ST2 29 M29 CS/687-1	ST229 M25 C13/42-1	ST445 M15 C7/1028-6																			Î														+		structure 93					structure 13-2	structure 273		structure 189	vitanations 100	SET AND/US	C0798/St 711	The state of the s
	9745	9744	9742	9741	9737	6908	3935	7237	3923 (ind 10) 5980		3	2	112	315-1	8	9	4.00	2	в						31			369	373	370	181	906 7/1	145	417	92 si	8 X	83	8	129	148	86 549	130	196	609	606-2	586	\$\$ ð	a	0.00 185-81	242	233	205	195	234	192	144	131	272	93-2	573-VII	563-IV	561-1	461J	249	317	248	189-2-2 254	188-6-3	188-6-2	711	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
											2014	2014	2009	1979	2006	X008	1001	2006	w						2006			1992	1992	1992	2992	1983	2974	2093	1997	1997	2997	2997	1997	1997	2981	2978	1995	1995	2995	1995	2983	2986	1100	1989	1989	2989 1989	1990	2989	1989	2989 1989	1989	886	1978	2014	2013	2013	2110	2978	1990	2989	1989	1989 9	2989	2998	VV1.

Table S2. Estimation of kinship coefficients by	NgsRelate for newly re	ported data
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				Autosomes			X chr           k0         # Sites           0         127139         0,           0         127139         0,           0,00         127139         0,           0,00         127139         0,           0,00         127139         0,           0,23         127139         0,           0,24         127139         0,           0,35         127139         0,				
Ind1	Ind2	# Sites	θ	k2	k1	k0	# Sites	θ			
BLF148	BLF149	665488	0,50	1	0	0	127139	0,50			
BVT609	BVT610	665488	0,50	1	0	0	127139	0,50			
MDV208	MDV233	665488	0,25	0,01	0,99	0,00	127139	0,26			
MDV208	MDV213	665488	0,25	0,00	1,00	0,00	127139	0,50			
BLF91	MGA46	665488	0,26	0,27	0,50	0,23	127139	0,38			
MDV213	MDV233	665488	0,26	0,26	0,50	0,24	127139	0,03			
MDV93.2	MDV93.3	665488	0,25	0,29	0,40	0,30	127139	0,32			
MDV195	MDV208	665488	0,17	0,00	0,64	0,35	127139	0,00			
BLG247-1	BLG247-2	1984995	0,12	0,00	0,47	0,52	137443	0,38			
BLF70	MDV248	665488	0,14	0,00	0,54	0,46	127139	0,06			
BLF53	BLF54	665488	0,15	0,01	0,59	0,40	127139	0,06			
SMP451	SMP471	665488	0,15	0,03	0,54	0,43	127139	0,21			
MDV195	MDV233	665488	0,08	0,00	0,31	0,68	127139	0,02			
MDV195	MDV213	665488	0,08	0,00	0,29	0,69	127139	0,00			
BLF53	BLF70	665488	0,10	0,00	0,42	0,58	127139	0,02			
BLF54	BLF70	665488	0,06	0,01	0,23	0,76	127139	0,00			
Esc637	Esc791	665488	0,07	0,02	0,24	0,75	127139	0,11			
CHOU8047	CHOU3935	665488	0,05	0,02	0,16	0,81	127139	0,11			
CHOU9741	CHOUF11P7B122	665488	0,04	0,00	0,15	0,85	127139	0,02			
BLP10	BLP69	665488	0,04	0,00	0,15	0,85	127139	0,04			

Table S3. Summar	y of prev	viously pusblished individua	Is used in the	shotgun dataset	Country	Sev	M(DNA br	Ybe	Source
FR_N_2500_2000_Bre FR_N_2500_2000_Bre	BRE445A BRE445C	Radiocarbon carte (caloce) or archaeological context date (BCE) 2500-2000 BCE 2500-2000 BCE	FR_N_2500_2000 FR_N_2500_2000	les Pointes et les Grévottes, Bréviandes, Aube les Pointes et les Grévottes, Bréviandes, Aube	France	F	Kibiai V (HV0a)	T ng	Source Parasayan et al., Parasayan et al.,
FR_N_2500_2000_Bre AT_5500_5000_LBK AT_5500_5000_LBK	BRE445D Asp6 15069	2500-2000 BCE 7575-7474 calBCE 5205-4907 calBCE (6090±25 BP, PSUAMS-4326)	FR_N_2500_2000 (LBK) Austria EN LBK	les Pointes et les Grèvottes, Bréviandes, Aube Asparn-Schletz Kleinhadersdorf Flur Marchleiten	France Austria Austria	F M F	T2c1e U5a1c1 N1a1a	-	Parasayan et al., March/Cell2022 MathissonNature2018
AT_5500_5000_LBK AT_5500_5000_LBK PG_4500_4200_CA	15070 Klein7	5209-4998 calBCE (6140±25 BP, PSUAMS-4224) 7244-7000 calBCE 4440 4252 calBCE (5565-35 BP, DSUAMS 1913)	Austria_EN_LBK (LBK) Reference	Schletz Kleinhadersdorf Volke Tomore, Dibukunitro	Austria Austria Rufoteite	M F	Kiala W1-119	C1a2 -	MathiesonNature2018 March/Cell2022 MathiesonNature2019
BG_4300_4300_CA BG_6100_S500_EN CH_Hunter-Gatherer	12505 12521 Bichon	4449-4532 CalBCE (5365323 BP, FSUAMS-1612) 5621-5481 calBCE (6615±30 BP, PSUAMS-1836) 11850-11579 calBCE	Bulgaria_N Bulgaria_N Bichon	Veliko Tarnovo, Dzhuływnisa Veliko Tarnovo, Dzhuływnisa Grotte du Bichon	Bulgaria Switzerland	M	H USb1h	G2a2b2b1a1b~ I2a1a2a	Mathiasoftwature2018 MathiasoftNature2018 JonesNatureCommunications2015
C2_4900_4500_STK DE_3300_3200_WBC DE_3300_3200_WBC	Kolin6 KH150610 KH150615	4910-4740 calBCE 4532±25 4462±24	Kolin Megalithic Germany WBC Germany WBC	Kolin Rondel, Bohemia Niedertiefenbach Niedertiefenbach	Czeck Republic Germany Germany	F F M	H H3aa J1c3g	iZalala	SanchezQuintePMAS2019 ImmelNatureCommunications2021 ImmelNatureCommunications2021
DE_3300_3200_WBC DE_3300_3200_WBC	KH150619 KH150620	4455±24 4491±25	Germany WBC Germany WBC	Niedertiefenbach Niedertiefenbach	Germany Germany	F M	HBaa X2c1	H2 Data2a2	ImmelNatureCommunications2021 ImmelNatureCommunications2021
DE_5300_4800_LBK DE_5300_4800_LBK	DER002 DER009	4423226 	Germany WBC Germany DER LBK Germany DER LBK	Derenburg Meerenstieg II Derenburg Meerenstieg II	Germany Germany	M	W5 HV+16311	G242b2b2	OhildebayevaMBE2022 OhildebayevaMBE2022
DE_5300_4800_LBK DE_5300_4800_LBK DE_5300_4800_LBK	Dil16 Ess7 Herx	7235-6998 calBCE 7050+6900 calBCE 7164-6993 calBCE	(LBK) (LBK) (LBK)	Dillingen- Essenbach- Herzheim	Germany Germany Germany	M	J1c6 USb2c1 K1a4a1i	G2a2b2a1 C1a2b	MarchiGel2022 MarchiGel2022 MarchiGel2022
DE_5300_4800_LBK DE_Hunter-Gatherer	LBK BDB001	5307-5071 calBCE BP; OxA-3136), 6593-6253 (7580±80BP; BIn-2130), 6750-6429 (7	LBK_EN Germany_Meso_BDB	Viesenhaeuser Hof, Stuttgart-Muehlhausen Bad Dürrenberg, Saxony-Anhalt	Germany Germany	F	T2c1b U4b1b1	11	LazaridisNature2014 OhildebayevaMBE2022
ES 3200 2500 CA ES 3200 2500 CA ES 3200 2500 CA	ATP2 11838	3265-2913 calBCE 2900-2675 calBCE 3356-2936 calBCE (4470±50 BP, Poz-83429)	C_Iberia_CA C_Iberia_CA Spain_C	El Portalon Cave, Sierra de Atapuerca El Portalon Cave, Sierra de Atapuerca Basque Country, Alava, Las Yurdinas II	Spain Spain Spain	F M F	U5b3 J1c3	H2	ValdiceraPNAS.2018 ValdiceraPNAS2018 UpsonNature2017
ES_3200_2500_CA ES_5400_4800_CAR ES_5400_4800_CAR	15838 CB13 Mur	2900-2300 BCE 5469-5327 calBCE (6410±30, Beta-384724) 5296-5076 calBCE (6226±20 BP, wk-40844)	Spain_C Iberia_EN Iberia_EN	Burgos, Atapuerca, El Mirador Cave Cova Bonica, Vallirana, Barcelona Andalusia. Murcie Taeos de Zuheros	Spain Spain Spain	F M	Kla+195 Kla2a J1c1b1	IZa1b1b1a1~ G2a2L1259	LipsonNatur2017 OlaldeMB2015 Valdios eraPNAS2018
ES_Hunter-Gatherer ES_Hunter-Gatherer FS_Hunter-Gatherer	Chan Labrana Canes	7305-7057 cal8CE (8155±42 8P, Ua-13398/Ua-38115) 5982-5741 cal8CE 5295-5035 cal8CE (6197±45 8P, Ox6,7148/A6,5294)	Iberia_HG.5G WHG Iberia_HG	Chan do Lindeiro La Brana-Arintero, Leon	Spain Spain Snain	F M F	U5b U5b2c U5a2a	Cla2 Da1bDa1	GonzalesFortesCurrentBiology2017 Otalde2014 GenzalesFortesCurrentBiology2017
FR_E_4700_4200_PF FR_E_4700_4200_PF	R0545 R0578	4789-4607 calBCE 4700-4500 calBCE	France_Neolithic France_Neolithic	Rosheim "Mitteifeld" "Rosenmeer" Rosheim "Mitteifeld" "Rosenmeer"	France	M	HSu U8b1b1	12a1a2 12a1a2	BrunelPNAS2020 BrunelPNAS2020
FR E 4250 3800 BORS MK FR E 4250 3800 BORS MK FR E 4250 3800 BORS MK	BERG02-2 BERG157-2 BERG157-7	4041-3802 calBCE 4300-3900 calBCE 4319-4050 calBCE	France_Neolithic France_Neolithic France_Neolithic	Saulager, Bergheim Saulager, Bergheim Saulager, Bergheim	France France France	F	J1c1b U5b1c	129192	BrunelPNAS2020 BrunelPNAS2020 BrunelPNAS2020
FR_E_S300_S000_LBK FR_Hunter-Gatherer	Sch72-15 PER503	5466-5215 calBCE 7177-7057 calBCE 2002-2021 calBCE	France_Early_Neolithic France_Mesolithic Errore_Ment_Aimo	Schwindratzheim Agris, Les Perrats Mont Aimó butorió i	France France	M F	T2f U5b1 K1xfx1	C1a2	BrunelPNAS2020 BrunelPNAS2020 Sentein OtherdeBNA52021
FR_N_3400_2900_MSOM FR_N_3400_2900_MSOM	2H07 2H10	3366-3104 calBCE 3341-3098 calBCE	France_Mont_Aime France_Mont_Aime	Mont-Aimé hypogée II Mont-Aimé hypogée II	France	F M	Kia4a1h H3	12a1b1b1	Seguin-OrlandoPNA52021 Seguin-OrlandoPNA52021
FR_N_3400_2900_MS0M FR_N_3600_3400_PostMK FR_N_4700_4300_Cerrly	2H11 PS54693 BUCH2	3351-3102 callSCE 3605-3349 callSCE 4700-4300 callSCE	France_Mont_Arme France_Neolithic France_Neolithic	Ntorit-Aume hypogee II Pont-sur-Seine Buchères	France France France	F	U5b3b U5b1-16189	H2a1	Segun-UrlandoPNAS2021 BruneIPNAS2020 BruneIPNAS2020
FR S 2900 2400 LNVe FR S 2900 2400 LNVe FR S 2900 2400 LNVe	GBVPL TORTE ROUOE	2574-2473 calBCE 2839-2500 calBCE 3321.2937 calBCE	France_Basse_Vigne_Perdue France_Tortues France_Rounuet	Grotte Basse de la Vigne Perdue, les Monges Grotte des Tortues, les Monges Grotte du Bounuet Moujan	France France France	F	J1c1 K1a2b H1+152		Seguin-OrlandoPNAS2021 Seguin-OrlandoPNAS2021 Seguin-OrlandoPNAS2021
FR_S_2900_2400_LNVe FR_S_2900_2400_LNVe	ROUQF ROUQH	3340-3096 calBCE 3346-3101 calBCE	France_Rouquet France_Rouquet	Grotte du Rouquet, Moujan Grotte du Rouquet, Moujan	France	M	V U2e1c1	l2a1a2 l2a1b1b1	Seguin-OrlandoPNA52021 Seguin-OrlandoPNA52021
FR_S_2900_2400_LNVe FR_S_2900_2400_LNVe FR_S_4350_4000_CH	ROUQV ROUQW CRE20D	3354-3102 callscs 3356-3101 callscs 4350-4000 callscs	France_Rouquet France_Rouquet France_Neolithic	Grotte du Rouquet, Moujan Grotte du Rouquet, Moujan Le Crès, Béziers	France France France	F M F	H3 X2c1 H-16291	12a1b1b1	Seguin-OflandoPNAS2021 Seguin-OflandoPNAS2021 BruneIPNAS2020
GB E 4000_3500_EN GB E 4000_3500_EN GB E 4000_3500_EN	Aveline Insington pastu Jubilee cave	3695-3384 cal. BCE (4809±45 BP, UBA-30800) 3656-3521 cal. BCE (4808±35 BP, UB-29004) 3648-3377 cal. BCE (4766±48 BP, UBA-32285)	England_Neolithic England_Neolithic England_Neolithic	Aveline's Hole, Somerset, England lington Pasture Cave, Brassington, Darbyshire, Eng Jubilee cave, North Yorkshire Dales, England	Great Britain Great Britain Great Britain	F M M	U5b1 J1c1 J1c	i2a2aiaia i2a2aiaia2	BraceNatEcolEvol2019 BraceNatEcolEvol2019 BraceNatEcolEvol2019
GB_E_4000_3500_EN GB_E_4000_3500_EN	Kelco_cave BurnGround	3650-3522 cal. BCE (4801±31 BP, OxA-13538) 3943-3711 cal. BCE (5023±34 BP, OxA-17173)	England_Neolithic England_Neolithic	Kelco cave, England Burn Ground, Gloucestershire, England	Great Britain Great Britain	M	J1 U562	IZa1b IZa2aiaia2	BraceNatEcolEvol2019 BraceNatEcolEvol2019
GB_E_4000_3500_EN GB_E_4000_3500_EN GB_Hunter-Gatherer	Eussels_lodge Cheddar	3180-3750, 3730-2180 calBCE 3755-3660 calBCE 8607-7982 cal. BCE (9100±100 BP, OxA-814)	England_Neolithic England_Neolithic England_Meso_CheddarMan	Coldrum, Trottisciffe, Kent, England Fussels Lodge, England Gough's Cave, Cheddar Gorge, Somerset, England	Great Britain Great Britain Great Britain	F M	K1 U5b1 U5b1	128281818	BraceNatEcolEvol2019 BraceNatEcolEvol2019 BraceNatEcolEvol2019
GB_S_3350_2750_LN GB_S_3350_2750_LN GB_S_3350_2750_LN	12932 12934 12978	2572-2348 calBCE (3962±29 BP, SUERC-68721) 3340-3023 calBCE (4466±33 BP, SUERC-69071) 3336-3024 calBCE (4466±29 BP, SUERC-68725)	Scotland_N Scotland_N Scotland_N	Scotland, Orkney, Isbister Scotland, Orkney, Isbister Scotland, Orkney, Isbister	Great Britain Great Britain Great Britain	F M	H5 U5a2c3 K1h1a1	12a1a2	OlaldeNature2018 OlaldeNature2018 OlaldeNature2018
GB S 3350 2750 LN GB S 3350 2750 LN	12980 13138	3364-3101 calBCE (4530±33 BP, SUERC-69073) 3312-2920 calBCE (4415±25 BP, PSUAMS-2156)	Scotland_N Scotland_N	Scotland, Orkney, Point of Cott Scotland, Argyll and Bute, Oban, Raschoille Cave	Great Britain Great Britain	F	H1 K1a4a1		OlaideNature2018 OlaideNature2018
GB 5 3350 2750 LN GB 5 4000 3300 EN GB 5 4000 3300 EN	1/554 12636 12637	3568-3102 CalBCE (4541±52 BP, SUENC-73433 ) 3516-3365 calBCE (4651±33 BP, SUERC-68640) 3510-3340 calBCE (4697±33 BP, SUERC-68641)	Scotland_N Scotland_N Scotland_N	Scotland, Orkney, Unstan Chamber Tomb Scotland, Orkney, Holm of Papa Westray North Scotland, Orkney, Holm of Papa Westray North	Great Britain Great Britain	F M	V Kibiai	12919291929	OlaideNature2018 OlaideNature2018 OlaideNature2018
GB_S_4000_3300_EN GB_S_4000_3300_EN GB_S_4000_3300_EN	13133 13134 13136	3627-3377 calBCE (4725±20 BP, PSUAMS-2154) 3630-3377 calBCE (4730±25 BP, PSUAMS-2155) 3516-3370 calBCE (4665±30 BP, PSUAMS-2069)	Scotland_N Scotland_N Scotland_N	Scotland, Argyll and Bute, Oban, Raschoille Cave Scotland, Argyll and Bute, Oban, Raschoille Cave Scotland, Argyll and Bute, Oban, Raschoille Cave	Great Britain Great Britain Great Britain	M	K1a+195 T2 H1+16189	12a1a2	OlaldoNature2018 OlaldoNature2018 OlaldoNature2018
GR_4500_3200_CA GR_4500_3200_CA	Klei10 Pal7	4230-3995 calBCE (5559±22 BP, MAMS-2303B) 4452-4350 calBCE (5559±29 BP, MAMS-23037)	Greece_Late_Neolithic.SG Greece_Late_Neolithic	Kleitos Paliambela	Greece Greece	M F	K1a2 J1c1	G2a2a1a2	Hofm anovaPNAS2016 Hofm anovaPNAS2016
GR_6400_6000_EN GR_6400_6000_EN GR_6400_6000_EN	Nea2 Nea3 Rev5	8173-8023 calBCE 8327-8040 calBCE 6438-6264 calBCE (7505±25 BP, MAMS-23036)	EN EN Greece_Neolithic	Nea Nikomedeia Nea Nikomedeia Revenia	Greece Greece Greece	F	Kia Kia2c X2b	62a2b2a1a1c	MarchiCell2022 MarchiCell2022 HofmanovaPNAS2016
HR_4500_2500_CA HR_4700_4300_MN HR_4700_4300_MN	15079 POP06 POP08	3651-3110 calBCE (4700±90 BP, Beta-187421) 4700-4300 BCE 4700-4300 BCE	Croatia_N_Starcevo Croatia Sopot culture Croatia Sopot culture	Radovanci Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia	Croatia Croatia Croatia	F	J1c2 K2b1 U8b1a1		MathiesonNature2018 FreilichScientificReports2021 FreilichScientificRenorts2021
HR_4700_4300_MN HR_4700_4300_MN	POP09 POP11	4700-4300 BCE 4700-4300 BCE	Croatia Sopot culture Croatia Sopot culture	Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia	Croatia Croatia	F	K124 T2b3		FreilichScientificReports2021 FreilichScientificReports2021
HR_4700_4300_MN HR_4700_4300_MN HR_4700_4300_MN	POP12 POP13 POP14	4700-4300 BCE 4700-4300 BCE 4763-4536 calBCE (5790±40 BP, Poz-90128)	Croatia Sopot culture Croatia Sopot culture Croatia Sopot culture	Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia	Croatia Croatia	F	T2c1d1 N1a1a1		FreilichScientificReports2021 FreilichScientificReports2021 FreilichScientificReports2021
HR 4700 4300 MN HR 4700 4300 MN	POP16 POP19 BOP27	4700-4300 BCE 4700-4300 BCE 4700-4300 BCE	Croatia Sopot culture Croatia Sopot culture	Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir Popova zemlja, Osijek, Croatia	Croatia Croatia	F	Niaiaia2 Niaiaia3 T2b31		FreilichScientificReports2021 FreilichScientificReports2021
HR 4700 4300 MN HR 4700 4300 MN	POP30 POP33	4700-4300 BCE 4603-4071 calBCE (5529±99 BP, Z-5732)	Croatia Sopot culture Croatia Sopot culture	Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia	Croatia Croatia	M	T2b11 K1a1	G2a2a2b3 G2a2aPF3147	FreilichScientificReports2021 FreilichScientificReports2021
HR_4700_4300_MN HR_4700_4300_MN HR_5500_4500_Sop	POP35 POP36 15078	4584-4458 calBCE (5690±25 BP, PSUAMS-4444) 4700-4300 BCE 4699-4545 calBCE (5770±25 BP, PSUAMS-2615)	Croatia Sopot culture Croatia Sopot culture Croatia_MN_Sopot	Beli Manastir-Popova zemlja, Osijek, Croatia Beli Manastir-Popova zemlja, Osijek, Croatia Osijek, Hermanov Vinograd	Croatia Croatia Croatia	M	1261a5 H H10	G2a2b2a1a1PF3345 C1a2b238888 J2a1a2b2~	FreilichScientificReports2021 FreilichScientificReports2021 MathiesonNature2018
HR_6000_5500_ICC HU_4500_4200_Leng HU_4500_4200_Leng	13433 11495	5975-5747 calBCE (6970±35 BP, PSUAMS-2259) 4496-4353 calBCE (5598±32 BP, MAMS-34819) 4236-4046-43876 (5200±35 BP, BSUAMS-4405)	Croatia_N_Cardial Hungary_LN_Lengyel	Zemunica Cave Apc-Berekalya I	Croatia Hungary	F M	H1 Niaia+152	(2atatb	MathiesonNature2018 GambaNatureCommunications2014 Olokidistum2018
HU 5300 4900 AVK HU 5300 4900 AVK	1/042 11498 NE1	4253-4046 CaBCE (5300±25 BP, F300AH5-4053) 5297-5048 caBCE (6207±30 BP, 0xA-27858) 5306-5071 caBCE (6237±32 BP, 0xA-27861)	Hungary_MN_ALPc Hungary_ALPc_MN	Debrecen Tocopart Erdoalja Polgar Ferenci hat	Hungary Hungary Hungary	F F	H USb2c	124141010	GambaNatureCommunications2014 GambaNatureCommunications2014
HU_5300_4900_AVK HU_5300_4900_LBKT HU_Hunter-Gatherer	NE5 NE6 KO1	5210-4990 calBCE (6164±64 BP,OxA-23763) 5211-4992 calBCE (6135±33 BP, MAMS-14821) 5788-5640 calBCE (6835±34 BP, OxA-23757)	Hungary_LBX_MN Hungary_LBX_MN Hungary_EN_HG_Koros	Kompolt-Kigyoser Apc-Berekalya I Tiszaszolos-Domaháza	Hungary Hungary Hungary	M	Jici Kia3a3 Ribi	Cla2 Cla2 I2a1a1b	GambaNatureCommunications2014 GambaNatureCommunications2014 GambaNatureCommunications2014
IE_3000_2700_LN IE_3000_2700_LN IE_3000_2700_LN	CAK530 CAK531 CAK533	2883-2634 calBCE 2881-2625 calBCE 2833-2459 calBCE	Late Neolithic Late Neolithic	Carrowkeel Carrowkeel Carrowkeel	ireland ireland	F M F	WSb H1 H	(2aibiaiai(+)	CassidyGenov2020 CassidyGenov2020 CassidyGenov2020
IE_3000_2700_LN IE_3500_3000_MN	CAK58 ANN1	3652-3384 calBCE 3638-3137 calBCE	Middle Neolithic Middle Neolithic	Cohaw Annagh	ireland ireland	M	H K1a+195	12a1b1a1a1^(+*) 12a1b1a1a1^(+¥3712)	CassidyScience2020 CassidyScience2020
IE 3500 3000 MN IE 3500 3000 MN IE 3500_3000 MN	ANN2 ASH1 BA64	3705-3379 GAIRCE 3641-3381 caIRCE 3343-3020 caIRCE (4465±38 RP, URA-7059)	Middle Neolithic Middle Neolithic Ireland Neolithic	Arinagn Ashleypark Ballynahatty, County Down	ireland ireland	M	H4a1a1 K2a9 HV0+195	(2a1b1a1a1~(+) (2a1b1a1a1~(+L1193)	CassidyScience2020 CassidyScience2020 CassidyPNAS2016
IE_3500_3000_MN IE_3500_3000_MN IE_3500_3000_MN	BG72 CH448 GNM1007	3635-3377 calBCE 3507-3106 calBCE 4793-4608 calBCE	Middle Neolithic Middle Neolithic Mesolithic	Baunogenasraid Glennamong Killuraeh	ireland ireland ireland	M	K1a4a1 H1 K1a+195	(ZaiaZaia (Zaibiaia(1~*)	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE_3500_3000_MN IE_3500_3000_MN	NG10 PB1327	3320-2922 calBCE 3647-3377 calBCE	Middle Neolithic Middle Neolithic	Site 2, Newgrange Parinabiliai	Ireland Ireland	M	U5b1+16189+16192 T2b3	12a1b1a1a1~(+,L1193,Y3712) 12a1b1a1a1~(+L1193)	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE 3500 3000 MN IE 3500 3000 MN IE 3500 3000 MN	P81794 P82031	3632-3333 CallBCE 3632-3374 callBCE 3774-3642 callBCE	Middle Neolithic Early-Middle Neolithic	Parknabinnia Parknabinnia Parknabinnia	ireland	F	11c6 K1a2b	(Zaiaib~(+)	CassidyScience2020 CassidyScience2020
IE_3500_3000_MN IE_3500_3000_MN	P8357 P8443	3636-3378 calBCE 3631-3362 calBCE 2026 2195 calBCE	Middle Neolithic Middle Neolithic	Parknabinnia Parknabinnia Rodenbiosia	ireland ireland	F M	U8b1b K1b1a1	12a1a2a1a	CassidyGenov2020 CassidyGenov2020 CassidyGenov2020
IE_3500_3000_MN IE_3500_3000_MN IE_3500_3000_MN	P8672 P8675	3263-2910 GHBCE; 3617-3138 GHBCE; 3617-3138 GHBCE	Middle Neolithic Middle Neolithic Middle Neolithic	Parknabinnia Parknabinnia Parknabinnia	Ireland Ireland	M	T2c1d+152 H1	12a1a1b~(+) 12a1a1b(+)	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE_3500_3000_MN IE_3500_3000_MN IE_3500_3000_MN	P8754 P8768 PN03	3642-3375 CAREE 3704-3522 CAREE 3944-3665 CAREE	Middle Neolithic Early-Middle Neolithic Early Neolithic	Parkhabenni a Poulnabrone Poulnabrone	Ireland Ireland Ireland	M	056243 H4a1a1 K1a1	12a1a1b~(+) 12a1b1a1a1~(+)	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE_3500_3000_MN IE_3500_3000_MN IE_3500_3000_MN	PN05 PN07 PN12	3629-3371 calBCE 3621-3198 calBCE	Middle Neolithic Early Neolithic Middle Neolithic	Poulnabrone Poulnabrone Poulnabrone	ireland ireland	M	H USb1c H	iZaiaib~(+) iZaibiaiai~(+,L1193) iZaibiaiai~	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE_3500_3000_MN IE_3800_3500_EN	PN16 ASH3	3633-3374 calBCE 3712-3539 calBCE	Middle Neolithic Early-Middle Neolithic	Poulnabrone Ashleypark	Ireland Ireland	F M	Kibiai T2cidi	iZaiaib~(+)	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE_3800_3500_EN IE_3800_3500_EN	PN04 PN05	3941-3661 calBCE 3635-3376 calBCE	Early Neolithic Middle Neolithic	Poulnabrone Poulnabrone	Ireland Ireland	M	H1+16189 K1a+195	12a1b1a1a1~(+,Y3712) 12a1b1a1a1~(+L1193)	CassidyScience2020 CassidyScience2020
IE_3800_3500_EN IE_3800_3500_EN IE_3800_3500_EN	PN10_PN113 PN112 PN13	3696-3535 calBCE 3940-3703 calBCE 3704-3536 calBCE	Early-Middle Neolithic Early Neolithic Early-Middle Neolithic	Poulnabrone Poulnabrone Poulnabrone	ireland ireland	F M M	USb2b H4a1a1a V	iZaibiaiai~	CassidyScience2020 CassidyScience2020 CassidyScience2020
IE_Meso_KGH6 IE_Hunter-Gatherer	KGH6 SRA62	3338-3028 calBCE 4226-3963 calBCE	Middle Neolithic Mesolithic	Newgrange, Main Chamber Sramore	ireland ireland	M	USb2a USa2d	12a1a2() 12a1b2(+52519)	CassidyScience2020 CassidyScience2020 Attact of Linear State
IT_3500_2500_CA IT_3500_2500_CA IT_3500_2500_CA	R4 R5	2950 - 3374 CalBCE 2950 - 2880 calBCE 2902 - 2877 calBCE	Copper Age Copper Age	Grotta Continenza Grotta Continenza	italy italy	F F	U8b1b1 K1a+195	GF1193	AntonioScience2019 AntonioScience2019 AntonioScience2019
IT_3500_2500_CA IT_5800_5200 IT_5800_5200	R1014 R16 R17	3500 - 2500 BCE 5301 - 5214 calBCE 5324 - 5223 calBCE	Copper Age Italy Neolithic Italy Neolithic	Monte San Biagio Ripabianca di Monterado Ripabianca di Monterado	italy Italy Italy	F M	G2a2a-PF3147 U5b2b3 U8b1b	HL901 J2a2a	AntonicGcience2019 AntonicGcience2019 AntonicGcience2019
IT_5800_5200 IT_5800_5200 IT_5800_5200	R18 R19 R6	5465 - 5232 calBCE 5345 - 5221 calBCE 5345 - 5211 calBCE 5342 - 5177 calBCE	Italy Neolithic Italy Neolithic Italy Neolithic	Ripabianca di Monterado Ripabianca di Monterado Gratta Continacco	Italy Italy Italy	F M M	H2a U5b3a1 K1a1	J2a1a1a2b2 R1h1h2x	AntonioScience2019 AntonioScience2019 AntonioScience2019
IT_5800_5200 IT_5800_5200	R10 R2	5717 - 5641 calBCE 6066 - 6002 calBCE	Italy Neolithic Italy Neolithic	Grotta Continenza Grotta Continenza	italy italy	F	T2c1+146 K1a2		AntonioScience2019 AntonioScience2019
11_5800_5200 17_5800_5200 17_5800_5200	КЗ R8 R9	3839 - 5723 CalBCE 5832 - 5715 calBCE 5607 - 5485 calBCE	Italy Neolithic Italy Neolithic Italy Neolithic	Grotta Continenza Grotta Continenza Grotta Continenza	italy Italy Italy	F M	Kia3 Kia4a1	G2a2a1a2b1b	AntonioScience2019 AntonioScience2019 AntonioScience2019
IT_Hunter-Gatherer IT_Hunter-Gatherer IT_Hunter-Gatherer	R11 R15 R7	10100 - 9816 calBCE 7284 - 7065 calBCE 8821 - 8642 calBCE	Mesolithic Castelnovian Mesolithic Mesolithic	Grotta Continenza Grotta Continenza Grotta Continenza	italy italy italy	M M M	12 USb3 USb1	i2aib2 i2aibia2a2ai i2aibia1aibia	AntonioScience2019 AntonioScience2019 AntonioScience2019
IT_Sar_4000_MN IT_Sic_5000_4700_MN	116168 14062	3949-3714 calBCE (5035±25 BP, PSUAMS-6926) 4984-4784 calBCE (5080±30 BP, PSUAMS-1950)	Italy_Sardinia_N Italy_Sicily_MN	Sardinia, Anghelu Ruju Sicily, Fossato di Stretto Partana	italy italy	M	U5b2b3 H1e	H2c1a~	FernandesNatureEcologyEvolution2020 FernandesNatureEcologyEvolution2020
LU_Meso_Loschbour LV_Hunter-Gatherer	4063 Loschbour ZVEI25	+167-4/94 CalBCE (5995±30 BP, PSUAMS-2263) 6221-5986 calBCE 5841-5636 calBCE (6840±55 BP, Hela-1212)	Itaty_Sicily_MN WHG Latvia_HG	Sicey, Fossato di Stretto Partana Echternach Zvejnieki	Italy Luxembourg Latvia	F M M	K1b1a U5b1a U2e1	IZa1b Ribiaia	FernandesNaturet.cologyEvolution2020 LazaridisNature2014 JonesCurrentBiology2017
LV_Hunter-Gatherer NO_Hunter-Gatherer NO_Hunter-Gatherer	ZVEJ32 Hum2 Steigen	6467-6249 calBCE (7525:t60 BP, LuS-8220) 7452-7275 calBCE (Combined over all Hum samples) 3950-3764 calBCF	Latvia_HG Scandinavian hunter-gatherer Scandinavian hunter-eatherer	Zvejnieki Hummervikholmen Steizen	Latvia Norway Norway	F M M	USaic USaid 12	12 12a1b	JonesCurrentBiology2017 GüntherPlosBiology2018 GüntherPlosBiology2018
PO_3000_2800_GAC PO_3000_2800_GAC	Koszyce_3_1 Koszyce_3_10	2884-2671 calBCE 2872-2578 calBCE	Poland_Koszyce_GAC Poland_Koszyce_GAC	Koszyce, site 3 Koszyce, site 3	Poland	F	T2b HV0a	U5b1+16189+@16192	SchroederPNAS2019 SchroederPNAS2019
PO_S000_2800_GAC PO_3000_2800_GAC PO_3000_2800_GAC	Koszyce_3_12 Koszyce_3_8 N38	2900-2696 CARECE 3072-2888 CARECE 3263-2903 CARECE	Poland_Koszyce_GAC Poland_Koszyce_GAC Poland_GAC	Koszyce, site 3 Koszyce, site 3 Brzesc Kujawski	Poland Poland	F F	s1a1b1e i1c3f T2c1-146	1231301	SchroederNAS2019 SchroederPNAS2019 FernandesScientRep2018
PO 3700 3400 TRB PO 3700 3400 TRB PO 4400 4000 BKG/PO Hunter/Cathore	N18 N20 r N22	3636-3389 calBCE 3636-3389 calBCE 4442-4240 calBCE	Poland_TRB Poland_TRB Poland_TRB	Piłkutkowo Piłkutkowo Brzesc Kniawschi	Poland Poland Poland	F	Niala1 H3t USa1r		FernandesScientRep2018 FernandesScientRep2018 FernandesScientRen2018
PO_4400_4000_BKG PO_4400_4000_BKG	N25 N26	4600-4000 BCE 4334-4068 calBCE	Poland_BKG Poland_BKG	Oslanki Konary	Poland Poland	F M	K2a T2b30		FernandesScientRep2018 FernandesScientRep2018
PO_4400_4000_BKG PO_4400_4000_BKG PO_4400_4000_BKG	N27 N28 N31	4600-4000 BCE 4251-3996 calBCE 4323-4052 calBCE	Poland_BKG Poland_BKG Poland_BKG	Ustonki Ostonki Ostonki	Poland Poland	M M F	V14 T2b H26		FernandesScientRep2018 FernandesScientRep2018 FernandesScientRep2018
PO_4400_4000_BKG PO_4400_4000_BKG PT_4300_3500_1111	N36 N42	4600-4000 BCE 4231-3979 GalBCE 4500 3500 B75	Poland_BKG Poland_BKG	Konary Oslonki	Poland Poland	F	J1c5 U5b2a1a		FernandesScientRep2018 FernandesScientRep2018 MartinismothesScienceScientPart
PT_4200_3500_MN PT_4200_3500_MN PT_4200_3500_MN	LugarCanto41 LugarCanto42 LugarCanto44	4500-3500 BLE 4500-3500 BLE 4500-3500 BLE	Portugal Neolithic Portugal Neolithic	Lugar do Canto Lugar do Canto Lugar do Canto	Portugal Portugal	F	H1e1a2		MartinianoPLoSGenetics2017 MartinianoPLoSGenetics2017 MartinianoPLoSGenetics2017
RO_Eneolithic RO_Hunter-Gatherer RO_Hunter-Gatherer	681 0C1 5C2	5300- 5454 calBCE 7471-7181 calBCE	Eneolithic Iron_Gates_HG Iron_Gates_HG	Gura Baciului Ostrovul Corbului Schela Cladovei	Romania Romania Romania	F M M	K1a4a K1+16362 USa1c	Ribia Ribiaia2	GonzalesFortesCurrentBiology2017 GonzalesFortesCurrentBiology2017 GonzalesFortesCurrentBiology2017
R5_6000_5500_Star R5_6000_5500_Star R5_6000_5500_Star	14918 LEPE48-2	6000-5300 BCE 8012-7867 calBCE 7931,7662 calBCE	Serbia_EN_Starcevo TEN E_AAN	Saraorci-Jezava Lepenski Vir	Serbia Serbia	F M	Kia4a1 Kia1 µ2	-	MathiesonNature2018 MarchiCell2022 MarchiCell2022
RS_6000_5500_Star RS_6000_5500_Star	STAR1 VC3-2	7589-7476 cal9CE 7565-7426 cal9CE	(Starcevo) (Starcevo)	Grad-Starcevo Vinca-Belo Brdo	Serbia Serbia	F M	T2e2 HV-16311		MarchiCell2022 MarchiCell2022
RS_Hunter-Gatherer RS_Hunter-Gatherer RS_Hunter-Gatherer	15236 VLASA32-2 VLASA7-3	8291-7826 cal8CE (8943±77 BP, BM-1146) 9741-9468 cal8CE 8764-8340 cal8CE	LM LM	Padina Vlasac Vlasac	Serbia Serbia Serbia	M M M	U5a2d U5a2a U5a2a	i2aiaibi~ G2a2aia3 Ribi	MathiesonNature2018 MarchiCell2022 MarchiCell2022
SE_3500_2800_Megal SE_3500_2800_Megal SE_3500_2800_Megal	Ansarve017 Ansarve8 Grahom	3330-2930 calBCE 3340-3030 calBCE 3050-2750 calBCF (#368+37 80 1104 14/007)	Ansarve Megalithic Ansarve Megalithic Scandinavian Nonlithic	Arsarve Arsarve Göldem Vastaesethood	Sweden Sweden	M M F	НV0а 1c5 н	i2a1b1a1 i2a1b1a1	SanchezQuintoPNA52019 SanchezQuintoPNA52019 StrutiumKrianra20118
SE_Meso_Motala12 TR_6500_6200_LN	Motala12 AKT16-2	5722-5628 calBCE 8635-8460 calBCE	Scandinavian hunter-gatherer EN	Motala, Kanaljorden Aktopraklik	Sweden Turkey	M F	U2e1 K1a3	NA	LazaridisNature2014 MarchiCell2022
1R_6500_6200_LN TR_6500_6200_LN TR_6500_6200_LN	BAR25-1 Bar31 Bar8	8384-8205 calBCE 6419-6238 calBCE 6212-6030 calBCE	EN EN EN	Baron Baron, Marmara Region, Northwest Anatolia Baron, Marmara Region, Northwest Anatolia	furkey Turkey Turkey	M M F	Nialal X2m Kla2	G2a2b2a3 G2a2b	MarchiCell2022 HofmanovaPNAS2016 HofmanovaPNAS2016
TR 6500 6200 LN TR 6500 6200 LN TR 6500 6200 LN	10707 10708 10709	6225-6065 calBCE (7272±34 BP, Tubitak-0455) 6224-6074 calBCE (7285±30 BP, PSUAMS-2103) 6223-6034 calBCE (7255±30 BP, PSUIAMS-24053)	Turkey_N Turkey_N Turkey_N	Northwest Anatolia, Marmara, Barcin Northwest Anatolia, Marmara, Barcin Northwest Anatolia, Marmara, Barrin	Turkey Turkey Turkey	F M M	Kia4 Nibia UR	J2a1 H	MathiesonNature2015 MathiesonNature2015 MathiesonNature2015
TR_6500_6200_LN GB_Hunter-Gatherer	10745 Gough	6387-6111 calBCE (7405±30 BP, PSUAMS-2105) 15020-14830 calBCE	Turkey_N Gough	Northwest Anatolia, Marmara, Barcin Gough's Cave, Cheddar Gorge, Somerset, England	Turkey Great Britain	M F	U8b1b1 USa2	Ĥ	MathiesonNature2015 CharltonNatureEcologyEvolution2022

#### Table S4. qpAdm admixture modelling of each individual

Group label (in this study) AT 5500 5000 LBK	Sample ID Asp6	Data type Shotgun	Source MarchiCell2022	ANF proportion 0.95	HG proportion 0.05	ANF proportion (se) 0.02	HG proportion (se 0.02	0.61	<pre>qpAdm_SNPs 975825</pre>
AT_5500_5000_LBK	15069	Shotgun	MathiesonNature2018	0,96	0,04	0,02	0,02	0,12	942111
AT_5500_5000_LBK	15070	Capture 1240k	MathiesonNature2018 MathiesonNature2018	0,99	0,01	0,02	0,02	0,92	773233
AT_5500_5000_LBK AT_5500_5000_LBK	15205	Capture 1240k Capture 1240k	MathiesonNature2018 MathiesonNature2018	0,95	0,05	0,02	0,02	0,32	772051
AT_5500_5000_LBK	15207	Capture 1240k	MathiesonNature2018	0,94	0,06	0,02	0,02	0,30	820741
CH_3500_2800_LNHo	Aesch10	Capture 1240k Capture 1240k	MathiesonNature2018 FurtwanglerNatureCommunications2020	0,95	0,05	0,02	0,02	0,02	816930 447948
CH 3500_2800_LNHo CH 3500_2800_LNHo	Aesch11 Aesch12	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,79	0,21	0,02	0,02	0,48	567296
CH_3500_2800_LNHo	Aesch13	Capture 1240k	FurtwanglerNatureCommunications2020	0,81	0,19	0,02	0,02	0,23	563093
CH_3500_2800_LNHo	Aesch14 Aesch15	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,81	0,19	0,02	0,02	0,86	437418
CH_3500_2800_LNHo CH_3500_2800_LNHo	Aesch17 Aesch18	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,81	0,19	0,02	0,02	0,06	577080 618424
CH_3500_2800_LNHo	Aesch19	Capture 1240k	FurtwanglerNatureCommunications2020	0,84	0,16	0,02	0,02	0,35	574764
CH_3500_2800_LNHo	Aesch1 Aesch20	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,81	0,19	0,02	0,02	0,12	562115
CH_3500_2800_LNHo CH_3500_2800_LNHo	Aesch21 Aesch22	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,81 0,80	0,19	0,02	0,02	0,01 0,06	565379 513949
CH 3500_2800_LNHo CH 3500_2800_LNHo	Aesch23 Aesch24	Capture 1240k	FurtwanglerNatureCommunications2020	0,82	0,18	0,02	0,02	0,65	600219 570867
CH 3500_2800_LNHo	Aesch2	Capture 1240k	FurtwanglerNatureCommunications2020	0,83	0,17	0,02	0,02	0,11	430412
CH_3500_2800_LNHo CH_3500_2800_LNHo	Aesch3 Aesch4	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,84	0,16	0,02	0,02	0,24 0,14	550002
CH_3500_2800_LNHo CH_3500_2800_LNHo	Aesch5 Aesch7	Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,84	0,16	0,02	0,02	0,48	519940 465324
CH_3500_2800_LNHo	Aesch8	Capture 1240k	FurtwanglerNatureCommunications2020	0,79	0,21	0,02	0,02	0,58	527772
CH_3500_2800_LNHo CZ_3800_3500_TRB	Aesch9 114167	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 PapacScienceAdvances2021	0,78	0,22	0,02	0,02	0,32	454560 717481
CZ_3800_3500_TRB CZ_3800_3500_TRB	114168	Capture 1240k Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,71	0,29	0,02	0,02	0,55	698997 746721
CZ_3800_3500_TRB	114170	Capture 1240k	PapacScienceAdvances2021	0,85	0,15	0,02	0,02	0,34	740373
CZ_3800_3500_TRB	114171	Capture 1240k Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,81	0,19	0,02	0,02	0,39	745424
CZ_3800_3500_TRB CZ 3800 3500 TRB	114173 114174	Capture 1240k Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,79 0,82	0,22	0,02	0,02	0,83	759495 731588
CZ_3800_3500_TRB	114175	Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,80	0,20	0,02	0,02	0,32	734907
CZ_3800_3500_TRB	116121	Capture 1240k	PapacScienceAdvances2021	0,79	0,21	0,02	0,02	0,10	597247
CZ_3800_3500_TRB CZ_3800_3500_TRB	17186	Capture 1240k Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,80	0,20	0,02	0,02	0,68	794762
CZ_3800_3500_TRB CZ 3800 3500 TRB	17188 17189	Capture 1240k Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,80	0,20	0,02	0,02	0,80	793679 787326
CZ_3800_3500_TRB	17191	Capture 1240k	PapacScienceAdvances2021	0,81	0,19	0,02	0,02	0,91	801279
CZ_3800_3500_TRB	17192	Capture 1240k Capture 1240k	PapacScienceAdvances2021 PapacScienceAdvances2021	0,56	0,44	0,02	0,02	0,23	778076
CZ_3800_3500_fRB DE_4000_3000_MLN	1/194 Tangermünde (TGM009)	Capture 1240k Capture 1240k	PapacscienceAdvances2021 RivollatScienceAdvances2020	0,81	0,19 0,70	0,02	0,02	0,52	/89106 664332
DE_4000_3000_MLN DE_4000_3000_MLN	10560 KH150610	Capture 1240k Shotgun	MathiesonNature2015 ImmelNatureCommunications2021	0,79 0,67	0,21 0,33	0,02 0,02	0,02 0,02	0,97 0,26	453332 964594
DE_4000_3000_MLN DF_4000_3000_M/N	KH150615 KH150619	Shotgun	ImmelNatureCommunications2021 ImmelNatureCommunications2023	0,60	0,41	0,02	0,02	0,30	974249 95991 2
DE_4000_3000_MLN	KH150620	Shotgun	ImmelNatureCommunications2021	0,64	0,36	0,02	0,02	0,21	975608
DE_4000_3000_MLN DE_4000_3000_MLN	KH150635 10172	shotgun Capture 1240k	mmeinatureCommunications2021 MathiesonNature2015	0,66	0,34	0,02	0,02	0,01	975561 944296
DE_4000_3000_MLN DE_4000_3000_MIN	Blätterhöhle (I1563) Blätterhöhle (I1565)	Capture 1240k Capture 12404	LipsonNature2017 LipsonNature2017	0,60	0,40	0,02	0,02	0,02	845696 783643
DE_5500_5000_LBK	Dil16	Shotgun	MarchiCell2022	0,98	0,02	0,02	0,02	0,41	975747
DE_SS00_S000_LBK	ESS/ Herx	Shotgun	MarchiCell2022 MarchiCell2022	0,95	0,04	0,02	0,02	0,12	975732
DE_5500_5000_LBK DE_5500_5000_LBK	DER002 DER003	Shotgun Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,99 0,97	0,01	0,02	0,02 0,02	0,55	882066 518530
DE_5500_5000_LBK DE_5500_5000_LBK	DER004 DER005	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,96	0,04	0,03	0,03	0,90	334773 489041
DE_5500_5000_LBK	DER006	Capture 1240k	ChildebayevaMBE2022	1,00	0,00	0,02	0,02	0,46	502801
DE_5500_5000_LBK	DER009	Shotgun	ChildebayevaMBE2022 ChildebayevaMBE2022	0,98	0,07	0,02	0,02	0,65	883139
DE_5500_5000_LBK DE_5500_5000_LBK	DER010 DER011	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,96	0,04	0,02	0,02 0,02	0,96	576749 475303
DE_5500_5000_LBK DE_5500_5000_LBK	DER012 DER013	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,98	0,02	0,02	0,02	0,01	574313 674049
DE_5500_5000_LBK	DER014	Capture 1240k	ChildebayevaMBE2022	0,95	0,05	0,02	0,02	0,29	487180
DE_5500_5000_LBK	DER013 DER017	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,95	0,02	0,02	0,02	0,37	333127
DE_5500_5000_LBK DE_5500_5000_LBK	DER018 DER019	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,97 0,93	0,03	0,02	0,02	0,47 0,29	479622 354450
DE_5500_5000_LBK	DER020 DER021	Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,96	0,04	0,03	0,03	0,75	272605
DE_5500_5000_LBK	DER022	Capture 1240k	ChildebayevaMBE2022	0,99	0,01	0,02	0,02	0,91	615484
DE_5500_5000_LBK	DER023 DER024	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,98	0,02	0,02	0,02	0,93	581830
DE_5500_5000_LBK DE 5500 5000 LBK	DER026 DER028	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,94	0,06	0,02	0,02	0,72 0,50	464096 676666
DE_5500_5000_LBK	DER029 DER030	Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,97	0,03	0,02	0,02	0,41	447606 382141
DE_5500_5000_LBK	DER031	Capture 1240k	ChildebayevaMBE2022	0,96	0,04	0,03	0,03	0,52	347610
DE_5500_5000_LBK	DER032 DER033	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,95 0,97	0,05	0,02	0,02	0,62	673762
DE_5500_5000_LBK DE 5500 5000 LBK	DER034 DER035	Capture 1240k Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,96	0,04	0,02	0,02	0,35	573363 460539
DE_5500_5000_LBK	DER036	Capture 1240k	ChildebayevaMBE2022 ChildebayevaMBE2022	0,92	0,08	0,02	0,02	0,84	663586
DE_5500_5000_LBK	Stuttgart	Shotgun	LazaridisNature2014	0,95	0,05	0,02	0,02	0,21	975699
DE_5500_5000_LBK	10046	Capture 1240k Capture 1240k	LipsonNature2017 LipsonNature2017	0,96	0,04	0,02	0,02	0,10	491216
DE_5500_5000_LBK DE_5500_5000_LBK	10054	Capture 1240k Capture 1240k	MathiesonNature2015 LipsonNature2017	0,96	0,04	0,02	0,02	0,47	890139 442343
DE_5500_5000_LBK	10057	Capture 1240k	LipsonNature2017	0,92	0,08	0,03	0,03	0,25	364413
DE_5500_5000_LBK	10100	Capture 1240k Capture 1240k	LipsonNature2017	0,95	0,02	0,02	0,02	0,88	595312
DE_S500_5000_LBK DE_S500_5000_LBK	10821 12036	Capture 1240k Capture 1240k	LipsonNature2017 LipsonNature2017	0,94 0,96	0,06	0,02	0,02 0,02	0,77	460495 390370
DE_5500_5000_LBK DE_5500_5000_LBK	10025	Capture 1240k Capture 1240k	MathiesonNature2015 MathiesonNature2015	0,97	0,03	0,02	0,02	0,71	794052 808622
DE_5500_5000_LBK	XN165	Capture 1240k	RivollatScienceAdvances2020	0,97	0,03	0,02	0,02	0,17	499282
ES_4300_3000_MLN	10408	Capture 1240k Capture 1240k	MathiesonNature2015	0,78	0,19	0,02	0,02	0,67	576623
ES_4300_3000_MLN ES_3200_2500_CA	10408 ATP16	Capture 1240k Shotgun	MathiesonNature2015 ValdioseraPNAS2018	0,78 0,82	0,22 0,18	0,02	0,02	0,17 0,45	480767 686871
ES_3200_2500_CA ES_3200_2500_CA	ATP2 CDM001	Shotgun Canture 1240k	ValdioseraPNAS2018 Villalba-MouroScienceAdvances2021	0,77	0,23	0,02	0,02	0,03	941031 446950
ES_3200_2500_CA	CDM002	Capture 1240k	Villalba-MoucoScienceAdvances2021	0,85	0,15	0,02	0,02	0,53	481146
ES_3200_2500_CA ES_3200_2500_CA	CDM003 CDM006	Capture 1240k Capture 1240k	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,79	0,21	0,02	0,02	0,95 0,63	4348/9 455063
ES_3200_2500_CA ES_3200_2500_CA	CDP001 CDP002	Capture 1240k Capture 1240k	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,82 0,81	0,18 0,19	0,02	0,02 0,02	0,56 0,93	666643 484600
ES_3200_2500_CA FS_3200_2500_CA	CDP006 CDP011	Capture 1240k	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,82	0,18	0,02	0,02	0,40	356389 527666
ES_3200_2500_CA	CLL001	Capture 1240k	Villalba-MoucoScienceAdvances2021	0,82	0,18	0,02	0,02	0,56	509071
ES 3200 2500 CA ES 3200 2500 CA	CLL002 CLL004	Capture 1240k	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,80	0,20	0,02	0,02	0,51	651083
ES_3200_2500_CA ES_3200_2500_CA	CLL005 CLL006	Capture 1240k Capture 1240k	viilalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,82	0,18	0,03	0,03	0,59 0,04	338588 541644
ES_3200_2500_CA ES_3200_2500_CA	CLL008 CLL009	Capture 1240k Capture 1240k	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,79 0,81	0,22 0,19	0,02 0,02	0,02 0,02	0,30 0,34	466468 510404
ES_3200_2500_CA FS_3200_2500_CA	CLL010	Capture 1240k	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021	0,78	0,22	0,02	0,02	0,83	458515 418751
ES 3200_2500_CA	CYH1 110279	Shotgun	This study OlaldeScience2010	0,72	0,28	0,02	0,02	0,37	576523 46643P
ES 3200 2500 CA	1102/8	Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,81	0,19	0,02	0,02	0,97	689883
ES_3200_2500_CA ES_3200_2500_CA	111300	Capture 1240k Capture 1240k	OlaldeScience2019	0,72	0,28	0,04	0,04	0,72	24/013 555861
ES_3200_2500_CA ES_3200_2500_CA	11838 11842	Shotgun Capture 1240k	LipsonNature2017 OlaldeScience2019	0,75 0,74	0,25	0,02 0,02	0,02	0,82	840267 508324
ES 3200_2500_CA ES 3200_2500_CA	11846 11976	Capture 1240k Capture 1240k	OlaldeScience2019 LipsonNature2017	0,77 0,75	0,24 0,25	0,02 0,03	0,02 0,03	0,87 0,24	643600 295185
ES_3200_2500_CA	11978	Capture 1240k	OlaldeScience2019	0,74	0,26	0,02	0,02	0,37	782181
ES_3200_2500_CA ES_3200_2500_CA	12473 13238	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,75	0,24 0,18	0,03	0,03	0,57	342037
ES_3200_2500_CA ES_3200_2500_CA	13239 13277	Capture 1240k Capture 1240k	UtaldeScience2019 OlaldeScience2019	0,83 0,69	0,18 0,31	0,05	0,05 0,03	0,60	236291 280980
ES_3200_2500_CA ES_3200_2500_CA	13432 15838	Capture 1240k Shotgun	OlaldeScience2019 MathiesonNature2015	0,80	0,20	0,02	0,02	0,52 0,33	580741 975259
ES 3200 2500 CA	17587 18149	Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,80	0,20	0,04	0,04	0,97	239957 255718
ES_200_2500_CA	18158	Capture 1240k	OlaldeScience2019	0,82	0,18	0,05	0,05	0,21	234634
ES_3200_2500_CA ES_3200_2500_CA	18197 18198	Capture 1240k Capture 1240k	UtaldeScience2019 OlaldeScience2019	0,83	0,17 0,18	0,02	0,02	0,93	659447
ES_3200_2500_CA ES_3200_2500_CA	18199 18364	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,80	0,20	0,02	0,02	0,57 0,08	766997 742248
ES 3200 2500 CA ES 3200 2500 CA	18365 18568	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,80	0,20	0,02	0,02	0,45	796080 485588
ES_4300_3000_MLN FS_4300_3000_MLN	110277	Capture 1240k	OlaldeScience2019	0,79	0,21	0,02	0,02	0,22	478544 409269
ES_4300_3000_MLN ES_4300_3000_MLN	110280	Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,80	0,20	0,02	0,02	0,56	291463
ES_4300_3000_MLN ES_4300_3000_MLN	110285	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,73 0,84	0,27 0,16	0,03	0,03 0,02	0,29 0,34	400633 602588
ES_4300_3000_MLN ES_4300_3000_MLN	111303 111304	Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,74	0,26	0,04	0,04	0,43	251566 249875
ES_4300_3000_MLN FS_4300_3000_MLN	111305 111206	Capture 1240k	OlaldeScience2019	0,80	0,20	0,02	0,02	0,31	536097 49231F
ES_4300_3000_MLN ES_4300_3000_MLN	ELT002	Capture 1240k	VillalbaMoucoCurrentBiology2019	0,80	0,20	0,02	0,02	0,41	492313
ES_4300_3000_MLN ES_4300_3000_MLN	ELT006 17547	Capture 1240k Capture 1240k	VillalbaMoucoCurrentBiology2020 OlaldeScience2019	0,80	0,20	0,02 0,04	0,02 0,04	0,71 0,62	682408 246077
ES_4300_3000_MLN ES_4300_3000_MLN	17549	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,82	0,18	0,02	0,02	0,19 0,37	374291 629210
ES_4300_3000_MLN	17679	Capture 1240k	OlaldeScience2019	0,84	0,16	0,05	0,05	0,96	228293
ES_4300_3000_MLN	17598	Capture 1240k	OlaldeScience2019	0,85	0,16	0,02	0,02	0,18	221666
ES_4300_3000_MLN ES_4300_3000_MLN	17601	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,84	0,15	0,02	0,02	0,52	435099 415045
ES_3200_2500_CA	17642 17643	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,72 0,76	0,28	0,02	0,02	0,55	759994 302482
E3_4500_5000_MEN			OlaldaSaianaa 2010	0.92	0.17	0.02	0.02	1 0 0 7	420541

EE 4300 3000 MIN	176.46	Conture 1240h	OlaldaScience3010	0.91	0.10	0.02	0.02	0.60	204010
ES 4300_3000 MLN	17647	Capture 1240k	OlaldeScience2019	0,83	0,17	0,07	0,07	0,12	221061
ES_5400_4800_CAR ES_5400_4800_CAR	CHA002 CHA003	Capture 1240k Capture 1240k	VillalbaMoucoCurrentBiology2020 VillalbaMoucoCurrentBiology2021	0,90	0,10 0,12	0,03	0,03	0,31 0,82	297978 451919
ES_5400_4800_CAR	10409	Capture 1240k	MathiesonNature2015 MathiesonNature2015	0,90	0,10	0,02	0,02	0,53	547540 585201
ES 5400 4800 CAR	10412	Capture 1240k	MathiesonNature2015	0,94	0,06	0,02	0,02	0,54	871102
ES_5400_4800_CAR	110942	Capture 1240k Capture 1240k	OlaldeScience2019	0,85	0,12	0,02	0,02	0,19	446186
ES_5400_4800_CAR ES 4300 3000 MLN	11972 111248	Capture 1240k Capture 1240k	LipsonNature2017 OlaldeScience2019	0,93	0,08	0,02	0,02	0,70 0,08	443134 758139
ES_4300_3000_MLN ES_4300_3000_MLN	17602	Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,81	0,19	0,03	0,03	0,64	319010
ES 4300_3000 MLN	17604	Capture 1240k	OlaldeScience2019	0,76	0,30	0,02	0,02	0,65	580756
ES_4300_3000_MLN ES_4300_3000_MLN	17605	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,72	0,29	0,02	0,02	0,16	454955
ES_5400_4800_CAR ES_5400_4800_CAR	CB13 Mur	Shotgun	ValdioseraPNAS2018 OlaldeMBE2015	0,89	0,11	0,02	0,02	0,12	598146 908161
ES_5400_4800_CAR	TOR6	Shotgun	FregelPNAS2018	0,80	0,20	0,03	0,03	0,64	332740
FR_E_4700_4200_PF FR_E_4700_4200_PF	SX33 SX29	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020	0,97	0,03	0,02	0,02	0,13 0,40	583133 434261
FR_E_4700_4200_PF FR S 5500 4600 CAR SMP	SX30 LBR001	Capture 1240k Capture 1240k	FurtwanglerNatureCommunications2020 RivollatScienceAdvances2020	0,90	0,10	0,02	0,02	0,69	502139 662445
FR_S_5500_4600_CAR_SMP	LBR002	Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,78	0,22	0,02	0,02	0,94	641370
FR_S_5500_4600_CAR_SMP	LBR004	Capture 1240k	RivollatScienceAdvances2020	0,70	0,23	0,02	0,02	0,51	637886
FR_S_S500_4600_CAR_SMP FR_S_S500_4600_CAR_SMP	LBR005	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,76	0,24 0,35	0,02	0,02	0,20	721943
FR_S_5500_4600_CAR_SMP FR_S_5500_4600_CAR_SMP	PEN0012 PEN003	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,52	0,48	0,02	0,02	0,87	668780 657506
FR_E_4700_4200_PF	ROS102	Shotgun	BruneIPNAS2020	0,85	0,16	0,03	0,03	0,01	322757
FR E 4700 4200 PF	ROS78	Shotgun	BruneIPNAS2020	0,87	0,13	0,02	0,02	0,36	475461
FR_E_4700_4200_PF FR_E_4700_4200_PF	OBN003 OBN007	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,68 0,93	0,32 0,08	0,02	0,02	0,75	603363 565623
FR_E_4700_4200_PF FR_E_4700_4200_PF	OBN008 OBN009	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,78	0,22 0,11	0,02	0,02	0,44 0,27	761822 651629
FR_E_4700_4200_PF	OBN010 OBN011	Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,79	0,21	0,02	0,02	0,62	614744 570815
FR_E_5300_5000_LBK	Mor6	Shotgun	BrunelPNAS2020	0,88	0,12	0,03	0,03	0,52	324991
FR_E_5300_5000_LBK	Schw432	Shotgun	BruneIPNAS2020 BruneIPNAS2020	1,00	0,04	0,03	0,03	0,39	319973
FR_N_3400_2900_Marne FR_N_3400_2900_Marne	CHOU3923 CHOU3935	Shotgun Shotgun	This study This study	0,74 0,69	0,27	0,02	0,02	0,65	452630 623746
FR_N_3400_2900_Marne FR_N_3400_2900_Marne	CHOU5980 CHOU6908	Shotgun	This study This study	0,75	0,25	0,02	0,02	0,77	533254 529971
FR_N_3400_2900_Marne	CHOU7237	Shotgun	This study	0,79	0,21	0,02	0,02	0,40	633528
FR_N_3400_2900_Marne	CHOU863	Shotgun	This study This study	0,78	0,22	0,03	0,03	0,40	425011
FR_N_3400_2900_Marne FR_N_3400_2900_Marne	CHOU9737 CHOU9740	Shotgun Shotgun	This study This study	0,80	0,20	0,02	0,02	0,87	369373 340085
FR_N_3400_2900_Marne FR_N_3400_2900_Marne	CHOU9741 CHOU9742	Shotgun	This study This study	0,76	0,24	0,03	0,03	0,00	354723 664933
FR_N_3400_2900_Marne	CHOU9743	Shotgun	This study	0,77	0,23	0,02	0,02	0,07	510356
FR_N_3400_2900_Marne	CHOU9745	Shotgun	This study This study	0,75	0,24	0,03	0,03	0,00	430491
FR_N_3400_2900_Marne FR_N_3400_2900_Marne	CHOUF11P6D13 CHOUF11P7B122	Shotgun Shotgun	This study This study	0,76	0,25	0,02	0,02	0,00	560591 658311
FR N 3400 2900 Marne FR N 3400 2900 Marne	CHOUF11P7B22 CHOUF11P9C22	Shotgun	This study This study	0,76	0,24	0,02	0,02	0,94	627139 478171
FR_N_3400_2000_MSOM	1H13	Shotgun	Seguin-OrlandoPNAS2021	0,73	0,27	0,02	0,02	0,72	715070
FR_N_3400_2900_MSOM	2H07 2H10	Shotgun	Seguin-OrlandoPNAS2021 Seguin-OrlandoPNAS2021	0,79	0,22 0,17	0,02	0,02	0,88 0,27	476956 975631
FR_N_3400_2900_MSOM FR_N_3600_3400_PostMK	2H11 BCM137	Shotgun Shotgun	Seguin-OrlandoPNAS2021 This study	0,41 0,75	0,59	0,02	0,02	0,17 0,34	976004 349228
FR_N_3600_3400_PostMK FR_N_3600_3400_PostMK	BLG2471 BLG2472	Shotgun	This study This study	0,26	0,74	0,02	0,02	0,01	910704
FR.N. 3600_3400_PostMK	BLG2472	Shotgun	This study	0,17	0,63	0,02	0,02	0,37	938776
FR_N_3600_3400_PostMK FR_N_3600_3400_PostMK	BLP68 CCF3151	Shotgun Shotgun	This study This study	0,83	0,17 0,20	0,02	0,02	0,91	544190 747421
FR_N_3600_3400_PostMK FR_N_3600_3400_PostMK	CCT112 118428	Shotgun Capture 1240k	This study PattersonNature2021	0,82	0,18	0,03	0,03	0,24	323647 372264
FR_N_3600_3400_PostMK	Mairy4249 PSS1	Shotgun	This study This study	0,46	0,54	0,03	0,03	0,42	349105
FR_N_4250_3700_Esc	Esc1018B	Shotgun	This study This study	0,81	0,19	0,02	0,02	0,23	507251
FR_N_4250_3700_Esc FR_N_4250_3700_Esc	Esc42 Esc48	Shotgun Shotgun	This study This study	0,79	0,21 0,25	0,02	0,02	0,54 0,16	605940 540006
FR_N_4250_3700_Esc FR_N_4250_3700_Esc	Esc637 Esc75	Shotgun Shotgun	This study This study	0,81 0,79	0,19 0,21	0,02	0,02	0,78	472045 679393
FR_N_4250_3700_Esc FR_N_4250_3700_Esc	Esc791 Esc97	Shotgun	This study This study	0,82	0,18	0,02	0,02	0,32	681674
FR_N_4250_3700_KK	BCG21	Shotgun	This study	0,82	0,18	0,02	0,02	0,25	618246
FR_N_4250_3700_MK	BLP67	Shotgun	This study This study	0,83	0,17	0,02	0,02	0,35	336861
FR_N_4250_3700_MK FR_N_4250_3700_MK	BLP69 CCF488	Shotgun Shotgun	This study This study	0,84	0,16 0,18	0,02	0,02	0,74 0,71	489845 621886
FR_N_4250_3700_MK FR_N_4700_4300_Cerny	CCT99 BUCH2	Shotgun Shotgun	This study BruneIPNAS2020	0,83	0,18	0,03	0,03	0,04	331229 455372
FR_N_4700_4300_Cerny	BLP31	Shotgun	This study	0,90	0,10	0,02	0,02	0,14	573829
FR_N_4700_4300_Cerny FR_N_4700_4300_Fleury	FLR003	Capture 1240k	RivollatScienceAdvances2020	0,89	0,11	0,02	0,02	0,60	669039
FR_N_4700_4300_Fleury FR_N_4700_4300_Fleury	FLR004 FLR005	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,85	0,15	0,02	0,02	0,08	694717 614087
FR_N_4700_4300_Fleury	FLR007 BEM4227	Capture 1240k	RivollatScienceAdvances2020	0,86	0,14	0,02	0,02	0,76	698343 646147
FR_N_4900_4700_VSG	BFM369	Shotgun	This study This study	0,88	0,14	0,02	0,02	0,32	562703
FR_N_4900_4700_VSG FR_N_4900_4700_VSG	BFM370 BFM373	Shotgun Shotgun	This study This study	0,93	0,07	0,03	0,03	0,92	321421 357461
FR_N 4900 4700 VSG FR_N 4800 4200 Gurgy	BFT181 GRG003	Shotgun Capture 1240k	This study RivollatScienceAdvances2020	0,89	0,11 0.12	0,03	0,03	0,72	354402 695622
FR_N_4800_4200_Gurgy	GRG008	Capture 1240k	RivollatScienceAdvances2020	0,85	0,15	0,02	0,02	0,03	646768
FR_N_4800_4200_Gurgy	GRG015 GRG016	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,84	0,16	0,02	0,02	0,54	636789
FR_N_4800_4200_Gurgy FR_N_4800_4200_Gurgy	GRG019 GRG021	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,87	0,13 0,13	0,02	0,02	0,45	714977 674471
FR_N_4800_4200_Gurgy FR_N_4800_4200_Gurgy	GRG022 GRG025	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,83	0,17	0,02	0,02	0,06	658288 664621
FR_N_4800_4200_Gurgy	GRG027	Capture 1240k	RivollatScienceAdvances2020	0,85	0,15	0,02	0,02	0,79	706762
FR_N_4800_4200_Gurgy	GRG032	Capture 1240k	RivollatScienceAdvances2020	0,87	0,13	0,02	0,02	0,38	695919
FR_N_4800_4200_Gurgy FR_N_4800_4200_Gurgy	GRG041 GRG043	Capture 1240k Capture 1240k	RivollatScienceAdvances2020 RivollatScienceAdvances2020	0,85	0,14 0,10	0,02	0,02	0,89	655085
FR_N_4800_4200_Gurgy FR_N_5100_4900_LBK	GRG052 BCM130	Capture 1240k Shotgun	RivollatScienceAdvances2020 This study	0,86	0,14 0,05	0,02	0,02	0,99	601578 263829
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	BCM345 BCP196	Shotgun Shotgun	This study This study	0,89	0,11 0.12	0,02	0,02	0,18	406665 613687
FR_N_5100_4900_LBK	BLF129	Shotgun	This study	0,90	0,10	0,03	0,03	0,84	356329
FR_N_S100_4900_LBK	BLF 1489 BLF 53	Shotgun	This study This study	0,92	0,08	0,02	0,02	0,48	425269
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	BLF54 BLF70	Shotgun Shotgun	This study This study	1,00 0,99	0,00	0,02	0,02	0,44 0,92	703459 372243
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	BLF80 BLF81	Shotgun Shotgun	This study This study	0,89 0,91	0,11 0,09	0,03 0,02	0,03	0,01 0,91	323439 440269
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	BLF91 BLF92	Shotgun	This study This study	0,88	0,12	0,03	0,03	0,98	369030 274558
FR_N_5100_4900_LBK	BLH417	Shotgun	This study	0,95	0,06	0,02	0,02	0,36	699234
FR_N_S100_4900_LBK	8V1586 BVT606	Shotgun	This study This study	0,91	0,10	0,03	0,03	0,42	330854
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	BVT607 BVT60910	Shotgun Shotgun	This study This study	0,85	0,15	0,03	0,03	0,21	35/577 756620
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	CCF145 CCF271	Shotgun Shotgun	This study This study	0,99 0,86	0,02 0,14	0,03	0,03	0,29 0,78	291530 344824
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	CCF606 CGH12	Shotgun	This study This study	0,92	0,08	0,02	0,02	0,72	676391 567746
FR_N_5100_4900_LBK	MAC66	Shotgun	This study	0,90	0,10	0,03	0,03	0,42	309926
FR_N_5100_4900_LBK	MD18661 MDV131	Shotgun	This study This study	0,90	0,10	0,02	0,02	0,63	563263
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV13I MDV144	Shotgun Shotgun	This study This study	0,91 0,93	0,09	0,02	0,02	0,19 0,49	500240 575786
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV181 MDV18862	Shotgun Shotgun	This study This study	0,88 0,92	0,12 0,09	0,03 0,02	0,03	0,29 0,46	368204 393108
FR_N_5100_4900_LBK	MDV1884 MDV1884	Shotgun	This study This study	0,91	0,09	0,02	0,02	0,16	639035 662115
FR_N_5100_4900_LBK	MDV18922	Shotgun	This study	0,90	0,09	0,02	0,02	0,29	462899
FR_N_5100_4900_LBK	MDV192 MDV195	Shotgun	This study This study	0,93	0,07	0,03	0,03	0,20 0,85	330167 554952
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV208 MDV213	Shotgun Shotgun	This study This study	0,97	0,03	0,02	0,02	0,19 0,14	699470 646435
FR N 5100 4900 LBK FR N 5100 4900 JRK	MDV214 MDV229	Shotgun	This study This study	0,84	0,17	0,02	0,02	0,59	568797 428255
FR_N_5100_4900_LBK	MDV233	Shotgun	This study	0,94	0,06	0,02	0,02	0,91	796641
FR_N_S100_4900_LBK	MDV234 MDV242	Shotgun	This study This study	0,99	0,01	0,02	0,02	0,96	551461 589229
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV248 MDV249	Shotgun Shotgun	This study This study	0,98	0,02	0,02	0,02	0,70	424345 328585
FR_N_5100_4900_LBK FR_N_5100_4900_JRK	MDV254 MDV272	Shotgun	This study This study	0,82	0,18	0,03	0,03	0,37	291705 499059
FR_N_5100_4900_LBK	MDV317 MDV219	Shotgun	This study This study	0,91	0,09	0,02	0,02	0,20	374874
FR_N_5100_4900_LBK	MDV5611	Shotgun	This study	0,94	0,05	0,03	0,03	0,72	533845
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV5632 MDV5634	Shotgun Shotgun	This study This study	0,89 0,98	0,11 0,02	0,03 0,04	0,03	0,89 0,34	313560 252802
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV5717 MDV616	Shotgun Shotgun	This study This study	0,84	0,16	0,02	0,02	0,29 0,19	570250 314615
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	MDV629 MDV932	Shotgun	This study This study	0,89	0,11	0,02	0,02	0,37	511949 783399
FR_N_5100_4900_LBK	MDV933	Shotgun	This study This study	0,87	0,13	0,02	0,02	0,21	663819
FR_N_S100_4900_LBK	MGA45 MGA48	Shotgun	This study This study	0,87	0,13	0,02	0,02	0,83	310471
FR_N_5100_4900_LBK FR_N_5100_4900_LBK	SMP4738 SMP45	Shotgun Shotgun	This study This study	0,60 0,89	0,40 0,11	0,02	0,02	0,55	570532 533328
FR N 5100 4900 LBK FR S 3400 2400 LNVe	SMP471 GBVPL	Shotgun	This study Seguin-OrlandoPNAS2021	0,89	0,11	0,02	0,02	0,06	496162 611704
FR S 3400_2400_LNVe FR S 3400_2400_LNVe	TORTE	Shotgun	Seguin-OrlandoPNAS2021	0,74	0,26	0,02	0,02	0,12	638422
FR_S_3400_2400_LNVe	ROUQF	Shotgun	Seguin-OrlandoPNAS2021 Seguin-OrlandoPNAS2021	0,82	0,18	0,02	0,02	0,28	540422
FR 5 3400 2400 LNVe	ROUQV	Shotgun	Seguin-OrlandoPNAS2021 Seguin-OrlandoPNAS2021	0,80	0,20	0,02	0,02	0,00	651750
FR_S_3400_2400_LNVe FR_S_5500_4600_CAR_SMP	ROUQW 14303	Shotgun Capture 1240k	Seguin-OrlandoPNAS2021 OlaldeNature2018	0,77	0,23 0,19	0,02	0,02	0,11 0,26	469322 702462
FR S 5500 4600 CAR SMP	14304	Capture 1240k	OlaldeNature2018	0,78	0,22	0,02	0,02	0,07	759167

FR_S_5500_4600_CAR_SMP	14305	Capture 1240k	OlaideNature2018	0,78	0,22	0,02	0,02	0,37	735409
FR_W_4300_4000_MN FR_W_4300_4000_MN	115034	Capture 1240k Capture 1240k	PattersonNature2021 PattersonNature2021	0,74	0,25	0,02	0,02	0,99	739578 771102
FR_W_4300_4000_MN FR_W_4300_4000_MN	115029	Capture 1240k Capture 1240k	PattersonNature2021 PattersonNature2021	0,73	0,27	0,02	0,02	0,21	754055
FR_W_4300_4000_MN	115031	Capture 1240k	PattersonNature2021	0,75	0,25	0,02	0,02	0,01	755963
FR_W_4300_4000_MN FR_W_4300_4000_MN	115032 PRI001	Capture 1240k Capture 1240k	PattersonNature2021 RivollatScienceAdvances2020	0,75	0,25	0,02	0,02	0,29 0,42	753698 596157
FR_W_4300_4000_MN	PRI006	Capture 1240k	RivollatScienceAdvances2020	0,79	0,21	0,02	0,02	0,67	453571
GB_E_4000_3500_EN GB_E_4000_3500_EN	Carsington_pasture_1	Shotgun	BraceNatureEcologyEvolution2019 BraceNatureEcologyEvolution2019	0,80	0,21	0,02	0,02	0,52	759555 974894
GB_E_4000_3500_EN GB_E_4000_3500_EN	Jubilee_cave Kelco cave	Shotgun Shotgun	BraceNatureEcologyEvolution2019 BraceNatureEcologyEvolution2019	0,79 0,76	0,21 0,24	0,02	0,02	0,41 0,34	775549 729795
GB_E_4000_3500_EN	NC2f	Capture 1240k	FowlerNature2021	0,81	0,19	0,02	0,02	0,41	778398
GB_E_4000_3500_EN GB_E_4000_3500_EN	NC3t NC5m	Capture 1240k Capture 1240k	FowlerNature2021 FowlerNature2021	0,82	0,18	0,02	0,02	0,34	950682 719399
GB_E_4000_3500_EN	SC1f	Capture 1240k	FowlerNature2021	0,80	0,20	0,02	0,02	0,44	660626
GB_E_4000_3500_EN	SE3m	Capture 1240k Capture 1240k	FowlerNature2021	0,77	0,23	0,02	0,02	0,08	941330
GB_E_4000_3500_EN GB_E_4000_3500_EN	BurnGround Coldrum 1	Shotgun Shotgun	BraceNatureEcologyEvolution2019 BraceNatureEcologyEvolution2019	0,79	0,21	0,02	0,02	0,55	698718 803240
GB_E_4000_3500_EN	Fussels_lodge_1	Shotgun	BraceNatureEcologyEvolution2019	0,78	0,22	0,02	0,02	0,40	817820
GB_E_4000_3500_EN GB_E_4000_3500_EN	13068	Capture 1240k Capture 1240k	OlaldeNature2018	0,85	0,15	0,02	0,02	0,13	600721
GB_E_4000_3500_EN GB_E_4000_3500_EN	13135	Capture 1240k Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,65	0,35	0,02	0,02	0,16	733113 587404
GB_E_4000_3500_EN	16624	Capture 1240k	OlaldeNature2018	0,80	0,20	0,02	0,02	0,00	625657
GB_E_4000_3500_EN GB_E_4000_3500_EN	16751	Capture 1240k Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,79	0,21	0,02	0,02	0,14	689659
GB_E_4000_3500_EN GB_E_4000_3500_EN	16759	Capture 1240k Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,78	0,23	0,02	0,02	0,11 0.52	718479 567339
GB_E_4000_3500_EN	16762	Capture 1240k	OlaldeNature2018	0,79	0,21	0,02	0,02	0,10	604211
GB_E_4000_3500_EN GB_S_3350_2750_MN	13035	Shotgun	OlaldeNature2018 OlaldeNature2018	0,80	0,20	0,02	0,02	0,00	926852
GB_S_3350_2750_MN GB_S_3350_2750_MN	12934	Shotgun	OlaldeNature2018	0,82	0,18	0,02	0,02	0,44	898626
GB_S_3350_2750_MN	13138	Shotgun	OlaldeNature2018	0,78	0,22	0,02	0,02	0,82	917926
GB_5_3350_2750_MN GB_5_3350_2750_MN	1/554	Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,81	0,19	0,02	0,02	0,09	781020
GB_S_3350_2750_MN GB_S_3350_2750_MN	12651	Capture 1240k Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,80	0,20	0,02	0,02	0,17	724500
GB_S_3350_2750_MN	12935	Capture 1240k	OlaldeNature2018	0,82	0,18	0,02	0,02	0,18	740370
GB_S_3350_2750_MN GB_S_3350_2750_MN	12977	Capture 1240k Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,82	0,18	0,02	0,02	0,12	728969 738893
GB_S_3350_2750_MN GB_S_3350_2750_MN	12979	Capture 1240k	OlaldeNature2018	0,82	0,18	0,02	0,02	0,96	737139
GB_S_4000_3300_EN	12633	Capture 1240k	OlaldeNature2018	0,79	0,21	0,02	0,02	0,75	695844
GB_S_4000_3300_EN GB_S_4000_3300_EN	12635	Capture 1240k Shotgun	OlaldeNature2018 OlaldeNature2018	0,85	0,15 0,21	0,02	0,02	0,11 0,72	712619 938161
GB_5_4000_3300_EN GB_5_4000_3300_EN	12637	Shotgun Capture 12405	OlaideNature2018 OlaideNature2018	0,82	0,19	0,02	0,02	0,23	859792 720160
GB_5_4000_3300_EN	12660	Capture 1240k	OlaldeNature2018	0,77	0,23	0,02	0,02	0,23	754426
GB_S_4000_3300_EN	12691 12988	Capture 1240k Capture 1240k	OlaldeNature2018 OlaldeNature2018	0,72	0,29 0,16	0,02	0,02	0,12 0,99	746133
GB_S_4000_3300_EN GB_S_4000_3300_FN	13133 13134	Shotgun	OlaideNature2018 OlaideNature2018	0,80	0,20	0,02	0,02	0,17	975293 938919
GB_S_4000_3300_EN	13136	Shotgun	OlaldeNature2018	0,81	0,19	0,02	0,02	0,17	945015
HR_4700_4300_MN HR_4700_4300_MN	POP06 POP08	Shotgun Shotgun	FreilichScientificReports2021	0,94	0,0/	0,02	0,02	0,52 0,87	720625 607432
HR_4700_4300_MN HR_4700_4300_MN	POP09 POP11	Shotgun	FreilichScientificReports2021 FreilichScientificReports2021	0,92	0,08	0,02	0,02	0,91 0.78	666298 651094
HR_4700_4300_MN	POP12	Shotgun	FreilichScientificReports2021	0,98	0,02	0,02	0,02	0,19	648198
HR_4700_4300_MN HR_4700_4300_MN	POP13 POP14	Shotgun Shotgun	FreilichScientificReports2021 FreilichScientificReports2021	0,92 0,93	0,08	0,02	0,02	0,00	695017
HR_4700_4300_MN	POP16	Shotgun	FreilichScientificReports2021	1,00	0,00	0,02	0,02	0,15	623179
HR_4700_4300_MN	POP15 POP27	Shotgun	FreilichScientificReports2021	1,00	0,02	0,02	0,02	0,33	635023
HR_4700_4300_MN HR_4700_4300_MN	POP30 POP33	Shotgun Shotgun	FreilichScientificReports2021 FreilichScientificReports2021	0,99 0,98	0,02 0,03	0,02	0,02	0,50 0,64	608066 560471
HR_4700_4300_MN	POP35	Shotgun	FreilichScientificReports2021	1,00	0,00	0,02	0,02	0,17	595325
HR_4700_4300_MN HR_6000_5500_ICC	13433	Shotgun	MathiesonNature2018	0,98	0,04	0,02	0,02	0,15	830489
HR_6000_5500_ICC HR_6000_5500_ICC	13498	Capture 1240k Capture 1240k	MathiesonNature2018 MathiesonNature2018	1,00	0,00	0,02	0,02	0,91 0.40	538789 716550
HR_6000_5500_ICC	14168	Capture 1240k	MathiesonNature2018	0,95	0,05	0,03	0,03	0,97	333672
HU_3600_3000_CA	12365	Capture 1240k Capture 1240k	LipsonNature2017	0,88	0,12	0,02	0,02	0,42	764520
HU_3600_3000_CA	12369	Capture 1240k Capture 1240k	LipsonNature2017	0,92	0,08	0,02	0,02	0,01	712893 784632
HU_3600_3000_CA	12788	Capture 1240k	LipsonNature2017	0,86	0,14	0,02	0,02	0,77	755121
HU_3600_3000_CA HU_3600_3000_CA	12790	Capture 1240k Capture 1240k	LipsonNature2017 LipsonNature2017	0,91 0,87	0,09 0,13	0,02	0,02	0,46 0,41	850000 760850
HU_5300_4900_LBKT_AVK	11498	Shotgun	GambaNatureCommunications2014 MathiesonNature2015	0,91	0,09	0,02	0,02	0,74	899401
HU_5300_4900_LBKT_AVK	11500	Capture 1240k	MathiesonNature2015	0,89	0,03	0,02	0,02	0,11	723541
HU_5300_4900_LBKT_AVK HU_5300_4900_LBKT_AVK	11505	Capture 1240k Capture 1240k	MathiesonNature2015 LipsonNature2017	1,00 0,92	0,00	0,02	0,02	0,36	575790 658254
HU_5300_4900_LBKT_AVK	NE1	Shotgun	GambaNatureCommunications2014	0,92	0,08	0,02	0,02	0,27	975608
HU_5300_4900_LBKT_AVK	11496	Capture 1240k	MathiesonNature2015	0,92	0,09	0,02	0,02	0,82	741566
HU_5300_4900_LBKT_AVK HU_5300_4900_LBKT_AVK	11904	Capture 1240k Capture 1240k	LipsonNature2017 LipsonNature2017	1,00	0,00	0,02	0,02	0,50	744672 707791
HU_5300_4900_LBKT_AVK	14196	Capture 1240k	LipsonNature2017	0,98	0,02	0,02	0,02	0,91	632046
HU_5300_4900_LBKT_AVK	12377	Capture 1240k	LipsonNature2017	0,95	0,05	0,02	0,02	0,47	638069
HU_5300_4900_LBKT_AVK HU_5800_5500_Star_Koros	12379	Capture 1240k Capture 1240k	LipsonNature2017 MathiesonNature2015	0,91	0,10	0,02	0,02	0,87	620488 566775
HU_5800_5500_Star_Koros	12794	Capture 1240k	LipsonNature2017	0,99	0,01	0,02	0,02	0,24	766371
HU_5800_5500_Star_Koros HU_5800_5500_Star_Koros	11877	Capture 1240k Capture 1240k	LipsonNature2017 LipsonNature2017	1,00	0,00	0,02	0,02	0,75	566129 681445
HU_5800_5500_Star_Koros IE_3500_3000_MN	11880 ANN1	Capture 1240k Shotgun	LipsonNature2017 CassidyScience2020	1,00	0,00	0,02	0,02	0,36	564517 764652
IE_3500_3000_MN	ANN2	Shotgun	CassidyScience2020	0,77	0,23	0,02	0,02	1,00	468646
IE_3300_3000_MN	BA64	Shotgun	CassidyPNAS2016	0,83	0,18	0,02	0,02	0,02	975050
IE_3500_3000_MN IE_3500_3000_MN	BG72 CH448	Shotgun Shotgun	CassidyScience2020 CassidyScience2020	0,78	0,22	0,02	0,02	0,92	778552 784662
IE_3500_3000_MN	GNM1007	Shotgun	CassidyScience2020	0,77	0,23	0,02	0,02	0,77	635586
IE_3300_3000_MN	NG10	Shotgun	CassidyScience2020	0,78	0,23	0,02	0,02	0,48	975947
IE_3500_3000_MN IE_3500_3000_MN	NGZ1 PB1327	Shotgun Shotgun	CassidyScience2020 CassidyScience2020	0,78 0,81	0,22 0,19	0,02	0,02	0,11 0,22	538997 625596
IE 3500 3000 MN	PB1794	Shotgun	CassidyScience2020	0,80	0,20	0,02	0,02	0,77	542191 710465
IE 3500 3000 MN	PB443	Shotgun	CassidyScience2020 CassidyScience2020	0,02	0,18	0,02	0,02	0,94	902528
IE_3500_3000_MN	PB581 PB672	Shotgun Shotgun	CassidyScience2020 CassidyScience2020	0,81	0,19	0,02	0,02	0,50	899487
IE_3500_3000_MN	PB675 PR754	Shotgun	CassidyScience2020 CassidyScience2020	0,71	0,29	0,02	0,02	0,48	975891 508842
IE_3500_3000_MN	PB768	Shotgun	CassidyScience2020	0,80	0,20	0,02	0,02	0,78	720341
IE_3500_3000_MN	PN03 PN06	Shotgun Shotgun	CassidyScience2020 CassidyScience2020	0,77	0,23	0,02	0,02	0,07 0,65	/55481 751195
IE 3500 3000 MN IE 3500 3000 MN	PN07 PN12	Shotgun	CassidyScience2020 CassidyScience2020	0,81	0,19	0,02	0,02	0,77	764049 655244
IE_3500_3000_MN	PN16	Shotgun	CassidyScience2020	0,82	0,18	0,02	0,02	0,64	532044
IE_3800_3500_EN	PN02	Shotgun	CassidyScience2020	0,78	0,22	0,02	0,02	0,97	754984
IE_3800_3500_EN IE_3800_3500_EN	PN04 PN05	Shotgun Shotgun	CassidyScience2020 CassidyScience2020	0,83 0,80	0,17 0,20	0,02	0,02	0,82	/60103 710317
IE_3800_3500_EN	PN10_PN113 PN112	Shotgun	CassidyScience2020 CassidyScience2020	0,80	0,20	0,02	0,02	0,38	883463 657717
IE_3800_3500_EN	PN13	Shotgun	CassidyScience2020	0,81	0,19	0,02	0,02	0,53	604147
11_3500_2500_CA 1T_3500_2500_CA	R1014 R24	Shotgun	AntonioScience2019 AntonioScience2019	0,88	0,12 0,16	0,02	0,02	0,45 0,75	578982
IT_3500_2500_CA IT_3500_2500_CA	R4 R5	Shotgun	AntonioScience2019 AntonioScience2019	0,89	0,11 0.13	0,02	0,02	0,26	959995 850036
IT_5800_5200_ICC	R16	Shotgun	AntonioScience2019	0,93	0,07	0,02	0,02	0,18	572191
11_5800_5200_ICC IT_5800_5200_ICC	R1/ R18	Shotgun	AntonioScience2019 AntonioScience2019	0,91	0,09	0,02	0,02	0,24	584818 607186
IT_5800_5200_ICC IT_5800_5200_ICC	R19 R6	Shotgun	AntonioScience2019 AntonioScience2019	0,96	0,04	0,02	0,02	0,02	561862 597287
IT_5800_5200_ICC	R10	Shotgun	AntonioScience2019	0,96	0,04	0,02	0,02	0,99	812353
IT_5800_5200_ICC	R3	Shotgun	AntonioScience2019	0,99	0,03	0,02	0,02	0,30	963887
IT_5800_5200_ICC IT_5800_5200_ICC	R8 R9	Shotgun Shotgun	AntonioScience2019 AntonioScience2019	1,00	0,00	0,02	0,02	0,77 0,17	568401 964102
IT_3500_2500_CA	114675	Capture 1240k	FernandesNatureEcologyEvolution2020	0,83	0,17	0,02	0,02	0,50	737802
IT_3500_2500_CA	114677	Capture 1240k Capture 1240k	FernandesNatureEcologyEvolution2020	0,82	0,18	0,02	0,02	0,48	736241
IT_3500_2500_CA IT_3500_2500_CA	114678 115941	Capture 1240k Capture 1240k	FernandesNatureEcologyEvolution2020 FernandesNatureEcologyEvolution2020	0,82 0,86	0,18 0,15	0,02	0,02	0,85	751312 690532
IT_3500_2500_CA	115942	Capture 1240k	FernandesNatureEcologyEvolution2020	0,88	0,12	0,02	0,02	0,17	585697
IT_3500_2500_CA	116165	Capture 1240k Capture 1240k	FernandesNatureEcologyEvolution2020	0,85	0,12	0,02	0,02	0,93	550495 550494
IT_3500_2500_CA IT_3500_2500_CA	116166 116168	Capture 1240k Shotgun	FernandesNatureEcologyEvolution2020 FernandesNatureEcologyEvolution2020	0,86	0,15	0,03	0,03	0,84 0.0R	282258 565360
IT_5000_4000_MN	115943	Capture 1240k	FernandesNatureEcologyEvolution2020	0,87	0,13	0,03	0,03	0,17	292563
IT_5000_4000_MN	115945	Capture 1240k Capture 1240k	remandeswatureEcologyEvolution2020 FernandesNatureEcologyEvolution2020	0,90	0,10	0,03	0,03	0,59	316937 506891
IT_5000_4000_MN IT_5000_4000_MN	14062 14063	Shotgun Shotgun	FernandesNatureEcologyEvolution2020 FernandesNatureEcologyEvolution2020	0,91 0,89	0,10	0,02	0,02	0,26 0,10	944212 882610
IT_5000_4000_MN	14064	Capture 1240k	FernandesNatureEcologyEvolution2020	0,93	0,07	0,02	0,02	0,93	726434
PT_3400_2000_CA PT_3400_2600_CA	10839	Capture 1240k Capture 1240k	OlaldeScience2019	0,75	0,25	0,04	0,04	0,2b	202459 592333
PT_3400_2600_CA PT_3400_2600_CA	111599 111600	Capture 1240k Capture 17404	OlaldeScience2019 OlaldeScience2019	0,79	0,22	0,02	0,02	0,33	492989 404200
PT_3400_2600_CA	111601	Capture 1240k	OlaldeScience2019	0,84	0,16	0,03	0,03	0,74	296578
PT_3400_2000_CA PT_3400_2600_CA	111605	Capture 1240k Capture 1240k	OlaldeScience2019	0,75	0,25	0,05	0,05	0,01	240000 554640
PT_3400_2600_CA PT_3400_2600_CA	111614 15076	Capture 1240k Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,82	0,18	0,02	0,02	0,62 0,35	594002 750928
PT_3400_2600_CA	15428	Capture 1240k	OlaldeScience2019 OlaldeScience2019	0,79	0,21	0,02	0,02	0,02	469363
PT_4200_3500_MN	LugarCanto41	Shotgun	MartinianoPLoSGenetics2017	0,02	0,10	0,02	0,02	0,33	619093
PT_4200_3500_MN	LugarCanto42	Shotgun	MartinianoPLoSGenetics2017 MartinianoPLoSGenetics2017	0,80	0,20	0,02	0,02	0,19	890731 802344
P1_4200_3500_MIN	LugarCarrott	Shorgan		-)		-)	-,	-,	

Group label	Sample ID	fastGT inferred generation	95% CI fastGT jackknifing	Sourcefind estimated HG ancestry
FR_N_5100_4900_LBK	BCP196	20	4	12%
FR_N_5100_4900_LBK	BLF81	30	9	7%
FR_N_5100_4900_LBK	BLF1489	11	3	6%
FR_N_5100_4900_LBK	BVT60910	24	6	11%
FR_N_5100_4900_LBK	CCF606	18	3	10%
FR_N_5100_4900_LBK	CGH12	28	5	12%
FR N 5100 4900 LBK	MDV186	15	4	7%
FR_N_5100_4900_LBK	MDV13-I	18	8	8%
FR_N_5100_4900_LBK	MDV131	25	3	10%
FR N 5100 4900 LBK	MDV144	24	10	6%
FR_N_5100_4900_LBK	MDV189-2.2	18	4	12%
FR N 5100 4900 LBK	MDV195	29	13	8%
FR N 5100 4900 LBK	MDV208	24	8	4%
FR N 5100 4900 LBK	MDV214	16	4	9%
FR N 5100 4900 LBK	MDV242	17	7	11%
FR N 5100 4900 LBK	MDV272	19	4	20%
FR N 5100 4900 LBK	MDV629	28	7	10%
FR N 5100 4900 LBK	MDV93.2	22	3	15%
FR N 5100 4900 LBK	MDV188-4	34	7	15%
FR N 5100 4900 IBK	MDV188-6.3	20	3	10%
R N 5100 4900 IBK	MDV561-1	10	4	5%
R N 5100 4900 LBK	MDV571-7	32	5	14%
R N 5100 4900 LBK	MGA45	20	5	10%
R N 5100 4900 IBK	SMP4738	9	1	46%
FR N 5100 4900 IBK	SMP451	23	5	12%
ER N 5100 4900 LBK	SMP471	19	3	10%
FR N 4900 4700 VSG	BEM327	13	4	11%
FR N 4900 4700 VSG	BEM369	33	5	14%
FR N 4250 3700 MK	BI P10	21	12	17%
R N 4250 3700 MK	BLP69	49	10	15%
FR N 4250 3700 MK	BCG21	32	7	19%
R N 4250 3700 MK	CCE488	39	6	18%
R N 4700 4300 Cerny	BI P31	10	3	13%
B N 4250 3700 Esc	Esc/12	19	3	24%
R N 4250 3700 Esc	Esc75	35	8	21%
R N 4250 3700 Esc	Esc97	36	0	26%
R N 4250 3700 Esc	Esc791	50		20%
R N 4250 3700 Esc	Esc1018B	35	4	20%
R N 3600 3400 Post MK	BI P68	53	10	16%
-R N 3600 3400 Post MK	CCE315-1	53	9	17%
-R N 3600 3400 Post MK	BIG247-1	16	4	81%
R N 3600 3400 Post MK	BIG247-3	14	4	51%
-R N 3400 2900 Chouilly H10	CHOU3935	57	13	31%
R N 3400 2900 Chouilly H10	CHOU5958	41	0	25%
R N 3400 2900 Chouilly H10	CHOLI6908	37	12	25/0
ER N 3400 2900 Chouilly H10	CHOU7237	21	7	20/0
EP N 2400 2900 Choully H11	CHOU19742	21	22	24/0
-N_N_3400_2900_Choully_H11	CHOU9742	30	25 45	25%
EP N 2400 2900 Chouilly H11	CHOLIE1106D12	01	40	2370
TR_N_3400_2900_Chouliny_H11	CHOUF11P0D13	31	14	2370

Table S5. fastGLOBETROTTER inference for admixture between Early European Farmers and Hunter-Gatherer surrogate groups for ancient individuals from this stu	ıdy
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Table S6. fastGLOBETROTTE	R inference for	r admixture	betwewen l	Early European Farmet and Hunter-Ga	atherer surrogat	e groups for radiocarboi	n dated ancient individuals
Target Group	Target Individual	Generations	95% CI	Date calBCE (OxCal mean date ± Standard deviation )	Admixture date BCE	Upper limit of admixture date BCE	Lower limit of admixture date BCE
Italy ICC	R16	12	7	5301-5214	5602	5795	5408
Italy ICC	R17	11	3	5324-5223	5583	5654	5511
Italy ICC	R19	11	12	5345-5221	5594	5935	5253
Italy ICC	R6	26	7	5242-5177	5924	6132	5716
Spain Cardial	Mur	9	5	5249-5107	5416	5567	5266
Spain Cardial	CB13	13	4	5445-5347	5766	5875	5657
Germany LBK	DER009	19	3	5152-5006	5599	5672	5527
Germany LBK	Herx	13	5	5164-4993	5441	5569	5314
Germany LBK	Dil16	15	5	5235-4998	5526	5656	5397
Hungary ALP	NE2	18	4	5297-5048	5679	5802	5556
Hungary ALP	NE5	21	7	5198-5020	5692	5900	5484
France-Aisne LBK	MDV188-6.3	20	3	5038-4916	5545	5633	5457
France-Aisne LBK	MGA45	20	5	5171-5043	5673	5807	5538
France-Aisne LBK	MDV93.2	22	2	5130-4976	5668	5725	5610
France-Aisne LBK	CCF606	18	3	4912-4778	5359	5453	5264
France-Aisne LBK	MDV561-1	10	4	5173-5055	5407	5532	5282
France-Aisne LBK	MDV571-7	32	5	5154-5000	5975	6102	5849
France-Champagne LBK	SMP471	19	3	4984-4872	5463	5550	5376
France-Champagne LBK	SMP4738	9	1	5177-5045	5364	5404	5325
Italy-Sicily Neolithic	14062	44	8	4984-4784	6108	6330	5886
Italy-Sicily Neolithic	14063	30	8	4987-4794	5727	5947	5507
France-Aisne Michelsberg	CCF488	39	6	3851-3689	4866	5036	4696
France-Aisne Michelsberg	BCG21	32	7	3888-3728	4706	4895	4517
France-Aisne Michelsberg	BLP10	21	12	4334-4056	4779	4977	4807
France-Aisne Cerny	BLP31	10	3	4684-4564	4892	5118	4439
Italy-Sardinia Neolithic	116168	75	26	3949-3714	5931	6651	5211
France-Aisne Post-Michelsberg	BLG247-1	16	4	3494-3398	3896	4017	3775
France-Aisne Post-Michelsberg	BLG247-3	14	4	3494-3398	3830	3945	3715
France-Aisne Post-Michelsberg	CCF315-1	53	9	3627-3515	5044	5307	4780
France-Aisne Post-Michelsberg	BLP68	53	10	3563-3409	4967	5243	4691
France-Champagne Post-Michelsberg	PSS4693	58	10	3605-3349	5094	5383	4806
France Mont-Aimé	2H11	26	4	3288-3138	3929	4036	3823
France Mont-Aimé	2H10	55	9	3341-3098	4744	5004	4485
England Early Neolithic	Aveline1	52	7	3631-3523	5035	5221	4850
England Early Neolithic	Carsington pasture1	47	7	3621-3537	4891	5095	4687
Italy Chalcolithic	R24	55	9	3626-3374	5034	5292	4776
Sweden Megalithic	Ansarve8	28	7	3340-3030	3972	4162	3781
Sweden Megalithic	Ansarve17	27	5	3330-2930	3882	4018	3746
Sweden Megalithic	Gökhem	34	9	3050-2750	3857	4123	3591
Germany Wartberg	KH150620	18	6	3334-3094	3729	3892	3566
Germany Wartberg	KH150615	15	5	3334-3025	3624	3750	3497
Germany Wartberg	KH150610	27	7	3365-3102	3977	4178	3776
Germany Wartherg	KH150635	20	2	3322-2924	3653	3723	3584

#### Table S7.Phenotypic inference with the HIrisPlex-S system

Group Label	Indvidual	Blue	Intermediate	Brown
FR_N_3600_3400_Post_MK	BLG2471	0,77	0,09	0,14
FR N 3600 3400 Post MK	BLG2472	0,84	0,09	0,07
ER N 3600 3400 Post MK	BIG2473	0.90	0.06	0.04
	5101475	0,50	0,00	, 0,04
ER-Aicpo Mocolithia	CCE711	0.56	0.19	0.25
rK-AISRE Mesolitriic	ULF/11	0,56	0,19	0,25
FR_N_5100_4900_LBK	BLF54	0,65	0,12	0,23
FR_N_5100_4900_LBK	BCP196	0,00	0,00	1,00
FR_N_5100_4900_LBK	BLF1489	0,00	0,00	1,00
FR N 5100 4900 LBK	BLF81	0,00	0,03	0,97
FR N 5100 4900 LBK	BLH417	0.01	0.03	0.96
ER N 5100 4900 LBK	BVT60910	0.03	0.07	0.90
ER N 5100 4900 LBK	0000010	0,00	0,00	1.00
FR_N_5100_4000_LDK	661000	0,00	0,00	1,00
FR_N_5100_4900_LBK	CGHIZ	0,01	0,03	0,97
FR_N_5100_4900_LBK	MDV186	0,01	0,05	0,94
FR_N_5100_4900_LBK	MDV131	0,03	0,06	0,91
FR_N_5100_4900_LBK	MDV13I	0,00	0,00	1,00
FR_N_5100_4900_LBK	MDV144	0,65	0,12	0,23
FR N 5100 4900 LBK	MDV188-4	0,87	0,06	0,07
FR N 5100 4900 LBK	MDV188-6.3	0.00	0.01	0.99
ER N 5100 4900 LBK	MDV/189-2.2	0.00	0.02	0.98
FR N 5100 4000 LBK	MDV105 E.E	0,00	0,01	0,00
FR_N_5100_4900_LBK	NDV 195	0,00	0,01	0,99
FR_N_5100_4900_LBK	IVIDV208	0,00	0,00	1,00
FR_N_5100_4900_LBK	MDV213	0,00	0,01	0,99
FR_N_5100_4900_LBK	MDV214	0,00	0,01	0,99
FR_N_5100_4900_LBK	MDV233	0,00	0,01	0,99
FR_N_5100_4900_LBK	MDV234	0,03	0,06	0,91
ER N 5100 4900 LBK	MDV242	0.00	0.01	0.99
ER N 5100 4900 LBK	MDV272	0.03	0.06	0.91
ER N 5100 4900 LBK	MDV5611	0.05	0,00	0.97
FR_IN_5100_4900_LBK	NDV5011	0,03	0,08	0,87
FR_N_5100_4900_LBK	MDV5/1-/	0,00	0,01	0,99
FR_N_5100_4900_LBK	MDV629	0,00	0,00	1,00
FR_N_5100_4900_LBK	MDV93.2	0,01	0,05	0,94
FR_N_5100_4900_LBK	MDV93.3	0,01	0,05	0,94
FR_N_5100_4900_LBK	MGA45	0,00	0,00	1,00
FR N 5100 4900 LBK	SMP4738	0.00	0.00	1.00
ER N 5100 4900 LBK	SMP45	0.01	0.05	0.94
EP N 5100 4900 LBK	SMD471	0.02	0.09	0.90
TR_N_5100_4500_EBR	51411-471	0,02	0,05	0,85
				1.00
FR_N_4900_4700_VSG	BFM327	0,00	0,00	1,00
FR_N_4900_4700_VSG	BFM369	0,00	0,01	0,99
FR_N_4250_3700_MK	BCG21	0,34	0,11	0,55
FR N 4250 3700 MK	BLP69	0,01	0,05	0,94
FR N 4250 3700 MK	CCF488	0,00	0,00	1,00
	Esc1018B	0.00	0.00	1.00
ER N 4250 2700 5++	Escr010	0,00	0,00	0.90
ED N 4250 2700 ESC	ESU42	0,04	0,08	0,69
FK_N_425U_37UU_ESC	ESC48	0,01	0,03	0,97
FR_N_4250_3700_Esc	Esc637	0,03	0,06	0,91
FR_N_4250_3700_Esc	Esc75	0,43	0,12	0,45
FR_N_4250_3700_Esc	Esc791	0,02	0,09	0,89
FR_N_4250_3700_Esc	Esc97	0,00	0,03	0,97
FR N 3600 3400 Post MK	BLP31	0.00	0.00	1.00
ER N 3600 3400 Post MK	BLP68	0.00	0.01	0.99
ER N 2600 2400 Rost Mar	CCE2151	0.02	0.06	0.91
111_14_3000_3400_POST_IVIK	UCP3131	0,05	0,00	0,91
FR_N_3400_2900_Chouilly_H10	CHOU3935	0,01	0,04	0,96
FR_N_3400_2900_Chouilly_H10	CHOU5980	0,00	0,00	1,00
FR_N_3400_2900_Chouilly_H10	CHOU6908	0,00	0,03	0,97
FR_N_3400_2900_Chouilly H10	CHOU7237	0,03	0,06	0,91
FR N 3400 2900 Chouilly H11	CHOU9742	0.65	0.12	0.23
ER N 3400 2900 Chouilly H11	CHOU9743	0.01	0.03	0.97
EB N 2400 2000 Cheville 1144	CHOUE1106D12	0,01	0,00	1.00
FR_N_2400_2900_Choully_H11	CHOUF11P0013	0,00	0,00	1,00
FK_N_3400_2900_Chouilly_H11	CHOUF11P/B122	0,00	0,01	0,99
FK_N_3400_2900_Chouilly_H11	CHOUF11P7B22	0,00	0,05	0,95
ES_3200_2500_CA	CYH1	0,00	0,00	1,00

Blond	Brown	Red	Black
0.02	0.71	0.00	0.27
0.13	0.67	0,00	0.20
0.12	0,67	0,00	0.21
0,11	0,07	0,00	0,21
0,00	0,58	0,00	0,42
0.27	0.53	0.00	0.19
0.00	0.30	0.00	0.70
0.01	0.38	0.00	0.61
0.03	0.69	0.00	0.28
0.02	0.51	0.00	0.47
0.10	0.56	0.00	0.34
0.01	0.29	0.00	0.71
0.02	0.42	0.00	0.56
0.12	0.51	0.00	0.37
0.09	0.54	0.00	0.37
0,00	0,32	0,00	0,68
0,30	0,54	0,00	0,15
0,29	0,61	0,00	0,10
0,00	0,34	0,00	0,66
0,02	0,56	0,00	0,42
0,02	0,55	0,00	0,43
0,00	0,25	0,00	0,74
0,06	0,64	0,01	0,29
0,10	0,56	0,00	0,34
0,02	0,48	0,00	0,50
0,09	0,57	0,00	0,34
0,00	0,27	0,00	0,73
0,06	0,74	0,00	0,20
0,11	0,58	0,00	0,31
0,03	0,47	0,00	0,49
0,00	0,38	0,00	0,62
0,13	0,61	0,00	0,26
0,09	0,69	0,00	0,22
0,00	0,51	0,00	0,49
0,00	0,18	0,00	0,82
0,09	0,65	0,00	0,26
0,02	0,62	0,00	0,36
0.01	0.20	0.00	0.70
0,01	0,29	0,00	0,70
0,00	0,51	0,00	0,05
0,08	0,69	0,00	0,23
0,09	0,57	0,00	0,34
0,00	0,33	0,00	0,67
0,00	0,31	0,00	0,69
0,13	0,58	0,00	0,29
0,03	0,38	0,00	0,59
0,08	0,47	0,00	0,45
0,08	0,63	0,00	0,28
0,02	0,58	0,00	0,40
0,02	0,46	0,00	0,52
0.00	0.34	0.00	0,66
0.03	0.39	0.00	0.59
0,14	0,58	0,00	0,28
	0.46	0.00	0.5
U,01	0,46	0,00	0,54
0,00	0,34	0,00	0,66
0,03	0,56	0,00	0,42
0,00	0,64	0,00	0,29
0,20	0,60	0,00	0,13
0,02	0,42	0,00	0,35
0,00	0,31	0,00	0,69
0,02	0,55	0,00	0,43
0,01	0,35	0,00	0,40
0,00	0,36	0,00	0,63

Light	Dark		Very Pale	Pale	Intermediate
Light	Daik		very raie	Fale	intermediate
0.08	0.02		0.04	0.12	0.90
0,08	0,52		0,04	0,15	0,60
0,41	0,35		0,05	0,50	0,67
0,55	0,43		0,05	0,49	0,40
0.01	0.00		0.00	0.00	0.61
0,01	0,99		0,00	0,00	0,01
0.72	0.27		0.00	0.00	0.67
0,75	0,27		0,00	0,00	0,87
0,01	0,99		0,00	0,00	0,51
0,01	0,99		0,00	0,00	0,09
0,03	0,95		0,01	0,20	0,72
0,03	0,90		0,00	0,01	0,12
0.02	0,98		0,04	0.02	0,55
0.05	0.95		6,00	0.01	0.54
0.42	0.58		0.00	0.12	0.70
0.34	0,56		0,00	0.14	0.75
0.00	1.00		0.00	0.00	0.06
0.64	0.36		0.01	0.14	0.63
0.61	0.39		0.03	0.25	0.69
0,01	0,99	1	0,00	0,09	0,82
0.11	0.89	1	0.00	0.00	0.14
0.03	0.97	1	0.00	0.02	0.36
0.01	0.99	1	0.00	0.00	0.04
1,00	0,00	1	0,01	0,06	0,92
0,21	0,79	1	0,00	0,05	0,59
0,07	0,93		0,00	0,05	0,61
0,20	0,80		0,00	0,10	0,49
0,00	1,00		0,00	0,00	0,11
0,21	0,79		0,00	0,08	0,65
0,25	0,75	1	0,00	0,06	0,67
0,06	0,94	1	0,01	0,06	0,55
0,00	1,00	1	0,00	0,00	0,13
0,51	0,49	1	0,00	0,10	0,87
0,30	0,70		0,00	0,06	0,66
0,01	0,99		0,00	0,00	0,04
0,00	1,00		0,00	0,02	0,68
0,16	0,84		0,01	0,16	0,83
0,07	0,93		0,03	0,21	0,76
0,02	0,98		0,00	0,02	0,34
0,01	0,99		0,00	0,00	0,01
				-	
0,19	0,81		0,02	0,06	0,76
0,33	0,67		0,00	0,11	0,81
0,01	0,99		0,00	0,00	0,14
0.00	1.00		0.00	0.04	0.64
0,00	1,00	1	0,00	0,04	0,64
0,31	0,69		0,01	0,13	0,66
0,21	0,79		0,00	0,00	0,05
0,30	0,64	1	0,01	0,22	0,77
0,18	0,62	1	0,02	0,07	0,55
0,04	0,98		0,01	0,13	0,78
0,00	0,52		0,01	0,07	0,72
0.00	1.00	1	0.00	0.00	0.06
0.09	0.91		0.00	0.15	0.80
0,52	0,48	1	0,01	0,16	0,82
	, <u> </u>	1			
0,01	0,99	1	0,01	0,04	0,49
0,00	1,00	1	0,00	0,00	0,05
0,03	0,97	1	0,01	0,02	0,28
0,12	0,88	1	0,00	0,08	0,47
0,62	0,38	]	0,01	0,14	0,78
0,08	0,92	]	0,00	0,02	0,55
0,00	1,00		0,00	0,01	0,09
0,03	0,97		0,00	0,04	0,58
0,02	0,98		0,08	0,36	0,56
0,01	0,99		0,00	0,00	0,04

Skin Colo

0,34 0,64 0,00 0,01 0,54 0,45

 0,76
 0,17
 0,00

 0,81
 0,03
 0,04

 0,14
 0,83
 0,02

0,31 0,20 0,05 0,00 0,37 0,07 0,20

0,91 0,04 0,01

0,45 0,90 0,69 0,42 0,07 0,27 0,73 0,36 0,00 0,95

0,00 0,01 0,04 0,00 0,01 0,02 0,00

0,03 0,01 0,00

0,01 0,05 0,00 0,00 0,00 0,16 0,18 0,03 0,00 0,00

0,00

Dark Dark to Black

0,00 0,00 0,00

0,09

0,03 0,01 0,00

0,31

 $\begin{array}{c|c} 0.04 & 0.28\\ 0.67 & 0.01\\ 0.88 & 0.08\\ 0.01 & 0.00\\ 0.70 & 0.16\\ 0.25 & 0.00\\ 0.48 & 0.00\\ 0.48 & 0.00\\ 0.48 & 0.00\\ 0.71 & 0.11\\ 0.10 & 0.00\\ 0.07 & 0.11\\ 0.10 & 0.00\\ 0.07 & 0.11\\ 0.10 & 0.00\\ 0.07 & 0.11\\ 0.10 & 0.00\\ 0.08 & 0.01\\ 0.92 & 0.02\\ 0.18 & 0.04\\ 0.02 & 0.02\\ 0.08 & 0.01\\ 0.08 & 0.01\\ 0.08 & 0.01\\ 0.08 & 0.01\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.22 & 0.00\\ 0.25 & 0.00\\ 0.25 & 0.00\\ 0.25 & 0.00\\ 0.25 & 0.00\\ 0.25 & 0.00\\ 0.00 & 0.01\\ 0.00 & 0.01\\ 0.01 & 0.00\\ 0.01 & 0.$ 

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# **Chapter III**

# Late Neolithic family burial reveals admixture dynamics during the third millennium BCE and the shaping of the European genome

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## **Abstract**

The 3<sup>rd</sup> millennium BCE was a pivotal period characterized by profound cultural and genomic transformations in Europe associated with migration of populations from the Pontic-Caspian steppe that shaped the ancestry patterns in the present-day European genome. By means of high-resolution analysis of whole genomes of a multiple family burial in France dating to about 2500 cal BCE, haplotype phasing of the genomes and genome reconstruction of an unsampled individual through its relative's genomes, we shed light on the hitherto undetected early-stage admixture patterns, dynamics and propagation of steppe-ancestry in the Late Neolithic context in Europe. We identified two main Neolithic/steppe-ancestry admixture pulses dating to the arrival of steppe populations in Eastern Europe around 2900 BCE and to their progression into Western Europe around 2500 BCE. These pulses reveal different expansion dynamics throughout Europe with striking links to different cultural phenomena, Corded Ware and Bell Beaker.

# **Introduction**

Past population migrations followed by admixture between migrating and autochthonous populations were discovered to leave traces in the genomes of the descendants, such as the first anatomically modern humans (AMHs) who migrated out of Africa and interbred with Neanderthals (1) or Upper Pleistocene AMH populations in Europe who were replaced by populations originating from southwest Asia (2). During the Holocene, two major population transformations occurred in Europe that shaped the present-day genomic landscape, the first one occurring in the course of the transition from the Mesolithic to the Neolithic and the second during the transition from the Late Neolithic to the Bronze Age. On the territory of present-day France the first one occurred at the end of the 6<sup>th</sup> millennium BCE (e.g., (3-5)), the second during the 3<sup>rd</sup> millennium BCE (e.g., (3, 4, 6)). While the first one was clearly associated with the introduction of the Neolithic cultures into Europe, the cultural association of the second one shows regional differences. The first genomic transformation was the consequence of Neolithic farmers (NFs), who descended from populations in western Anatolia and/or the Aegean (e.g., (7, 8)), migrating into Europe that had been occupied since the end of the last Ice Age by

Mesolithic hunter-gatherers (HGs) (2). This led to admixture between the two populations (e.g., (3-5, 9-12)). The second transformation event was the consequence of gene flow from pastoralist populations of the European Pontic-Caspian steppe moving northwards and visible in burials associated first with the Corded Ware Culture (CWC) in eastern, Central and northern Europe and later in Bell Beaker and Bronze Age contexts (e.g., (3, 6, 13, 14)). On the territory of present-day France (further called "France") this steppe ancestry has been found in Bell Beaker and Bronze Age burials dating to the mid 3<sup>rd</sup> millennium BCE (4, 6, 15). Similar observations were previously made in Central and northern Europe and Great Britain in archaeological contexts associated with the Corded Ware Culture (CWC) and the Bell Beaker Complex (BBC), respectively (3, 6, 13) (14). Thus, in contrast to the Neolithic transformation of Europe that introduced both a new lifestyle and a new genomic component, the Late Neolithic/Copper Age-Bronze Age transformation followed a more complex pattern involving 600 years of migration and spread of different populations and cultures in Europe and formation of a new social and economic order (16, 17).

Based on archaeological evidence, three successive Europe-wide migration phenomena have been postulated for the period between ca. 3100 to ca. 2450 BCE, namely (i) migrations of various steppe peoples with pit-grave (kurgan/yamna) burial traditions (currently called "Yamnaya"), (ii) of peoples in Central Europe associated with the CWC and (iii) of peoples using Bell Beaker funerary rituals (e.g., for review (17) and citations therein). The first two phenomena seemingly followed a (south)east-(north)west dispersal direction in Europe, i.e., around 3000 BCE from the Pontic Steppes (Dniester-Dnieper area), to Central Europe, (Hungary, Bohemia and Germany), where the CWC with its characteristic cord-decorated pottery formed out of the encounter of steppe and Late Neolithic traditions (16). The CWC also spread to the North Sea arriving in the  $29^{\text{th}}$  c. BCE (e.g., (16, 17) and references therein).

The origin of the third phenomenon, the BBC, is still unclear and controversially discussed. The major controversy is caused by the uncertainty of the dates associated with sites in which typical items of the Beaker package have been found, mostly individual items and rarely the entire BBC set, the most emblematic being a bell-shaped vessel, but also stone wrist-guards or flint knives of the type Grand Pressigny. Two hypotheses confront each other concerning the origin of the BBC: the first hypothesis proposes an origin of the Maritime beakers on the Iberian Peninsula where some of the earliest radiocarbon dates, around 2823-2658 cal BCE ( $4,220\pm45$  BP), testify to the presence of the BBC (18-20). During a subsequent early phase, the BBC would have spread from the Mediterranean shores quickly northwards along the Atlantic coast and

along the Rhône-Saône valleys (21). The early BBC is proposed to have then developed into the Europe-wide Bell Beaker civilization with four geographically distinct Beaker cultures in the southwest, south, north and east of Europe (22, 23). The second hypothesis proposes an origin in the Lower Rhine, more specifically the Rhine-Meuse-Delta, where the culturally ambiguous maritime All-Over-Corded (AOC) and All-Over-Ornamented (AOO) beakers were found in the context of single graves dating to ca. 2,600 BCE, i.e., preceding the Maritime Bell Beakers. This led to the formulation of the so-called Dutch Model of BBC origins (24).

The problem with these hypotheses is that difficulties in the chronological resolution render dates imprecise owing to numerous radiocarbon plateaus throughout the 3rd millennium BCE (25). The resulting wide calibration spans have so far hampered thus far the identification of the cradle of the BBC. The absence of a clear answer to this question, however, does not obscure certain fundamental lines of evidence for large-scale processes. On the one hand, the Bell Beaker societies in the Iberian Peninsula, as successors of the sophisticated Chalcolithic Iberian societies with their fortified mega-sites, seemed to have catalyzed a truly Pan-European movement characterized by a vast trading network of goods like salt, copper, ceramics, ivory and amber within Europe as well as with Asia and Africa based on pre-existing Chalcolithic networks (26). On the other hand, a change in funerary rituals from the collective graves and megaliths, which had prevailed for 2000 years, to individual burials with the introduction of gender differentiation and warrior display, is interpreted as the consequence of CWC influence (23, 27). Indeed, the AOO beakers developed in the Rhine-Meuse delta in single grave contexts of the Vlaardingen culture (3400-2500 cal BCE), roughly contemporary to Bell Beaker pottery (28). In the 26<sup>th</sup> century BCE in northern and west-central France, individual graves with AOC/AOO beakers, maybe predating the Maritime beakers, argue in favor of a fast northsouth "leap-frog" dispersal along preexisting Neolithic flint networks (17). In northern France, the AOC burials of Blignicourt dating to 2857-2488 cal BCE (29) and Ciry-Salsogne « La Bouche à Vesle » dating to 2,574-2,452 cal BCE (30) could be witnesses of this southward movement along the Rhine and Meuse lending support to parts of the *Rückstrom* hypothesis (31). Such a move might have been achieved in a lifetime as individual mobility was shown, based on <sup>87</sup>Sr/<sup>86</sup>Sr-isotope analyses, to be high during this period, at least in some areas (32). Moreover, these two graves belong to a series of burials in France, the Meuse-Moselle areas and the eastern part of the Netherlands containing Grand Pressigny flint knives, hinting at a vast flint exchange network (28, 30).

The river Rhine, a natural environmental boundary, seems to have been the western limit of CWC distribution and a contact zone where CWC and BBC met, blended and spread further ((17) and references therein). The Middle Rhine (Meuse-Moselle region) may have seen the blending of the AOC Beakers from the Lower Rhine and the Maritime Beakers from the Upper Rhine, the region that has the largest Maritime beaker collection known in central Europe, dated to shortly after 2600 BCE (17). The origin of the latter, however, is unclear. While it cannot be excluded that they came from the Lower Rhine, it has been hypothesized that they rather traveled with Iberian pioneers moving north via the Rhône-Saône rivers spreading the BBC (17). In both scenarios, the Upper Rhine region would have been what V. Heyd calls "the spring board" for the Maritime Beaker radiation to the East.

These European-wide cultural transformations were seemingly accompanied by the transformation of the composition of populations. Indeed, paleogenomic analyses revealed large genomic shifts over short time periods that hint to migrations of people with steppe ancestry related to the Yamnaya from the Samara steppe in present-day Russia to northwest Europe and admixture with local Neolithic individuals, such as those associated with the Globular Amphora culture (GAC), a Late Neolithic culture (3400-2800 BCE) from the northern and eastern part of Central Europe involved in the admixture events with the people from the steppes (e.g., (3,4, 6, 13-15, 33, 34)). This led to an east-west cline of steppe-ancestry in the CWC-associated population (35), with varying proportions of steppe-ancestry translating regional differences of interactions with groups coming from the steppe, which is also reflected in the material culture (34). Concomitantly with the dispersal throughout Europe of steppe ancestry, a shift in Ychromosome haplotypes was detected with rapid expansion of the R1b M269 (R1b1a1b) lineage, similar to the one found in Samara Yamnaya (R1b Z2103, R1b1a1b1b) (3, 34), whereas in north-eastern Europe, the major Y haplogroup spreading during the CWC was the R1a M417 (R1a1a1) and its derivative Z465 (R1a1a1b) (36), indicating more complex steppe ancestry diffusion patterns than one just involving the Yamnaya.

The earliest European arrival of the steppe ancestry has hitherto been detected in Central Europe, in Bohemia, in individuals associated with the early CWC dating to about 3000-2800 BCE (14). The early Bohemian CWC individuals are generally characterized by high steppe ancestry, reaching 80-90%, and a Y-haplotype belonging to the R1b L151 lineage (R1b1a1b1a1a) and its following derivative U106 (R1b1a1b1a1a1). The later CWC-associated population is characterized by the additional presence of Latvian-like ancestry and the dominance of another Y-haplotype R1a-M417 (R1a1a1) that is more characteristic of north-

eastern Europe suggesting complex population dynamics in Central Europe during the CWC period (14). This complexity, as seen through the male Y-lineage, is also observed in Bohemia during the subsequent BBC expansion, between 2400 and 2000 BCE, where the R1b-P312 (R1b1a1b1a1a2), another derivative of the L151 lineage, became dominant alongside progressive erosion of the percentage of steppe-ancestry (14). Based on the pattern of the geographic distribution of the Y-haplogroups of the L151 lineage, Papac and colleagues suggested that the R1b-P312 lineage originated around the Lower Rhine valley followed by an expansion associated with the spread of the BBC, and thus that the BBC expansion into Bohemia was concomitant with an eastward migration from western steppe-ancestry groups (14). These replacement waves of Y-lineages hint to complex and changing male dominance patterns in groups whose movements are associated with cultural shifts.

The expansion of steppe-ancestry in western Europe is less precisely documented since the distribution in time and space of genetically analyzed ancient individuals is patchy and uneven. Nevertheless, thanks to a denser dataset, the timing of the arrival of the steppe-ancestry in present-day Switzerland could be estimated to have taken place around 2700 BCE, between 2860-2460 BCE, with a rapid increase upon arrival to  $\sim 60\%$  followed by a decrease to 25-35% over the following 1000 years (37). If not due to a sampling bias, this arrival time may be slightly earlier than in Germany (3) (38), where it is detectable about 100 years later (37). The carriers of the steppe ancestry in Switzerland were found to be genetically similar to CWC-associated individuals from the Middle-Elbe-Saale region in Germany with a high steppe ancestry component suggesting that the population associated with this cultural horizon was relatively homogeneous across large parts of Central Europe (37). The Neolithic source population of the carriers of steppe-ancestry who arrived in Switzerland was closer to individuals associated with the GAC (37). Yet, not all individuals in Switzerland carried steppe-ancestry, and even 1000 years after its arrival, there were still individuals around without the corresponding signature. This pattern suggests limited admixture between carriers of steppe-ancestry and local Late Neolithic farmers.

Steppe-ancestry associated with Y haplogroup R1b P312 arrived later in the Iberian Peninsula, and is detected in northern Spain around 2400 BCE (39) and in southern Spain around 2200 BCE (40). Here, individuals with and without steppe-ancestry lived together for a few hundred years but ultimately steppe-ancestry penetrated into all genomes (6) (39, 40). Steppe-ancestry arrived in the British Isles at a similar period, around 2450 BCE, and this

arrival is associated with the spread of the BBC (6) and the introduction of Y-haplogroup R1b L21 (R1b1a1b1a1a2c1), derived from the P312 haplogroup (41).

Since its initial observation, a male bias in the steppe ancestry propagation in Europe has been contentious (42, 43). The sensitivity and specificity of the sex bias detected depend both on the methods used and the quality and richness of the X-chromosome data, with particular variations linked to the SNP density of the capture array and of the shotgun genome coverage. In CWC individuals from Germany, a sex-bias was detected in two individuals dated around 2600 BCE but was not detectable in the later Bronze age individuals (44). A sex bias has also been observed in Switzerland where the increase of Neolithic ancestry in steppe ancestry individuals between 2700 and 2000 BCE was driven preferentially by Neolithic females, during a period of cohabitation of these populations with two distinct ancestries (37). In Estonia, during the CWC between 2800 and 2000 BCE, the steppe ancestry propagation was also male-biased even though it involved a population distinct from the Yamnaya that carried Y-haplogroup R1a Z645 (36).

To better understand the spread of steppe ancestry in Western Europe, a clear view of the phenomenon in France is required due to its geographic position not only between eastern and Central Europe and the far west (British Isles), but also between the northwest and southwest of Europe (Iberian Peninsula). The 3<sup>rd</sup> millennium BCE transformation of the genomic landscape in France has, however, been sketched only in broad strokes. The genomes of roughly a dozen individuals in Bell Beaker and Bronze Age contexts in both northern and southern France are characterized by a substantial steppe ancestry-related genomic portion, around 50% (38-68%), and by males who were carriers of the steppe-related Y-chromosome haplotype group R1b-M269, with most individuals typed at higher resolution belonging to the P312 group (4, 6, 15). The aforementioned AOC burial CBV95 (Ciry-Salsogne « La Bouche à Vesle » in northern France), a single burial dated to 2574-2452 cal BCE, was a carrier of both a substantial genomic portion of steppe ancestry and the Y-chromosome R1bM269 lineage, while the BBC burial PEI2 (Dolmen des Peirières18, Villedubert, Aude, southern France) from a collective grave of men, women and children and dated to 2564-2302 BCE (3935 +/- 30BP), had no steppe ancestry and carried the Neolithic Y-chromosome lineage  $G_{2a2b2b1a1} \sim (4)$  akin to individual I1392 from Hegenheim, Alsace, dated to ,835-2472 calBCE/ 4047 +- 29 BP (6). This heterogeneous situation was also encountered in the Iberian Peninsula where only a part of the BBC-associated burials carry steppe ancestry and individuals without any steppe-related ancestry were still present at least until 1950 BCE (6, 40).

From these various lines of evidence arises a picture of  $3^{rd}$  millennium BCE European societies of very diverse genetic origins facing each other with regionally different outcomes. The CWC seems to emerge after the encounter between Late Neolithic populations in Central Europe and various migrating steppe people from eastern Europe (14). In contrast, it is not clear whether the BBC results from the encounter between local Neolithic people and migrants with steppe-ancestry or if it developed fully prior to the arrival of steppe-ancestry. Indeed, most of the early Iberian BBC-associated individuals were found to be unadmixed descendants of the previous Neolithic populations (6). The propagation of the BBC from the southwest/west to Europe's north and east, such as southern Poland, involved carriers of both southern Neolithic ancestry and steppe ancestry of the R1b M269 and its derivative P312 (14, 34). Little is known, however, about the fine-scale processes at the individual level that led to these profound genomic transformations accompanying the cultural transformations hampered by the dating uncertainties. Genetic data from individuals involved in these processes could compensate this limitation and fill in the information gap.

Here we present the paleogenomic study of a Late Neolithic collective burial from the Paris Basin in northern France demonstrating a "real-time" observation of the particular circumstances under which the steppe ancestry component was first introduced into the Neolithic gene pool. Moreover, the genomes enabled us to model the origins of the different genomic components hence shedding light on the admixture dynamics and on questions of the origins, directions, timing and mechanisms of the expansion of steppe-ancestry at the end of the first half of the 3<sup>rd</sup> millennium BCE in western Europe as well as their initial features.

## **Results**

## Archaeological context of a Late Neolithic collective burial

The LBK settlement of "Bréviandes les Pointes et les Grèvottes » (hereafter "Bréviandes"), near Troyes in the southern Paris Basin, was also repeatedly used as a burial ground from the Early Neolithic ( $\sim$ 5200 cal BCE) to the beginning of the Final Bronze Age ( $\sim$ 1200 cal BCE). Several graves with few or no associated artifacts were radiocarbon-dated to the later Neolithic. Among them, a multiple burial of seven individuals in a subcircular pit named BRE445 (Fig. 1A) produced no other finds apart from a circular bone bead and a dog paw (Fig.S3). The bones of the individuals (BRE445 A-E, FK, HI, hereafter abbreviated as A, B, C, D, E, FK, HI) are rather well preserved and unfragmented. The burial comprises three adult women, an adult man, two young children and a neonate, a newborn or yet unborn baby. According to the anthropological analysis estimated that the three women A, B and E were respectively 20-39, 20-30 and around 60 years old at death, while the adult man was 20-39 years old. The two children HI and C, a boy and a girl, were respectively 4-8 and 6-10 years old at death. Direct radiocarbon dates on the bones were obtained from the individuals B, FK, and E and range between 2580-2275 cal BCE (98,9%), 2580-2284 cal BCE (99.6%) and 2706-2287 cal BCE (96.9%), respectively (see Table S1 and Fig. S8), assigning the burials to the Late Neolithic period. Apart from signs of stress and degeneracies the skeletons did not show traces of particular pathologies (see supplementary text). Variation in the bone morphology, as measured through the cnemic indices, discriminate individual FK from the others. Signs of violence were not identified. The temporal succession of the inhumations could only partially be determined based on stratigraphic data alone (see supplementary text). The spatial layout of the skeletons shows that some of the bones of the earlier burials had been disturbed on arrival of a new corpse, although there was no evidence for intentional spatial displacement. The archaeological and anthropological analysis concluded that this was most likely a family burial (see supplementary text).

#### Genetic and isotopic characterization of the individuals of the family burial at Bréviandes

In search of further information to understand the BRE445 burial, we produced whole genomes from the petrous bones of each of the individual of the burial with a coverage of 0.75X to 4.6 X (median coverage 1X). When we determined the haplogroups of the mitochondrial genomes and of the Y-chromosomes we obtained a first glimpse of the family relationships of the burials (Fig. 1B). Shared mitochondrial haplotypes together with age at death of the individuals suggest individuals FK, HI and D to be first generation descendants of E, A and B, respectively. FK and HI shared the same Y-chromosome haplotype R1b-L151 suggesting, if their age at death is taken into account, that they could be father and son. Only individual C does not share her mitochondrial haplotype with any other individual of the burial. These conclusions were confirmed when the whole genome data were analyzed with NgsRelate (45) and READ (46) and the results combined with the anthropological data allowing us to reconstruct the family relationships (Fig. 1B, Table S2): the burial consists of one nuclear family comprising three generations, together with a mother, her child and a single child who were not related genetically to the individuals of the nuclear family. The analysis of runs of homozygosity of their genomes using the package hapROH (47) showed that none of the individuals was inbred (Fig. S9). The combination of genetic, anthropological and archaeological results also enabled reconstruction of the most likely temporal sequence of the burials (Supplementary Materials). Since the adult man FK and his son HI were the first to be buried, the mother of FK and grandmother of HI in the middle of the burial and at an intermediate time point and the mother of HI at the end, we can conclude that the genetically unrelated individuals who are embedded within the burial structure must have been part of the social community that was buried here. The combined genetic, anthropological and archaeological results identify this collective grave as a singular case of a group with mixed social and biological ties important enough to be conserved in burial.

Through genotyping using the forensic Hirisplex-S assay (48) we reconstructed some phenotypic traits of the BRE445 individuals, such as the color of the eyes, the skin and the hair (Table S3). This analysis suggests that all of the individuals had brown eyes, that the hair color of individuals E and FK was lighter than of individuals A, HI, D, C, and B, and that B had the darkest hair color. It also suggests that B had the darkest skin tone followed by D, while the others had a lighter skin color.

To shed further light on the constitution of this group, we performed a stable strontium isotope analysis ( $^{87}$ Sr/ $^{86}$ Sr ratio) on both teeth and bones of the adult individuals and on faunal remains to reveal potential life time mobility of the individuals (supplementary text and Table S9). The rationale behind this analysis is that the  $^{87}$ Sr/ $^{86}$ Sr ratio in teeth show the incorporation of Sr isotopes during infancy while the content of Sr isotopes in the bones reveals the incorporation during the last 10-20 years before death (49-51). The obtained values were compared with those obtained from contemporaneous faunal remains analyzed to reveal the local signature (Table S9). Combining the  $^{87}$ Sr/ $^{86}$ Sr ratio results and the age at death of the individuals, the results suggest potential lifetime mobility only for individuals E and B and lack of mobility for the other adult individuals. Finally, these values were compared with those graphical regions in agreement with the values obtained. Here it suggests a mobility pattern for individuals E and B comprising but potentially also going beyond the Paris Basin including the north/northeast or east/southeast of France.

# Genomic composition of the individuals of the BRE445 burial and haplotype reconstruction of the missing grandfather

To obtain a deeper insight into the potential genetic origins of the Bréviandes individuals, we performed ChromoPainter analysis (53) on a dataset of 116 imputed ancient genomes including only one representative of the related individuals of each "biological family" and excluding all other related individuals. With this dataset, we generated a haplotypic coancestry matrix, on which principal component analysis (PCA) and fineSTRUCTURE (53) were performed. Both the dimensionality reduction through PCA and the dendrogram analysis with fineSTRUCTURE allowed us to identify and visualize different genetic clusters and structures within the dataset. The first two PCs strongly differentiate three ancestral populations, i.e., northwest Anatolian Neolithic farmers (ANF), Western hunter-gatherers (WHG) and individuals associated with the Yamnaya culture of the Pontic steppe (Fig. 2A and Fig S10-11). PC1 separates ANF from HG/Yamnaya ancestries whereas PC2 separates WHG from Yamnaya ancestries. Since Yamnaya-related steppe ancestry is a mix of Eastern European hunter-gatherers (EHG) and Caucasian hunter-gatherers (CHG) (54), and since Western and Eastern HGs are also separated along PC2, PC2 could be considered as approximating a west to east cline of the European Mesolithic ancestries.

The European individuals from Neolithic to Bronze Age contexts, including those from Bréviandes, are positioned between the three ancestry poles in a manner that reflects their ancestry proportions (Fig. 2A and Fig. S10-11). Neolithic individuals without any steppe ancestry are distributed on a line that can be drawn between the ANF and the WHG clusters. The proportion of steppe-ancestry in the genomes of Late Neolithic and Yamnaya-associated individuals, estimated in the individuals grouped in four clusters using SOURCEFIND ((*55*); Fig. 2A a-d, bottom part), positions the carriers of steppe ancestry along a line of increasing steppe-ancestry. The five female individuals from Bréviandes cluster with Late Neolithic and Chalcolithic genomes from France and Spain, respectively, in cluster "a" and are devoid of steppe ancestry (Fig. 2A and Fig. S10-11). In contrast, the two related male individuals HI and FK, are positioned within clusters "b" and "c", respectively, because of varying steppe ancestry proportions, that of the son HI being half of that of his father FK, in agreement with the absence of steppe ancestry found in his mother A (Fig. 2A and Fig. S10-11).

Since the proportion of steppe ancestry found in FK being about 35-37%, we predicted that this proportion should be twice as high in his father, since the mother of FK, individual E, is devoid of this steppe ancestry (Fig. 2A and Table S4). This high steppe ancestry proportion in FK prompted us to reconstruct the phased genotype of the unsampled father of FK, herein referred to as YY, using the phased genotypes of FK and E. Since only one haploid genome of YY could be inferred, that of the gamete that led to FK, we modeled YY as a pseudo-diploid homozygous at all positions, using only the positions where the phased genotypes of FK and E allow for unambiguous deduction of the allele that was contributed to FK by YY (Fig. S12 and supplementary methods). The date associated with this individual was inferred from the radiocarbon dated individuals FK and E assuming they all died within the same time frame (see supplementary methods and Table S1).

A new genome from a BBC-associated individual in northern France is carrier of steppe ancestry

The identification of steppe ancestry in the FK individual and the scarcity of contemporaneous shotgun genomes from northern France (only a single BBC individual from Ciry-Salsogne « La Bouche à Vesle » was known genomically, CBV95 ((4) and Table S5) prompted us to improve the resolution of our analysis by adding another genome. We produced the genome of an individual from Saint-Martin-la-Garenne (SMGB54), west of Paris in the Yvelines, radiocarbon-dated to 2410-2129 cal BCE (97.8%) and representing a 30-49-year-old

man buried with BBC funerary rituals, in particular with a shale wrist-guard of BBC type (Fig. S4-5; Table S1). This individual is also a carrier of steppe ancestry (Fig. 2A, blue diamond) and was included in the further analyses.

SMGB54 is found in cluster "c" with FK and other BBC and Bronze age individuals from France as well as Bronze Age Hungarian and Croatian individuals. The pseudo-diploid genome of the reconstructed individual YY is found in cluster "d" (Supp Fig. S11) with individuals showing genomic profiles with a similarly high steppe ancestry proportion. It is remarkable that the two most contemporaneous individuals associated with the BBC/AOC in northwestern Europe, CBV95 from northeastern France and I5748 from the Netherlands, are clustering with YY.

### Spatio-temporal high-resolution analysis of Late Neolithic genomes

Our fineSTRUCTURE analysis reveals similar relationships between individuals as seen with the PC1-PC2 plot, yet it provides better defined clusters with respect to geographical origins (Fig.2B and Fig. S13). The fineSTRUCTURE dendrogram separates first the individuals with a high proportion of steppe or HG ancestry from those with high ANF ancestry. Within the dendrogram's first group, the next bifurcation separates the HG and steppe ancestry, and then, among the latter ones, the Yamnaya individuals are separated from the BBC, CWC, and Early Bronze age-associated Europeans with high steppe ancestry. Among this latter group, the final separation is shallow but notably distinguishes Central European from a subpart of more western individuals that are found in either of the final two subgroups. The reconstituted YY genome belongs to this western subgroup. Among the group with high ANF ancestry, the first bifurcation separates the individuals with steppe ancestry from those devoid of this ancestry. Among those with no steppe ancestry, the next bifurcation separates individuals according to their WHG ancestry: a first group comprises all initial ANF and later splits into two groups, a European group with little WHG ancestry and a second group with higher WHG ancestry. This latter then divides into three subgroups, one with individuals buried in Poland, one with individuals from France, mostly northern France, and Italy, and one with individuals from France, mostly southern France, and Iberia. Strikingly, the Bréviandes individuals devoid of steppe ancestry (namely the females A, B, C, D, E) are found in this latter subgroup consisting mostly of southern France/Iberian origin. The individuals with both significant WHG and

steppe ancestries, and dating to periods corresponding to the Late Neolithic and the Middle Bronze Age, separate first into two clusters discriminated by their extent of steppe ancestry: a first group with higher steppe ancestry later subdivided into a group originating from Croatia and Hungary, and a group mostly originating from France that includes individual FK. The second group carrying lower steppe ancestry can be subdivided into two groups, one including mostly Iberian individuals as well as individual HI and a group of more diverse geographic origins.

Since the hierarchical clustering approach of the fineSTRUCTURE analysis produced clusters that could be connected to their geographic origin once the major effect of the admixture of the three source populations has been taken into account, we explored whether this geographic signal can also be detected in the PCA. Indeed, PC3-PC4 reveal a correlation between haplotypes and geography mostly for samples dating to later periods, i.e., from the Late Neolithic to the Middle Bronze Age (Fig. 2C showing individuals colored according to geographic origin and Fig. S14-15). West to east and south to north clines are clearly visible, irrespective of the cultural association of individuals, indicating that a fine-scale genetic structure was established at continental level during this time period, possibly due to the accumulation of genetic drift in different parts of Europe. Strikingly, if the proportion of the three source ancestries account for most of the signal detected in PC1 and 2, these proportions appear to contribute only marginally to PC3 and 4 as there seems to be no correlation between location on the 2D plane and any of these proportions (Fig. S16). Late Neolithic individuals from southern France and Iberia group together and are clearly distinct from most samples from northern France with the notable exception of the five female Bréviandes individuals with no steppe ancestry, A, B, C, D and E (see Fig. S14-15). The BBC individual SMGB54 is also associated with the southern France cluster. This indicates that these individuals all have a stronger genetic link to southern than to local populations. In contrast, the reconstituted YY individual has a clear northern signature that is localized in PC3-4 at the outer boundary of the cluster constituted of individuals from northern France/Netherlands/British Isles/Czechia, referred to herein as the northern European cluster (Fig. S14-15). YY's son FK occupies an intermediate position due to the southern component brought about by his mother E, which puts him in the middle of the northern European cluster (Fig. 2C). Finally, his grandson HI is again located halfway between his father FK of northern European affinity and his mother A of southern affinity, which puts him in between the two clusters (Fig. S14-15).

### The Bréviandes burial recapitulates the steppe ancestry admixture dynamics in Europe

To explore whether we could extend our findings to a larger number of individuals than those for whom complete genome data allowed inference of haplotypes, we used SNP-based approaches to incorporate the individuals that had been genotyped using sequence capture with the 1240k SNP array. We used qpAdm analysis (56) grouping samples based on their location and associated cultural complex or context dates (Fig.3A and Table S6-7). As previously reported (6), we observe a dilution of steppe-related ancestry proportions through a northeast to southwest cline. It is striking that the Bréviandes burial recapitulates the general continental admixture dynamics, in particular the dilution of steppe ancestry with ANF-WHG ancestry. To better pinpoint the date when this ancestry dilution took place, we plotted the percentage of steppe-ancestry as a function of calibrated radiocarbon age of the individuals and color-coded them according to their geographical location (Fig. 3B). We further highlighted the earliest individuals from France, Switzerland and the Netherlands to evaluate the first arrival of stepperelated ancestry into France. We observe a progressive decrease in steppe ancestry in Western Europe spreading over a 1000-year-period between ~3000 and ~2000 BCE starting from a high level of steppe ancestry to levels found in early CWC-associated individuals from Czechia in the 3000-2500 BCE period, followed by a slow decrease for the late CWC- and BBCassociated individuals from Central Europe, as previously reported (14). In the following 1000 years (2000-1000 BCE), the percentage of steppe ancestry appears to reach a broad equilibrium with regional differences in equilibrium values, the values being at least twice as high in the Netherlands and the British Isles than in Iberia (6). In France, we observe a rapid decrease in steppe ancestry within a few hundred years between 2500-2300 BCE approaching the steadystate value found later in southwestern Europe. This rapid decrease suggests that the dynamics of the admixture between populations with steppe ancestry and local Neolithic farmers differed in this area from the general trends observed in Central and northwestern Europe. Strikingly, the Bréviandes collective grave amounts to a real-time snapshot of this process capturing it in action at the moment it occurred. The reconstituted YY corresponds to the earliest documented arrival of steppe ancestry in France, between 2600 and 2500 BCE, followed by the nearly contemporaneous individual CBV95 from nearby Ciry-Salsogne in the Paris Basin. This ancestry is found later in BBC individuals I1389/I1390 (first degree relatives from Sierentz, Les Villas d'Aurele, Upper Rhine, Alsace and dated respectively to 2468-2278 and 2480-2210 cal BCE (6)) and GBVPK (Grotte Basse de la Vigne Perdue, southern France, dated to 2461-2299 cal BCE (15)), in eastern and southern France, respectively. However, earlier individuals from

these same regions do not carry this ancestry, whether they are associated with the BBC or not (BBC-associated individuals I1392 from Hegenheim, Alsace, eastern France, dated to 2833-2475 cal BCE (6), and PEI2 from the Dolmen des Peirières, Villedubert, Aude, southern France, dated to 2564-2302 cal BCE (4) and individuals not associated with BBC, GBVPL (15) and I16247 (41)).

To infer the admixture dates between European Late Neolithic and steppe-related groups, we used fastGLOBETROTTER relying on phased haplotypes (57), in contrast to DATES that uses only unphased data (58). Indeed, because of the use of unphased SNPs, DATES relies on the ancestry covariance pattern between the test genome and those of two source populations, and simulation reveals that it provides varying values in case of complex admixture scenarios involving unequal contributions of three ancestral groups (58). Accordingly, when evaluating the admixture between steppe ancestry and Late Neolithic farmers that are themselves admixed between ANFs and HGs, extremely different admixture dates are obtained using DATES for some test individuals depending on the individuals used to represent the Late Neolithic source population (Table S10). In contrast. the admixture dates estimated with fastGLOBETROTTER are much more resistant to the uncertainties of the true structure of the source population (Table S10). The fastGLOBETROTTER approach was applied on the admixed individuals, FK and SMGB54, as well as other admixed individuals dating to the period after 2500 cal BCE. We estimated the admixture dates of the incorporation of the first admixture event in terms of number of generations with a jack-knifing procedure to generate 95% CI. (see Methods section). We plotted the calibrated mean age of the samples and their inferred admixture dates assuming 28 years per generation. We detected two admixture pulses differing by ~500 years between the admixture dates of the two individuals FK and SMGB54 analyzed herein (Fig. 3C). These two pulses are also observed when analyzing 19 additional BBC and Bronze age individuals as visible on the density plot, which recapitulates all phased genomes analyzed (Fig. 3C, Table S8). Note that even though individual FK is an F1 descendant of the second admixture pulse the dating of this admixture is that of his father YY because no recombination between the steppe and Neolithic ancestry haploid genomes had yet occurred. Individuals associated with the BBC from southern France, the Netherlands and Czechia gave rise to initial admixture dates similar to that of FK approximately dating back to 2900 BCE (YY gave a similar date, Table S8). In contrast, more recent admixture dates, around 2500 BCE, were inferred for other individuals from France including SMGB54, but also from the British Isles and Iberia.

We further exploited the haplotypic coancestry matrix by calculating the distribution of haplotypic length and chunk donation by Yamnaya individuals in order to understand the effect on the steppe ancestry haplotypes of different mixing behaviors between admixing groups. Fig.3D represents the distribution of the genome-wide ratio of steppe haplotype lengths to chunk number where steppe-related ancestry proportions are represented by a color scale to highlight that there is no overall correlation between the chunk length/count ratio and the ancestry proportion. Individual HI whose genome experienced a rapid dilution of steppe haplotypes after two successive introgressions of Neolithic haplotypes, was observed as an outlier compared to the other individuals, and individual FK is also at the end of the overall distribution since both experienced a 4-fold and 2-fold reduction in chunk number, respectively. The small reduction in chunk length may be due to the small generation number insufficient for recombination to exert its effect on chunk size. This analysis, alongside the previously presented dating estimate of the admixture between individuals with steppe and Neolithic farmer ancestries suggests that most steppe ancestry individuals preferentially interbred with individuals of similar ancestries and only rarely mated with Neolithic farmers, thus preserving for many generations high levels of steppe ancestry. In contrast, when an individual with steppe ancestry integrated a Neolithic farmers' group, his/her steppe ancestry would have been quickly diluted in a few generations. Such an event can be detected clearly only in the first generations, as observed here in the collective burial of Bréviandes.

To detect any potential sex-bias in the spread of steppe ancestry we performed a ChromoPainter analysis on the imputed X chromosome dataset followed by a PCA analysis. Surprisingly, the X-chromosome diversity on PC2 of the source populations (HG, ANF, Yamnaya) is higher than for the entire genomes since the latter cluster more closely together (compare Fig. S17A and Fig. 2A). The PCA of X chromosome coancestry matrix was plotted with a heatmap of the autosomal steppe ancestry proportions (Fig. S17). This analysis shows that on PC2 the individuals with HG/ANF ancestry but lacking steppe-ancestry on the X-chromosome are the furthest away from the Yamnaya individuals, while individuals with the highest amount of steppe-ancestry on the X-chromosome, and therefore closest to the Yamnaya individuals, there is no clear sex bias in the genetic flux between Late Neolithic and steppe ancestries. There are, however, exceptions to this trend. Indeed, some of the individuals with low-steppe ancestry on the X, which are thus on the left side of PC2 in Fig. S17, have medium and high steppe-ancestry on the autosomes, as shown by the yellow and green colors in the
heatmap. (Fig. S17B). These individuals are mostly from France, but some are also from the British Isles. This reveals a novel phase of female-driven incorporation of Late Neolithic ancestry into the steppe ancestry individuals when they spread into western Europe associated with the second admixture pulse.

### **Discussion**

Prior to the characterization of the genetic diversity in Europe during the  $3^{rd}$  millennium BCE, archaeological evidence pointed to the coexistence in western and central Europe of regionally diverse cultures, mainly the Late Neolithic cultures, the CWC and the BBC (e.g., (17, 22)). Genomic data showed that the spread of the CWC and the BBC coincided with population movements. While the CWC was associated with the spread of steppe-ancestry, which was described as massive (3), the latter is characterized by a more complex pattern, which cannot easily be attributed to human movements and hitherto remained elusive (6).

### Real-time observation of the arrival of steppe-ancestry in France through the genome analysis of an unusual Late Neolithic collective burial in the Paris Basin

Our high-resolution genomic analysis of the Late Neolithic collective burial BRE445 of Bréviandes in the southern of the Paris Basin, brought to light the mechanisms and direction of the admixture processes in western Europe between Late Neolithic farmers and descendants of nomads from the Pontic-Caspian steppe. This Late Neolithic burial dated to around 2500 cal BCE lacked associated grave-goods. It appeared to the archaeologists as a family burial, despite an obvious lack of adult men, since it consisted of three adult women and one adult man as well as one male and two female children and a female neonate. Combining genetic, anthropological and archaeological data, we can estimate that the burial was in use for up to 20 years (see Supplementary Material), which suggests that the deaths were not caused by an epidemic. Furthermore, traces of violence were not found on the skeletons, making it unlikely that it was mass burial due to a catastrophic act of violence. The analysis of the genomes identified three kinship groups: (i) a group comprising three generations consisting of a grandmother E, her son FK, her grandson HI and his mother A, (ii) a group consisting of a mother B and her neonate daughter D and (iii) an unrelated girl C. All female individuals of the three groups were carriers of Neolithic genomes characterized by a western hunter-gatherer proportion and a Neolithic proportion of Anatolian/Aegean origin. The genome coverage was high enough to impute and phase the haplotypes. Thus, we could use tools that maximize the higher precision inherent to the analysis of haplotypes and could detect signatures that distinguish Late Neolithic individuals according to their geographic origin. In our analysis the genomes of these Neolithic women show a closer affinity to Neolithic and Chalcolithic individuals from southern France and the Iberian Peninsula than to contemporary individuals from northern Europe suggesting that the women themselves, or their ancestors, came from southwestern Europe (Fig. 2C).

The <sup>87</sup>Sr/<sup>86</sup>Sr isotopic signature of the BRE445 adult individuals enabled us to put forward a hypothesis about the history of the individuals that constituted the group buried at Bréviandes. Grandmother E might have grown up in a place with a slightly different <sup>87</sup>Sr/<sup>86</sup>Sr isotopic signature than the one prevalent in Bréviandes. We cannot identify the exact area where she grew up, it could be anywhere in the blue area of Fig. S7, i.e., preferentially in northern or southeastern France) but when we superpose the <sup>87</sup>Sr/<sup>86</sup>Sr isotopic map of France (Fig. S7) with the genomic PC3-PC4 plot correlated to the geographical map (Fig. 2C), we can propose that E came from an area south of the Paris Basin. This is true for individual B, too, although the childhood <sup>87</sup>Sr/<sup>86</sup>Sr signature of B is slightly different from the one of E. According to the <sup>87</sup>Sr/<sup>86</sup>Sr ratio values, only E and B would have been non-locals while all the other individuals analyzed would have spent their lives in the area of Bréviandes. FK, the son of a man with steppe ancestry and E was born in Bréviandes and so was HI, the son FK had with the local Neolithic woman A. We could make use of the haplotype phases of FK and his mother E to reconstruct one haploid copy of the genome of the missing father of FK whom we have called YY. The pseudo-diploid genome of YY has a signature shared with individuals of steppe ancestry from northern Europe (Bohemia, Poland, Netherlands, northern France and the British Isles). FK as an offspring of individuals with these two distinct ancestries, therefore plots halfway between these two distinct groups. The admixed individual FK clusters with BBC individuals from France (SMGB54, analyzed here, and GBVPK, analyzed previously (15)), and with later Early and Middle Bronze age individuals from France. This indicates that the twofold dilution of the typical northern/central European steppe ancestry with Late Neolithic south-western European ancestry observed in FK is akin to the admixture pattern found in BBC and Bronze age genomes in France. The further two-fold dilution following admixture with

Late Neolithic south-western European ancestry, as observed in HI, the son of FK and A, leads to an admixture combination typical of Bronze age individuals from the Iberian Peninsula.

On the basis of this pattern of genetic similarities between various Late Neolithic individuals, the kinship relationships between the BRE445 individuals as well as the <sup>87</sup>Sr/<sup>86</sup>Sr isotopic signatures we can propose the following hypothetical narrative: we suggest that E moved to Bréviandes before or after having met YY, likely a member of a foreign group of different ethnicity related to the descendants of steppe nomads, where she gave birth to FK, the son of YY, who grew up in this Late Neolithic context. FK had a son, HI, with the Neolithic woman A. Father and son died at the same time, or HI shortly after his father. FK, A and B all died as middle-aged adults. The only older individual belonging to the first generation was E. Individual B who might also have come from another location, maybe as a child, settled at Bréviandes and had a child with a Neolithic man not present in the burial. Taking all these data together, the picture emerges of a group whose members were buried together because they had either kinship or social links. In contrast, in a nearby but partially destroyed, contemporary single burial of a ~30-year-old woman (BRE444) we did not detect first or second degree of kinship with any BRE445 individual (data not shown). This means that the BRE445 individuals were buried by someone aware of these relationships. The male adult individual, FK, excludes the possibility of an all-female burial, but the fathers of the other individuals were not included in this grave. The physical appearance of the individuals did not set them apart from other Neolithic individuals (e;g., (33, 34, 59)). Indeed, they all had genetic signatures suggesting brown eyes, dark skin, except for B and D who likely had a lighter skin color, and dark hair except for FK and E whose hair could have been a chestnut color.

### The genomes of the Late Neolithic burial at Bréviandes reveal the European-wide sexbiased admixture process involving steppe ancestry

While most details of these individuals' life history of these individuals cannot be reconstructed, this peculiar burial reveals some aspects of processes involved in the arrival of steppe ancestry on the territory of present-day France. Grandfather YY was the carrier of the steppe-ancestry proportion that we found in the genomes of his son FK and grandson HI (Fig. 2A). While the steppe-ancestry proportion in the reconstructed pseudodiploid genome of YY resembles the proportion in contemporary CWC individuals in Poland (*13, 34*) and Bohemia

(14), it is reduced (~35-37%) in his son FK to a proportion found in Late Neolithic and Bronze Age individuals from Germany, Switzerland and southern France (6, 15, 37, 44). In his grandson it is even further reduced to levels also found in Bronze Age Spain and Italy (6, 60, 61). Thus, within only two generations, incorporation of Neolithic ancestry into the admixed steppe-Neolithic gene pool led to the sharp decrease of the steppe-ancestry proportion to a level observed in individuals post-dating 2500 cal BCE. The speed of this process and its low frequency during what we identify as the initial phase of the steppe-ancestry expansion in western Europe might explain why the process had escaped observation so far: it needed to be captured in "real-time", as was possible in BRE445. This burial is a lucky case of a snapshot of a mating event involving a steppe-ancestry individual who could be considered as a mobile early steppe-ancestry pioneer. He probably came to France from the Lower Rhine as suggested by his northern Europe angenetic signature.

This result unveils the fundamentals of the early-phase admixture process between local Neolithic and migrating steppe-ancestry groups with which steppe-ancestry introgressed into the European Neolithic gene pool, and, more so, about the groups' most likely mating behavior. Indeed, our family snapshot shows that admixture between steppe-ancestry carriers and Neolithic individuals led to stark dilution of the steppe-ancestry portion of the genome within two generations. For individuals to keep for several generations a substantial steppe-ancestry proportion in their genomes, such as the 70% or more of steppe ancestry found in the majority of Late Neolithic and Bronze Age individuals of eastern and Central Europe (3, 6, 13, 14, 37, 44, 60), they must have mated mostly between members of their group with similar ancestry and only sporadically with Neolithic farmers in agreement with the inferences based on modelling of the first series of captured genome data (62). We estimated that the admixture between individuals with steppe and Neolithic ancestry was not linear but rather followed a pattern characterized by a bimodal distribution thanks to the use of an admixture dating tool adapted to haplotypes, fastGLOBETROTTER (57), a procedure more robust than the SNPbased approach used by DATES (58) when applied to the diversity of samples analyzed here (Fig. 3C and Table S10). The first admixture pulse occurred around 2900 BCE (Fig. 3B and C), i.e, around the time when the first individuals with steppe ancestry could be identified in eastern and central Europe, (e.g., (3, 13)) (14, 63)). This first admixture pulse between migrating individuals with steppe-ancestry and Late Neolithic farmers appeared sex-biased as individuals with higher steppe ancestry on the autosomes than on the X chromosome were detected in the early CWC (44). Then followed the period of relative stasis discussed above, when CWC-

associated individuals mated preferentially with individuals of similar dominant steppe ancestry, allowing a large proportion of individuals to remain around 70-80% steppe ancestry. This slightly admixed population pursued its migration to the north and west of Europe following this internal mating pattern and only occasionally mated with local Late Neolithic farmers, as detected for example in southern Poland (*34*).

In western Europe, around 2500 BCE, we detected a new pulse of admixture between Late Neolithic and steppe ancestry in the genome of SMGB54 from Saint-Martin-la-Garenne "Les Bretelles" associated with the BBC (2339-2139 cal BCE) harboring ~68% steppe-ancestry (Fig. 3A and B and Table S7), but also in later Bronze age individuals from France, the Iberian Peninsula and the British Isles (Fig. 3C). Using a haplotype-based approach we also detected differences in the extent of steppe ancestry on the chromosome X and the autosomes affecting individuals from France, but also from the British Isles (Fig. S7). This pattern reveals that there was a sex-bias in the admixture process associated with this second pulse. with an excess of males over females of steppe ancestry, the former relying more on local females of Neolithic ancestries to produce offspring. This is in agreement with the mitochondrial lineages found in the analyzed individuals that lack steppe haplotypes W and U2 (Tables S5-S6). Individual FK from Breviandes could be considered as the earliest representative of this second pulse of admixture detected as it occurred. Since FK is an F1 hybrid between a Neolithic female, E, and a man of steppe ancestry, YY, the haplotype block length-based dating of admixture by fastGLOBETROTTER detected only the previous admixture pulse of YY, because no meiosisdependent recombination between the maternal and paternal genomes had yet occurred in FK.

The high steppe-ancestry portion, long steppe-ancestry haplotype chunks and an admixture date estimated at 2500 cal BCE of the genomes of SMGB54 points to a recent admixture event, about twelve generations before his birth, which could have occurred in northern France where individuals with northern steppe ancestry blended with individuals with southern Neolithic genomes without steppe-ancestry. Thus, both SMGB54 and the male individuals from the Breviandes grave are evidence for the second pulse of admixture between steppe ancestry men and Neolithic women. Since this second pulse is detected also in later Bronze age individuals from Western Europe, which, like SMGB54, did not show a marked further erosion of steppe ancestry, we can infer that following the second pulse of admixture with Neolithic women, most individuals resume the mating preference with steppe-ancestry carriers. This brief but rather general pattern of admixture with Neolithic women in Western Europe around 2500 BCE suggests a modification of the pattern or rhythm of the westward expansion of steppe-ancestry

carriers when reaching the Rhine valley. A slow and regular expansion would allow the maintenance of contacts between the pioneers and the neighboring original groups, thus permitting sufficient opportunities of mating with partners of similar steppe-ancestry. A similar pattern of exchanges of females of similar ancestry has been detected in the Lech Valley in Germany during the BBC and Bronze Age (44). This pattern may thus have been a general trend associated with steppe-ancestry groups already before the BBC, which could explain the relative stasis after the first pulse of admixture. Pulses of admixture suggest, however, rapid expansion of male-dominated pioneer groups moving in a single generation over distances too long to maintain enough "mating links" with their community of origin. This process would have led to more active recruitment of local women of Neolithic ancestry. Therefore, the two pulses would testify two more rapid expansion phases, the first one around 2900 BCE in Eastern Europe and the second around 2500 BCE in Western Europe. Strikingly, the second admixture pulse occurred at the time when the BBC spread throughout Europe associated with steppeancestry. It is tempting to speculate that these two events were associated, in particular in light of the proposal that the BBC originated from a Neolithic ancestry community in the Iberian Peninsula (18).

These different lines of evidence could be taken as an indication for the phase when male pioneers with steppe ancestry arrived in France from the north and admixed with local Neolithic women, just as we observed it at Bréviandes where the steppe-ancestry proportion of grandfather YY was quickly diluted in his grandson BRE445HI. This dilution of the steppeancestry in the Neolithic gene pool is in agreement with archaeological data that provide no evidence for a replacement of the local Neolithic cultures by the early phase BBC (22). Subsequently, during BBC phase 2 in France, a steady-state was reached and the steppeancestry was not further diluted in the Neolithic genomes, again suggesting an endogamic mode of reproduction of the steppe-ancestry carriers, comparable to the mode observed during the CWC in Central Europe.

We observed in real-time this pioneer mating pattern in the Bréviandes family grave that reveals solely male-driven introgression of the steppe-ancestry into a Neolithic population. Grandfather YY represents such a pioneer and is the first witness of the arrival of steppeancestry in the territory of present-day France. The traces left in the later steppe-ancestry descendants reveal that similar events happened elsewhere. During westward progression, the steppe-ancestry individuals in northern France reached a steady-state level of 50 to 60% Neolithic ancestry, as seen in SMGB54 and FK. Once reaching the British Isles, however, the immigrants kept their initial steppe-ancestry proportion for about 500 years, arguing for the almost complete absence of admixture with local Neolithics ((6) and Fig 3B). Further incorporation of Neolithic ancestry into the steppe-ancestry background occurred during the southward migration toward the Iberian Peninsula leading to the dilution of the steppe-ancestry typical of these individuals who are characterized by only about 25% steppe-ancestry on average ((6) and Fig. 3B)

### Blending of populations and associated cultures

The genomes of the two male individuals buried in single graves in the Paris Basin and postdating 2,500 cal BCE, i.e., CBV95 and SMGB54, are respectively characterized by ~68% and  $\sim$ 44% steppe-ancestry. The cultural attributes of the former (notably a corded beaker and a Grand-Pressigny flint dagger (30) associate him with the AOC/AOO that probably developed out of the CWC in the Lower Rhine area and spread southwards through the Rhine Valley (17), in agreement with his Neolithic genomic portion that relates him to the northern cluster. Conversely, although at present a speculation, the stone wrist-guard of the latter might be the attribute of an archer, either a hunter and/or a warrior or both. Moreover, SMGB54 was probably related to the BBC. This cultural attribute together with the clustering of his genome with those from the south could make him a witness of admixture between northern AOC pioneers moving southwards and mixing with Neolithic or Chalcolithic farmers from southern France or the Iberian Peninsula. Alternatively, the northern pioneers with steppe-ancestry moved southwards and admixed with northwards expanding southern BB users. Thus, SMGB54 could reflect movement along the Atlantic façade followed by inland incursions along rivers like the Seine. Other individuals from southern France, e.g., I1388, I12575, I3874, I3875 (6), PEI2 (4) and GBVPK (15), but also from the Upper Rhine Valley (Hegenheim, I1392 (6)) may be witnesses of the Rhône-Saône valley expansion. It is likely that the Late Neolithic populations of the north and the south of present-day France experienced the confrontation with different cultures through similar demographic mechanisms. The blending between the northern corded ware and the southern Bell Beaker users could have led to a hybrid culture, known as BBC, that rapidly expanded all over Europe, as proposed previously (16, 64).

Thus, the genome data from this study in the context of those published previously from other areas unveil how the BBC spread in western Europe. It is important to note that not all BBC-associated individuals in France were carriers of steppe-ancestry (e.g., I1392 (6), GBVPL

(15) and PEI2 (4)). This hints to a continuous process of assimilation of the BBC socio-cultural model without population replacement by people with steppe ancestry. Rather, the adoption of this new culture seemed to be accompanied by local and additional intra-regional admixture, which followed a heterogenous pattern depending on the groups involved and led to both the disappearance of the Neolithic culture and the transformation of the Neolithic genome. Thus, the process of the introduction in western Europe of the steppe-ancestry and of the BBC resembles the interaction between Mesolithic hunter-gatherers and Neolithic farmers a few millennia earlier that led to the disappearance of the Mesolithic culture and the integration of hunter-gatherer genomes into the Neolithic gene pool (e.g., (3) (4, 13)).

### **Conclusion**

To conclude, our study of an unusual burial dated to the Late Neolithic enables direct observation, almost in real-time, of the bimodal admixture process in Europe of dispersing people with steppe ancestry who disperse in Europe and local Late Neolithic groups or individuals. The generalization of the results obtained from our data suggests that this genomic transformation process took place during a period of profound cultural change. We propose that the CWC would have been developed after the initial encounter of migrating nomads from the steppes with local Late Neolithic populations in eastern and central Europe, as has been previously suggested (e.g., (16, 17)) and references therein). Subsequently, no further admixture with Late Neolithic individuals would have occurred. In the west, the propagation mode changed to leap-frog dispersal through "pioneers", i.e., mobile individuals, during the early phase mostly men, who admixed with local Neolithic women, causing the dilution of their genomes with the Neolithic gene pool. Since we found no correlation between the spread of steppe-ancestry and the spread of the BBC during this early phase, the cultural spread seems to have been stimulated by people with steppe-ancestry only during later phases. After 2500 cal BCE, the descendants of the admixed groups moved southwards, mating with Late Neolithic individuals of France and the Iberian Peninsula, thus recruiting southern Late Neolithic ancestry into the admixed steppe-Neolithic ancestry. This process explains the establishment of a north-south steppe ancestry gradient, as it is still present today. The persistence of this pattern and the maintenance of the steppe-ancestry portion in the European genome up to the present day argues for a higher reproductive rate of individuals with steppe-ancestry in the later phase,

ultimately out-competing the Neolithic farmers. This process also reflects a shift to the profoundly different societal system observed in the Bronze Age (44) and eventually led to the replacement of the Neolithic genomes. Thus, this transformation process concerned both the cultures and the biology of the populations involved and led to the establishment of the western European genome that has prevailed up to now.

### Material & Methods

### **Radiocarbon Dating and Strontium Isotope Analysis**

The samples were AMS <sup>14</sup>C-dated at Tandem Laboratory, Uppsala University, Uppsala, Sweden. The <sup>87</sup>Sr/<sup>86</sup>Sr-isotope analyses were performed by Paul Fullagar under the direction of T. Douglas Price, The Archaeological Chemistry, at the University of Chapel Hill, NC 27599, USA.

#### **DNA extraction and Library Construction**

Ancient DNA work was carried out in a high containment laboratory as described (65-67). The dense pyramidal parts of the petrous bones were isolated using a flame-sterilized diamonddisc of a Dremel. Bone pieces were then ground to fine powder in a 6775 Freezer/Mill®Spex SamplePrep in liquid nitrogen as described previously (4). The further protocol deviated from the previous one. Briefly, about 100 mg of bone powder were washed three times for 15 min. each with 1 ml 0.5 M sodium phosphate buffer at pH 8.0 Each sample was rinsed with 1 ml TT buffer made of 10 mM Tris HCl pH 8.0 and 0.1% Tween 20 One ml extraction buffer (0.5 M EDTA pH 8.0, 0.05% Tween 20, 250 µg/ml Proteinase K, and 0.14 M β-mercaptoethanol) was added to each sample and incubated on a rotating wheel for ~30 hours at 37°C. After this first incubation, the samples were centrifuged at  $6000 \times g$  for 1 minute. The supernatant was removed and kept for purification. Another 1 ml extraction buffer was added to the pellet and after resuspension, incubated for another 30 hours on a rotating wheel at 37°C. After this second incubation step, all samples were centrifuged at  $6000 \times g$  for 1 minute. The supernatants from both incubation periods were pooled together in 2 ml tubes, mixed well and then centrifuged at maximum speed for 2 minutes. One ml of the supernatant was used for the following purification step using 5M40 binding buffer (5M Guanidine HCl, 40% isopropanol,

120 mM Sodium Acetate (NaAc) pH 5.2, 0.05% Tween 20; (68). 1 ml of each sample extract was purified with ~10 ml 5M40 binding buffer through Qiagen columns under vacuum, rinsed twice with 1 ml Buffer PE (Qiagen) and eluted with twice 30 µl of TET buffer (10 mM Tris-HCl pH 8.0, 1 mM EDTA, 0.05% Tween 20) following (69)

Libraries were constructed using 6 µl of extract and the NEBNext Ultra II DNA Library Prep Kit for Illumina (NEB, Ipswich, MA, USA) after a pretreatment with USER enzyme mix (NEB, Ipswich, MA, USA) as described by the manufacturer. An unindexed Y-shaped adapter was ligated, the ligated libraries were first amplified for 8 cycles with the Illumina Rd1 and Rd2 sequencing primers, then 20% of the library was further amplified for 12 cycles with Illumina unique dual indexed adapter primers. The libraries were purified using 1.3 volume of SPRI beads (Macherey-Nagel<sup>TM</sup> NucleoMag<sup>TM</sup> NGS Clean-up and Size Select) for two successive rounds of purification.

### **Processing of Sequencing Data**

All data processing steps were performed using shell instructions and in-house written scripts. The raw output of Illumina sequencers was in the BCL format. Because of the high number of in-house barcodes used, we performed the initial demultiplexing and fastq conversion using bcl2fastq (Illumina) on the laboratory server. Sequence quality was assessed using FastQC (Babraham bioinformatics - citation). Paired-end reads were merged and trimmed for adapters using leeHom (70). Reads larger than 28 bp were selected using awk and mapped onto the Human Reference Genome hs37d5 using BWA (Burrows-Wheeler Aligner) version 0.7.17 (71) with a seed length of 18. Aligned sequences in BAM format were processed with Samtools v.1.9. (72) to create index files and flagstat reports, and to select and sort mapped reads. Picard tools (http://broadinstitute.github.io/picard/) was used to remove duplicates. Multiple libraries were merged by Samtools v.1.9 before, followed by filtering the mapping quality (-q 20). Damage patterns were analyzed using mapDamage v.2.2.1 followed by end-clipping using BamUtil (https://genome.sph.umich.edu/wiki/BamUtil: trimBam). According to the damage pattern, three to four bases at the ends of each read were clipped for the UDG-treated libraries and 10 bases for non-UDG treated libraries.

#### **Uniparental Haplogroups, Sex Identification and Contamination Estimation**

The clipped bam files were used as inputs to run Haplogrep2, Haplocheck and HaploGrouper (73, 74) for the classification of mitochondrial haplogroups and the estimation of contamination level, respectively, which showed no detected contamination in the mtDNA data. To determine the sex of each individual, chromosome counts were performed using index statistics (idxstats) of Samtools on bam files by using exclusively the reads with mapping quality higher than 20 to prevent confusing effects of repetitive regions. Then the ratio of the proportion of read counts normalized to chromosome length for both the X and Y, normalized for each to the average of the autosomal proportion was used. We used the ANGSD software to estimate contamination on the basis of X chromosome for male individuals (75). HaploGrouper approach (76) was performed on the bam files of male individuals to classify Y-haplogroups (Table S1).

### **Genotype Calling and Dataset Preparation**

We followed two different genotyping approaches, which are genotype imputation and pseudo-haploid calling, in order to prevent the possible false positive calls that could come from direct diploid genotyping due to low coverage of the majority of ancient samples. To generate an imputed and phased dataset, GLIMPSE (v.1.1.1) (77) was used for imputing the ancient genomes, namely 8 individuals from the current study and 111 publicly available ancient individuals. We followed the procedure described in the online Glimpse tutorial (https://odelaneau.github.io/GLIMPSE/tutorial\_hg19.html), using Genotype Likelihoods (GL) computed with Bcftools (mpileup -I -E, call -Aim parameters) using the 1000 Genomes Project phase 3 reference panel excluding the indels. We filtered out from the imputed genomes the positions that have MAF lower than 5% in the 1000G reference panel. Then, we applied a further filtration of Genotype Posterior Probability lower than 0.99 and genotype missingness rate of 0 for downstream analyses. We use the autosomal sites in the 1240k SNP capture (*38*) to select 1240k SNPs that were used for calling, with Samtools mpileup and the pileupCaller pipeline (https://github.com/stschiff/sequenceTools), the bam files resulting from either shotgun sequencing or in-solution target capture.

# Estimation of Kinship, Pigmentation Profile and Runs of Homozygosity (ROH)

We inferred the relatedness between individuals coming from the complex burial described in the current study using a combination of two complementary approaches, NgsRelate and READ softwares (45, 46). We used a mixed group of 56 ancient Western European individuals covering the periods of the Middle Neolithic, Late Neolithic, and Bronze Age to provide a distribution of ancestral proportions in the background allele frequency similar to that found in the complex burial. The first NgsRelate (v.2) analysis was performed using as input the genotype likelihood and allele frequency of these 56 individuals calculated from the bam files using ANGSD and the autosomes. To infer the pedigree, we performed a second NgsRelate analysis using ANGSD and the X chromosome data in the same manner as with the autosomes. A third NgsRelate analysis was performed using as input a vcf containing the imputed genotypes of these 56 individuals. The estimated kinship (theta) and Cotterman (k0, k1, k2) coefficients from these three analyses were compared to the ideal values obtained using simulations by Yaka et al., 2021 (Table S2). READ was used to analyze pseudo-haploidized genotypes of individuals from the complex burial to further corroborate the NgsRelate-inferred relationships. We also calculated the normalized 1-P0 (mismatch rate) values from the output of Read as described (78) (Table S2). To establish the pedigree shown in Fig. 1, we used the kinship relationships determined by these analyses, the uniparental haplogroups (mitogenomes and Y chromosomes), the genetic sex and the estimation of the anthropological age at death.

In order to predict the pigmentation profile of the newly reported individuals, we used HIrisplex-S (79) and the imputed genotypes. We checked the HIrisplex-S output for consistency by manual verification of the genotypes and allele depths obtained without imputation. We applied HapROH (47) in order to identify ROH blocks longer than 4 cM on the Late Neolithic individuals from France.

#### **Population Genetic Analyses**

We ran ChromoPainter/fineSTRUCTURE (53) on the imputed and phased data using different sets of individuals so that no relatives are analyzed simultaneously. We used four datasets including all unrelated individuals with the related individuals grouped as follows: 1) FK-A-D; 2) E-A-B; 3) HI-B; 4) YY-A-D. After estimation of switch and mutation rates using 10 expectation-maximization (EM) iterations, each haplotype was painted using the others (-a 0 0). We applied fineSTRUCTURE's Markov chain Monte Carlo (MCMC) model on the

resulting coancestry matrices with 3,000,000 burn-in and 2,000,000 sampling iterations. After the extraction of the maximum observed posterior probability state and 100,000 hill-climbing iterations, the trees were inferred by using the maximum concordance state as it is used in the PoBI study ( $\beta 0$ ). To obtain input files for SOURCEFIND v2 (55) and fastGLOBETROTTER (57) we ran ChromoPainter v2 with 10 iterations of EM to infer parameters on chromosomes 1, 8, 15 and 22. Then, the copy vector and painting samples files were generated for the 22 autosomes by using the inferred parameters and the ancestral groups, ANF, WHG, and Yamnaya (as described in the text), as donor populations to paint recipient individuals. We ran fastGLOBETROTTER to infer the admixture dates for each individual by ANF, WHG, and Yamnaya ancestral populations as donor populations while using European Late Neolithic (without any Yamnaya ancestry) and Yamnaya populations as surrogate populations. This was followed by a jackknife resampling step as implemented in the software in order to calculate the confidence intervals. These CIs were calculated using the delete-m<sub>j</sub> jackknife variance estimator formula of Busing et al. ( $\beta I$ ).

qpAdm (56) was run using the Admixtools package (82) on the 1240k dataset for individuals coming from both shotgun sequencing and in-solution target capture data. We used Mbuti, Ust'-Ishim, Kostenki14, Sunghir3, Karelia, Motala12, and Iranian Neolithic genomes as the reference groups. Target individuals that could not be modeled as the product of a three-way admixture event were modeled as the product of a two-way admixture event.

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### **Author contributions**

EMG and TG conceptualized and supervised the project; OP performed the laboratory work and the formal data analyses; OP, EMG and TG analyzed and interpreted the data; CL, CP, LB, CDJ and AC provided the archaeological samples; CL and CDJ provided the archaeological contexts; LB, AC, CP, IR and EV provided anthropological data; CB supervised the sequencing platform; EMG and TG wrote the paper with help from OP and input from CL.

**Competing Interests.** The authors declare that they have no competing financial interests that might have influenced the work described in this manuscript.

### Data availability

Sequence data generated for this study are available from EBI European Nucleotide Archive PRJEBXXX.

### **Figures**



**Fig. 1. A collective burial in the Paris Basin** (**A**) Map showing geographical locations of samples analyzed in this study. Schematic representation of the collective burial at Bréviandes. (**B**) Estimated age of death and uniparental haplogroup information of the Bréviandes individuals. (**C**) Pedigree plots showing kin relationships between the Bréviandes individuals. (**D**) Pedigree plots showing the genomic component of Yamnaya-related steppe and Late Neolithic ancestries between the Bréviandes individuals. Empty boxes and circles indicate unsampled individuals. Dotted lines indicate the individual whose genome is reconstructed. Iconographic reconstruction of the burial: Elisabeth Vauquelin.



**Fig. 2. Fine-scale genetic structure of Neolithic and Bronze Age individuals** (**A**) Principal Component Analysis (PCA) based on ChromoPainter haplotypic coancestry matrix (top) and SOURCEFIND ancestry component estimates (bottom) of selected individuals in the PCA plot (see Table S4-S5). The variance explained by PC1 and PC2 are, respectively, 45,8% and 30,5%. Individuals E and HI were added to the ancestry plot independently of the PCA. The squares a-d are ordered according to increasing steppe-ancestry content. (**B**) fineSTRUCTURE clustering dendrogram based on the same coancestry matrix. Zoomed clusters correspond to different fineSTRUCTURE dendrograms based on coancestry matrices

including other related Bréviandes individuals. See Figure S13 for the original dendrograms. (**C**) The PC3-PC4 plot of the same PCA (top) showing only European Late Neolithic and Bronze Age samples colored based on their geographical locations and the locations of these samples on the geographical map (bottom). The plot has been rotated clockwise to have a similar orientation as the geographical map. The variance explained by PC3 and PC4 are, respectively, 2,9% and 2,5%.



Figure 3: Spatiotemporal analysis of Yamnaya-related steppe ancestry (A) Circular graph display of the three-way qpAdm models for Late Neolithic and Bronze Age individuals grouped by location, archaeological context and dates. (B) Relative Yamnayarelated ancestry proportions plotted against mean radiocarbon dating values. Individuals of interest are highlighted with black outlines. The names of individuals from France are shown with boxes and indication of geographical regions in France. (E: East, W: West, S: South, N: North). For Bre445YY, the radiocarbon date of Bre445E is used. For Bre445HI, the radiocarbon date of Bre445FK minus one generation (28 years) is used. (C) Admixture dates and their 95% confidence interval of generation times (in black) inferred by fastGLOBETROTTER software and mean radiocarbon dating values of individuals (top). Density curve of inferred dates for each autosome of individuals calculated by the jackknife resampling step (bottom). (D) Box plot (n=51) of normalized Yamnaya-related haplotype chunk counts and chunk lengths ratios. Ancestry proportions calculated by SOURCEFIND of each sample are highlighted as a heatmap.

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### 1. Descriptions of archaeological sites

### 1.1. Bréviandes les Pointes & les Grèvottes [ZAC St Martin 1] (Aube, France)

#### Christophe Laurelut, Lola Bonnabel

The site, just in the south of the city of Troyes (Champagne, France) is located on an old terrace of the river Seine outside its alluvial plain. A first excavation took place in 2006 and mainly concerned a pioneer settlement of the middle/younger LBK (~5200 BCE). The site was then repeatedly used as a burial ground during the Middle Neolithic (Cerny culture, c. 4700-4500 BCE), the end of the Neolithic and the Early to Middle Bronze Age (c. 1750-1300 BCE). It was finally occupied again during the middle phase of the Late Bronze Age until the early Iron Age (Hallstatt A2-C, c. 1100-620 BCE).

The burials dated to the end of the Neolithic are concentrated in three clusters distributed on the edges of the LBK village. Their absolute chronology runs from the end of the 4th millennium (~3100-2900 BCE) to the Final Neolithic with an apparent chronological gap between features that can be attributed to its first part (~2900-2600 BCE) and the later features (~2600-2300 BCE). Thus, these clusters presumably do not belong to a single occupation; but they all contribute to the creation of a funerary landscape that seems to focus on the former LBK settlement area, over 2000 years after its abandonment.



Figure S1: Plan of the site Bréviandes les Pointes & les Grèvottes [ZAC St Martin 1] with the burials of the different occupation phases highlighted. Recut by a later (Iron Age) extraction pit, the western cluster remained unnoticed until the end of excavation. It includes three burials, two individual (burials BRE443 and BRE444) and one collective (BRE445). The morphology of these features was diversified, with each one corresponding to a specific model. Burials BRE444 and BRE445 were analyzed genetically in the present study and will be presented in more detail. They are the latest Neolithic burials dating to 2600-2300 BCE.

### **Burial BRE444**



Burial BRE444 was partially destroyed by an Iron Age pit. The burial is of a young woman (<30 years old) who had been placed on her right side with her (missing) head oriented toward the north. The presence of empty spaces in the grave could be deduced from the morphology of the skeleton as well as the presence of a cover retaining the sediment. The burial is contemporary with the grave BRE445.

**Figure S2 : Burial BRE444** (photo © Inrap).

### **Burial BRE445**

The Iron Age extraction pit cutting the burial destroyed the upper part of the grave and its access. Around 1 m below the excavation surface, a ~30 cm thick layer was all that remained from the subcircular 1.55m\*1.25 m funerary chamber. The only associated grave goods were a circular bone bead found on the neck of individual A, and the paw of a young dog, dated to the same period as the human remains.

Seven individuals were buried in this grave: an adult woman A, lying on the right side in a bent position with her head toward the north; a young adult woman B, lying on the right side in a crouched position with her head toward the south; a  $8 \pm 2$  year-old young child crouched on its right side C; a perinatal D; an elderly woman E, lying in crouched position on her right side, head toward the south; an adult man FK lying on his back slightly turned to the right side, head toward the north; a  $6 \pm 2$  year-old child HI, crouched on its left side, head toward the west.



Figure S3: Collective burial BRE445. (photo © Inrap).

Radiocarbon dating of the individuals of burial BRE445: Table S1



Radiocarbon profiles (OxCalv4.4.4. Bronk Ramsey (2021); for the individuals of burial BRE445 (A to HI), and the dog from the same burial (BRE445\_chien) calibrated using incal 20, (*I*).

The depositional order was partially reconstructed from the stratigraphic data:

1) Placed on the bottom of the pit, the young man FK, the child HI and the child C were the first to be deposited. There is no clear stratigraphic relationship between them that would indicate their order of deposition, but the spatial layout of the part of the skeletons not displaced by later burials shows that the man FK was deposited in the center of the grave, the child HI along his back and the child C in a more peripheral position to the south. This could suggest that the man was the first inhumated, but he may also have been at the center of a simultaneous double or triple burial.

2) The elderly woman E was also deposited in the center of the grave, above FK and HI whose bones were partially displaced /pushed away on this occasion to make room for the new burial.

3) Lastly, the young women A and B were deposited simultaneously or at a short interval, B above the woman E and A above the child C. The bones of the previously buried individuals were again partially moved to make room for the new incomers.

The remains of the perinatal D lay in an ambiguous position at the level of E's belly, suggesting her possible pregnancy, but this hypothesis did not fit with her estimated age. The association of D with B, whose arms seem to cross on D's remains, is more probable.

Individuals A and B were deposited on a 10 cm thick layer of sediment. A similar layer of sediment was also found in the upper part of the burial on top of their skeletons. The orientation of perinatal D could not be determined because the skeleton was incomplete.

#### Anthropological study of the individuals:

#### Cécile Paresys, Isabelle Richard

The anthropological study of the buried individuals suggests a family burial without exclusion of a particular sex or age class.

Based on the surface degeneracies of the sacroiliac pelvis, individual A was attributed to a 20 to 39-year-old woman. No infectious or traumatic lesion on the bones was diagnosed. The individual has only slight cribra orbitalia and osteoarthrosis. The dentition is incomplete with ante mortem loss of molars, the teeth show caries and tartar.

The age of individual B was estimated at 20 - 30 years based on the absence of synostosis of the medial epiphyses of the clavicles and at 20-39 years based on the surface degeneracies of the sacroiliac pelvis. The individual has only slight cribra orbitalia. The dentition is complete with little caries and tartar and some signs of hypoplasia. The sex was determined at 100% to be female.

Individual C was a 8 + 2-year-old child as deduced from its dental mineralization stade, and 5 to 6.5 years old based on the metrical estimation of the length of the limbs (humerus : 192 mm; radius : 141 mm; ulna : 156 mm; femur : 264 mm; tibia : 216 mm). The individual shows a slight cribra orbitalia and some tartar on the teeth.

Only a few bone fragments are preserved from the perinatal individual D (fragments of the skull, the clavicle, the ribs, vertebras, as well as humerus, ulna, femur and coxal fragments). The metrical estimation of its femur (71 mm) suggests, based on the method of Adalian, that it was between the 34,4 et 41,08th week of its intra-uterine life. The hypothesis was put forward that D was the child of E and that it was buried with its mother while still being in utero. This hypothesis was invalidated by the genetic results.

Individual E is represented by its skull, the mandible, a maxilla fragment, five teeth, and several post-cranial bone fragments. According to the sacroiliac pelvis surface degeneracies, the individual was more than 60 years old. The sex could not be clearly determined but was suspected to be female. No stress indicators could be identified, but signs of osteoarthrosis in the upper part of the skeleton. No infectious or traumatic bone lesion was found. There are no indications for ante mortem tooth loss, but the teeth show caries and tartar.

The skeleton of individual HI is almost complete and well preserved. It is a 6 + 2-year-old child according to the mineralization stage of the teeth and 4.5 to 5.5 years old according to the metrical estimation of the limb bones (humerus : 168 mm ; radius : 132 mm ; femur : 232 mm ; tibia : 187 mm). The only stress indicator is a cribra orbitalia of stage 2. No infectious or traumatic bone lesion was found. The permanent molars do not show any traces of wear, but there are slight traces of wear on the temporary teeth. There are no traces of tartar or caries on the teeth.

The skeleton of individual FK is almost complete and well preserved. The absence of synostosis of the medial epiphyses of the clavicles suggests that the individual was 20 to 30 years old, and 20-39 years based on the surface degeneracies of the sacroiliac pelvis. The probabilistic sex diagnosis yielded a male at 97% confidence. The only stress indicator is a slight cranial hyperostosis. The 27 teeth show some tartar and traces of wear, but not ante mortem loss. The lower jaw has stage 2 periodontitis.

Reconstruction of the constitution of the collective burial BRE445 based on stratigraphic and genetic data

The stratigraphic succession observed in the collective burial establishes that the first individuals to be buried either simultaneously or shortly after each other were FK and HI, followed by E. C is at the bottom of the grave, but without any direct relation to FK, HI and E. The sedimentation between E and C and the following individuals B, D and A, maybe due to the first decay of the feature after some time of use, could suggest a longer interval between burial E/C and B/D/A. Individual A was probably the last individual inhumated, shortly after or simultaneously with B/D. As an alternative to a linear, successive single burials model, the data allow for three simultaneous inhumation phases comprising first FK, C and HI, then E, and finally B, D and A. Based on stratigraphic data alone it is not possible to decide between these two scenarios, or any other intermediate scenario.

The genealogical relationships deduced from the genetic results and the age differences between the related individuals E, A, FK and HI were used to reconstruct the burial's duration use. The first to be buried were generations 2 and 3 (FK and HI), followed by generation 1 (E). The last individuals to be buried belonged to generation 2 (A). Thus, while generation 2 was involved in the initial and the final phase of the burial, generation 1 was involved in the intermediate phase, and generation 3 in the initial phase.

The position of the remains of B strengthens the hypothesis that B died during delivery and that she was buried with her baby D in her arms.

There are two cases in this burial where the mother survives her child. This is the case for E and A whose sons, FK and HI, respectively, died before them. The total number of deceased infants (3) for four adults is high and, although statistically not significant, corresponds to an overrepresentation of this age class.

The age difference between the elderly woman (+60 years old at death) and her son, the man FK (20-30 years old at death) enables a probabilistic evaluation of the time between the two burials. If an early age of 15 years for E's motherhood is assumed, and an early death at 20 years for her son FK, the upper time span between the two burials could be 25 years [60-(15+20) =25]. If a relatively late age of 25 years for E's motherhood is assumed and a later death at 30 years for FK, the time between the two burials would be of only 5 years [60-(15+20) =5].

The same estimation can be made between female A (20-40 years old at death) and her son HI ( $6\pm 2$  years old at death). There may be around 20 years between the two burials if A's motherhood is estimated at 15 years and her age at death at 40 years [40-(15+6) =19 $\pm 2$ ]. If A

gave birth to HI at an age of 20 years, the time difference would only be 5 years [30-(20+6) =5].

Although these estimations are based on different values (age differences at death of an elderly and an adult woman on one hand, and of an adult woman and a child on the other), the differences are comparable. While in the first case this difference concerns the first and second inhumation level, however, in the second case it concerns the whole burial (level 1 and 3). Therefore, the duration of the use of the burial is situated in a relatively reduced time span of one generation at most, but probably less.

### 1.2. Saint-Martin-la-Garenne

### Cynthia Domenech-Jaulneau, Aloïs Corona

The individual primary burial at Saint-Martin-la-Garenne, Yvelines, "Les Bretelles" (SMGB54) was discovered at the bank of the Seine (2). The burial reflects the funerary ritual of the Bell Beaker Culture and dates to the extreme end of the Neolithic (~2200 BCE). AMS radiocarbon-dating of the SMGB burial yielded  $3800\pm30$  BP, calibrated via IntCal2020 (1).to



2410-2129 cal BCE (97.8%). The grave, dug into the subsoil, was probably accompanied bv a structure on the surface since four concrete limestone blocks were placed on the northern side of the pit. It was probably located on the edge of a funerary area. Domestic 4th occupations from the millennium were discovered nearby.

Figure S4 : burial at Saint-Martin-la-Garenne

The anthropological analysis showed that the individual was a robust, healthy 30-49-yearold man without any visible bone pathology. He was deposited on his left side in a crouched position and with the head oriented to the north-east. The corpse was inhumated into the subsoil. The skeleton is not complete and although the bones are brittle but their morphological preservation is relatively good.



The colluvial deposits on top of the burial contained mixed finds dating from the Neolithic to modern times. The burial itself contained only one grave good, a shale wristguard characteristic of the Bell Beaker culture. It was found next to the elbow of the right arm. It is a polished, rectangular object with a perforation at each end. Nowadays, this kind of object is made of leather and used by archers to protect the internal side of the lower arm against the friction of the bow strings after the shot. Alternatively, it could have been used as sharpener for copper or bronze blades.

## Figure S5 : The shale wrist-guard discovered from the burial at Saint-Martin-la-Garenne.

1.3. Ciry-Salsogne « La Bouche à Vesle » (Aisne, France)

Although no new genomic data from the burial at Ciry-Salsogne « La Bouche à Vesle » have been produced in the present study, the sequence data we had previously obtained (3) were reanalyzed in our present study and used in the comparative analyses showing that it is an important specimen. Therefore, it is described here.

CBV is an individual burial located in the Aisne-valley in northern France at Ciry-Salsogne « La Bouche à Vesle » (4). The skeleton is rather poorly preserved. The corpse was placed on its back and had not been wrapped in a shroud. It was radiocarbon dated to  $3970 \pm -30$  (GrA-32767), 2575-2359 cal BCE using IntCal20 (1, 3).

The grave goods comprise a Bell Beaker vase, a flint flake, a deer antler and a flint dagger (4). The technique used to decorate the vessel is known from the Netherlands. This decoration style relates to the Dutch All-Over-Corded (AOC) group, characterized by individual burials and corded beakers that are different from classical Bell Beaker vessels (4). The dagger, made of flint from Grand-Pressigny (Centre-Val de Loire, southwestern part of the Paris Basin), is another feature that this burial shares in terms of raw material and style with burials in the north of Germany and the Netherlands, in association with vases of the style AOC and others (4). As in the case of similar burials in northern Germany and the Netherlands, no arrowheads were present. The deer antler is perforated in the center recalling arc-shaped Bell Beaker pendants (4).

To conclude, both structural elements of the CBV grave and the burial practice are comparable to graves in the Moselle region and in Luxembourg (4).

### 2. Stable Isotope analysis (<sup>87/86</sup>Sr ratio)

#### Eva-Maria Geigl

Life-time mobility of individuals across geologically distinct areas can be evaluated by determining the bioavailable  ${}^{87}$ Sr/ ${}^{86}$ Sr ratio (5, 6). This determination is based on the strontium that had entered the skeletons through soils and the food chain after its release from eroding bedrock (7). Depending on the rubidium content of a rock and its age, the amount of  ${}^{87}$ Sr – expressed as the  ${}^{87}$ Sr/ ${}^{86}$ Sr ratio – varies among geological units between about 0.7000 and 0.7500 and occasionally above. Since strontium in the diet replaces the calcium in biological apatite but is not metabolized, the measured  ${}^{87}/{}^{86}$ Sr ratio in skeletal tissues reflects the uptake during their formation (5). Therefore, changes in the food source can be reconstructed through the measurement of the  ${}^{87}/{}^{86}$ Sr ratio in the skeletal tissue ( $\beta$ ). Owing to the existence of other, non-geological sources of Sr isotopes in the biosphere, one has to compare the isotopic signature obtained for an individual with the biologically-available signature in the area around the burial (6,  $\beta$ ). This necessitates the comparison with a baseline map of the strontium isotopic variation across a region. Such a terrestrial baseline map for archaeological provenance studies has been established for continental France based on the  ${}^{87/86}$ Sr ratios of plants and soil leachates (g).

While the <sup>87/86</sup>Sr ratios in bone reflect the strontium ingested over the last one or two decades before death, the <sup>87/86</sup>Sr ratios obtained from dental enamel represent the childhood signal. Bone is remodeled throughout an individual's lifetime. During this lifelong process mature bone tissue is removed from the skeleton and new bone tissue is formed (10). Thus, the <sup>87/86</sup>Sr ratios reflect the bone metabolism during the last one or two decades before death and provide a summary measure of the local <sup>87/86</sup>Sr ratio (6, 8, 11). Conversely, the tooth enamel forms during tooth-specific childhood periods, is not remodeled afterwards and resists rather well post-mortem taphonomic alteration (6, 8, 11). As a consequence, the <sup>87/86</sup>Sr ratio from the local baseline values can indicate that an individual was a first-generation migrant, more so if the <sup>87/86</sup>Sr ratio in long bone diaphysis corresponds to a local signal since the latter shifts toward local values over time (6, 8, 11).

The  $^{87/86}$ Sr ratios of small animals testify for the local signature and were shown to be strongly correlated with those of indigenous prehistoric humans (6, 11). As a note of caution, one has to consider, however, that bone has a higher likelihood of containing diagenetic Sr isotopes than enamel.

To analyze life-time mobility patterns of the individuals of burial BRE445, their 87/86Sr ratio was determined by T. Douglas Price, Archaeological Chemistry, Middleton WI, USA. Both teeth and bones were analyzed to detect differences between childhood and adulthood and thus differences in provenance. In particular, premolars were analyzed, which erupt between 9 and 13 years (12), and shaft fragments of femurs yielding a signal summarizing the last one or two decades of the life of the individual. As a local control, bones of a Neolithic cow and a Neolithic hare were subject to the same analysis. The hare is supposed to carry a local signature as it would not have a lifetime mobility.

Sample	species	tissue	skeletal element	<sup>87</sup> Sr/ <sup>86</sup> Sr ratio
BRE445A	Human	enamel	PM2	0,7081
BRE445A	Human	bone	shaft frag femur	0,7081
BRE445B	Human	enamel	PM1	0,708673
BRE445B	Human	bone	shaft frag	0,708165
BRE445E	Human	enamel	PM1	0,7088
BRE445E	Human	bone	shaft frag femur	0,7082
BRE445FK	Human	enamel	PM2	0,7081
BRE445FK	Human	bone	shaft frag femur	0,7081
BRE149t	hare	bone	shaft frag	0,7082
BRE45-2	COW	bone	shaft frag	0,7085

Table S9: 87Sr/86Sr ratio of the analyzed samples



Figure S6: <sup>87/86</sup>Sr ratio of the analyzed samples, the adult Bréviandes individuals and faunal samples; dark blue triangles: values obtained from teeth; light blue diamonds: values obtained from bones.

The <sup>87/86</sup>Sr values of both teeth and bones of individuals A and FK are in the same range. This argues for these individuals having spent their life in the surroundings of the burial, in agreement with the value of the hare representing a local, low-mobility control. The value for the domestic cow is different (higher) suggesting that the cow could have come from somewhere else. Since domestic animals such as cattle and pigs were mobile in these societies and circulated in social networks and were subject to transhumance, this is a plausible result. The value for the premolar of individual E, however, is higher by 0.0006 compared to the bone value. Since the teeth enamel forms during childhood and is not remodeled later this suggests that E spent her childhood in a location with a different geology than the one around Bréviandes les Pointes & les Grèvottes (ZAC St Martin 1) meaning that she might originally not be from this area. She possibly spent her adult life in Bréviandes, at least after giving birth to FK who carries a local Sr isotopic signature, in agreement with the bone values of individual A and the hare. The difference between the tooth and the bone values of individual B is with 0.005 less pronounced than in E, but might hint to a non-local provenance, too.

We compared the obtained  $^{87/86}$ Sr values to the baseline map of continental France (9). The site of Bréviandes is located in the Paris Basin that is characterized by a rather homogenous geology (Figure S7) (9). The site itself is located on an ancient terrace of the river Seine and the substrate is a relatively thin silt cover, probably of Weichselian origin, which is eroded and remodeled at the site. The isotope values of this location are in the range of 0.7076-0.7090, in agreement with the values obtained from the analysis of the human and faunal individuals of the site.



**Figure S7: Surface geological map of France** (BRGM: Geoscience for a sustainable earth; https://www.brgm.fr/en/news/news/open-science-free-access-brgm-digital-geological-maps) with sample sites from the IRHUM dataset marked as black dots (9). The site of Bréviandes (ZAC St Martin 1) is indicated as white star.

### Conclusion

The <sup>87/86</sup>Sr values obtained in the present study suggest that the life-time mobility of individuals E and B of BRE445 could have comprised an area that goes beyond the Paris Basin. These two individuals, especially individual E, may have spent their childhood either in the north or northeast of France, or in the east/southeast (Rhône valley) of France before arriving in the Paris Basin and Bréviandes.
## **Additional Supplementary Figures**



Figure S8. Calibrated (IntCal20; (1)) radiocarbon dating profile of individuals of interest for this study.



Figure S9. Runs of Homozygosity (ROH) values for blocks longer than 4 cM of Late Neolithic individuals in France



Figure S10. Three dimensional PC1-PC2-PC3 plots from different angles for the same dataset shown in Fig. 2A.



Figure S11. PC1-PC2 plots based on ChromoPainter autosomal coancestry matrix for datasets including different members of related Bréviandes individuals. Plot A is used in the Figure 2A.



Figure S12. The schematic representation of building the pseudo-diploid genome for unsampled father of BRE445FK individual.



Figure S13. fineSTRUCTURE dendrograms based on ChromoPainter autosomal coancestry matrix for datasets including different members of related Bréviandes individuals. The four clusters highlighted (top) are used in the Figure 2B.



Figure S14. PC3-PC4 plots based on autosomal ChromoPainter coancestry matrix for datasets including different members of related Bréviandes individuals.



**Figure S15. Same PC3-PC4 plots shown in the Figure S14 highlighting geographical locations of Late Neolithic and Bronze Age individuals.** Plot A is used in the Figure 2C.



Figure S16. PC3-PC4 plots based on ChromoPainter X-chromosome coancestry matrix. A. The plot identifying the genomes used. B. The plot showing the autosomal steppe ancestry proportions (color gradient). The smaller red circles correspond to Neolithic individuals without any steppe ancestry.



Figure S17. PC1-PC2 plots based on ChromoPainter X-chromosome coancestry matrix. A. The plot identifying the genomes used. B. The plot showing the autosomal steppe ancestry proportions (color gradient) and the sex of the individuals. European Neolithic individuals without steppe ancestry are shown as smaller triangles. Ancestral groups that are used to infer the ancestry proportion (HG, ANF, Yamnaya) are shown as empty triangles.

Although the X-chromosome PCA shows that the genetic heterogeneity of the source population on the X-chromosome is higher than on the autosomes (compared with Fig. 2A), there is a global correlation as revealed by a red-to-green gradient from right (steppe-ancestry side) to left (HG/ANF ancestry side). Some individuals with relatively high steppe-ancestry on the autosomes (green to yellow) have a higher Neolithic ancestry on the X-chromosome as shown by their position on the left of the PCA plot.

Sample ID	Location	Country	Latitude	Longitude	Radiocarbon Dates	Sex	MtDNA hg	Y hg	Sampled material	Esimated age of death	Coverage (X)	Contamination Xchr	Contamination MtDN
Bre445A	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095 E	-	F	K1b1a1		petrous	20-39	0,75	-	Not Detected
Bre445B	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095 E	2580-2275 calBCE (98,9%) 3940 + 40 BP (GrN-31284)	F	T2c1e		petrous	20-39	0,77	-	Not Detected
Bre445C	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095 E	-	F	V (HV0a)		petrous	6-10	0,95	-	Not Detected
Bre445D	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095 E	-	F	T2c1e		petrous	Neonate	0,96	-	Not Detected
Bre445E	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095 E	2706 - 2287 calBCE (96.9%) 4000 + 50 BP (GrN-31285)	F	U5b		petrous	>60	1,1	-	Not Detected
Bre445FK	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095E	2567 - 2339 cal BCE (95.4%) 3945 ± 35 BP (Ua-69965 )	Μ	USb	R1b1a1b1a1a	petrous	20-39	4,6	0,006305	Not Detected
Bre445HI	les Pointes et les Grèvottes, Bréviandes, Aube	France	48.256N	4.095 E	-	м	K1b1a1	R1b1a1b1a1a	petrous	4-8	1,2	0,010296	Not Detected
SMGB54	Saint-Martin-la-Garenne, Yvelines, Île-de-France	France	49.040N	1.689E	2339-2139 cal BCE (4189 calBP beta)	Μ	T2b3+151	R1b1a1b1a1a	petrous	30-49	2,3	0,003613	Not Detected

## Table S1. Summary of arhcaeologial and genetic information on individuals from the newly reported data

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Ind1	Ind2	nSites	9	k0	k1	k2	nSites	θ	k0
BRE445B	BRE445D	720361	0,24	0,11	0,83	0,06	523883	0,26	0,00
BRE445E	BRE445FK	1541359	0,23	0,10	0,90	0,01	523883	0,25	0,00
BRE445FK	BRE445HI	1723629	0,23	0,09	0,90	0,01	523883	0,26	0,00
BRE445A	BRE445HI	804074	0,22	0,17	0,77	0,06	523883	0,25	0,00
BRE445E	BRE445HI	1013374	0,12	0,61	0,32	0,07	523883	0,14	0,43

Kin-relationship	Autosomal $\theta$	chrX $\theta$	k o	k ı	k 2
Mother-son	0,25	0,5	0	1	0
Father-daughter	0,25	0,5	0	1	0
Father-son	0,25	0	0	1	0
Sisters	0,25	0,375	0,25	0,5	0,25
Brothers	0,25	0,5	0,25	0,5	0,25
Brother-sister	0.25	0.25	0.25	0.5	0.25

Table S2 (Yaka et al., Variable kinship patterns in Neolithic Anatolia revealed by ancient genomes, Current Biology (2021), https://doi.o

0000000         0001	Table S3-2.Fu POS	nctional variation - dbSNP ID rs11547464	for the positions REF G	ALT	Gene	GT (imputed) 6	SFK SP (imputed) 6 1999 0 001 0	BR GT (imputed)	E445HI GP (imputed)	SM GT (imputed)	1GB54 GP (imputed)	B GT (imputed)	RE445A GP (imputed)		B GT (imputed)	BRE445B GT (imputed) GP (imputed) 0/0 100	BRE445B B GT (imputed) GT (imputed) 0/0 100 0/0	BRE445B         BRE445C           GT (imputed)         GP (imputed)         GT (imputed)           0/0         1.0.0         0/0         0.999.0.01.0	BRE4456 BRE445C B GT (imputed) GT (imputed)	BRE445B         BRE445C         BRE445C         BRE445C           [T (imputed]         GP (imputed)         GP (imputed)         GP (imputed)         GP (imputed)           [0] 0/0         0/0         0/0         10.0         0.0	BRE45B         BRE45C         BRE45D         E           GT (imputed)         GP (imputed)         GT (imputed)
00         0000         000         000         0000         000         0000         000         0000         000         000         0000         000	POS	dbSNP ID	REF	ALT	Gene	GT (imputed) G	SP (imputed)	ST (imputed)	GP (imputed)	GT (imputed)	GP (imputed)	GT (imputed)	GP (imputed)	GT (imputed)	GP (imputed)	GT (imputed)	GP (in	puted)	iputed) GT (imputed)	10010 GT (imputed) GP (imputed)	puted) GT (imputed) GP (imputed) GT (imputed)
00         0000         000         001         000 <td>89986154</td> <td>rs885479</td> <td><u>م</u> ،</td> <td>₽ 3</td> <td>MC1R</td> <td>0/0</td> <td>1,0,0</td> <td>0/0</td> <td>1,0,0</td> <td>0/0</td> <td>1,0,0</td> <td>0/0</td> <td>0.983,0.017,0</td> <td>0/0</td> <td>1,0,0</td> <td>0/0</td> <td>6:0</td> <td>98,0.002,0</td> <td>98,0.002,0 0/0</td> <td>98,0.002,0 0/0 0.993,0.007,0</td> <td>98,0.002,0 0/0 0.993,0.007,0 0/0</td>	89986154	rs885479	<u>م</u> ،	₽ 3	MC1R	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.983,0.017,0	0/0	1,0,0	0/0	6:0	98,0.002,0	98,0.002,0 0/0	98,0.002,0 0/0 0.993,0.007,0	98,0.002,0 0/0 0.993,0.007,0 0/0
00         08000960         0.0         0.00 <t< td=""><td>89986144</td><td>rs1805008</td><td>c</td><td>٦</td><td>MC1R</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>0.996,0.004,0</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>0.999,0.001,0</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>0.0</td><td>999,0.001,0</td><td>999,0.001,0 0/0</td><td>999,0.001,0 0/0 1,0,0</td><td>999,0.001,0 0/0 1,0,0 0/0</td></t<>	89986144	rs1805008	c	٦	MC1R	0/0	1,0,0	0/0	0.996,0.004,0	0/0	1,0,0	0/0	0.999,0.001,0	0/0	1,0,0	0/0	0.0	999,0.001,0	999,0.001,0 0/0	999,0.001,0 0/0 1,0,0	999,0.001,0 0/0 1,0,0 0/0
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00         0000966         000         0001         001         001         010	89985918	rs1805006	c	A	MC1R	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 1,0,0	1,0,0 0/0 1,0,0 0/0
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000         000 <td>33951693</td> <td>rs16891982</td> <td>c</td> <td>۵</td> <td>SLC45A2</td> <td>1/1</td> <td>0,0,1</td> <td>0/1</td> <td>0,1,0</td> <td>1/1</td> <td>0,0,1</td> <td>0/1</td> <td>0,1,0</td> <td>0/0</td> <td>0.931,0.069,0</td> <td>0/1</td> <td></td> <td>0,1,0</td> <td>0,1,0 0/1</td> <td>0,1,0 0/1 0,1,0</td> <td>0,1,0 0/1 0,1,0 1/1</td>	33951693	rs16891982	c	۵	SLC45A2	1/1	0,0,1	0/1	0,1,0	1/1	0,0,1	0/1	0,1,0	0/0	0.931,0.069,0	0/1		0,1,0	0,1,0 0/1	0,1,0 0/1 0,1,0	0,1,0 0/1 0,1,0 1/1
000         00010         000         0010	89328335	rs12821256	٦	c	KITLG	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.989,0.011,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 0.901,0.099,0	1,0,0 0/0 0.901,0.099,0 0/0
38331         8130825         C         I         IC         0 <t< td=""><td>457748</td><td>rs4959270</td><td>c</td><td>A</td><td>EXOC2</td><td>1/1</td><td>0,0,1</td><td>1/1</td><td>0,0,1</td><td>0/1</td><td>0,1,0</td><td>1/1</td><td>0,0,1</td><td>0/1</td><td>0,0.994,0.006</td><td>1/1</td><td></td><td>0,0.02,0.98</td><td>0,0.02,0.98 0/0</td><td>0,0.02,0.98 0/0 1,0,0</td><td>0,0.02,0.98 0/0 1,0,0 0/1</td></t<>	457748	rs4959270	c	A	EXOC2	1/1	0,0,1	1/1	0,0,1	0/1	0,1,0	1/1	0,0,1	0/1	0,0.994,0.006	1/1		0,0.02,0.98	0,0.02,0.98 0/0	0,0.02,0.98 0/0 1,0,0	0,0.02,0.98 0/0 1,0,0 0/1
SB31136         K104002         C         I         CC         I <thi< th="">         I         I         &lt;</thi<>	396321	rs12203592	c	٦	IRF4	0/0	1,0,0	0/0	0.981,0.019,0	0/0	0.992,0.008,0	0/0	0.865,0.133,0.002	0/1	0.081,0.749,0.17	0/0		0.589,0.396,0.015	0.589,0.396,0.015 0/1	0.589,0.396,0.015 0/1 0.032,0.968,0	0.589,0.396,0.015 0/1 0.032,0.968,0 0/0
STAND         C         I         CCCA         QI         DID         DID <thdid< th=""> <thdid< th=""> <thdid< th=""></thdid<></thdid<></thdid<>	88911696	rs1042602	c	A	TYR	0/0	1,0,0	0/1	0.001,0.999,0	0/1	0.001,0.999,0	0/1	0.004, 0.529, 0.467	0/0	0.993,0.007,0	0/1		0.004,0.996,0	0.004,0.996,0 0/0	0.004,0.996,0 0/0 1,0,0	0.004,0.996,0 0/0 1,0,0 0/0
380103         rs240133  <	28230318	rs1800407	c	-	OCA2	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.981,0.019,0	0/0	1,0,0	0/0	_	1,0,0	1,0,0 0/0	1,0,0 0/0 0.9,0.1,0	1,0,0 0/0 0.9,0.1,0 0/0
S235651         s1219382         A         G         HERC         Q1	92801203	rs2402130	G	A	SLC24A4	0/1	0,1,0	0/1	0,1,0	0/0	1,0,0	1/1	0,0,1	0/1	0,1,0	0/1	_	0,1,0	0,1,0 0/1	0,1,0 0/1 0,1,0	0,1,0 0/1 0,1,0 0/1
3218090         cd         ASP         Q         L         Q         L         Q         L         Q	28365618	rs12913832	A	G	HERC2	0/1	0,1,0	0/1	0,1,0	0/0	0.98,0.02,0	0/0	0.939,0.06,0	0/0	0.922,0.078,0	0/1	_	0.132,0.868,0	0.132,0.868,0 0/0	0.132,0.868,0 0/0 0.957,0.043,0	0.132,0.868,0 0/0 0.957,0.043,0 0/1
Section         Sitzed	33218090	rs2378249	G	Þ	ASIP	1/1	0,0,1	1/1	0,0,1	0/1	0,1,0	1/1	0,0,1	1/1	0,0,1	1/1		0,0,1	0,0,1 1/1	0,0,1 1/1 0,0,1	0,0,1 1/1 0,0,1 1/1
Montane         Montane <t< td=""><td>92773663</td><td>rs12896399</td><td>G</td><td>Ŧ</td><td>SLC24A4</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>0.999,0.001,0</td><td>0/0</td><td>1,0,0</td><td>0/1</td><td></td><td>0,1,0</td><td>0,1,0 0/0</td><td>0,1,0 0/0 1,0,0</td><td>0,1,0 0/0 1,0,0 0/0</td></t<>	92773663	rs12896399	G	Ŧ	SLC24A4	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.999,0.001,0	0/0	1,0,0	0/1		0,1,0	0,1,0 0/0	0,1,0 0/0 1,0,0	0,1,0 0/0 1,0,0 0/0
JY0980         rs683         C         A         rynel (1)         Qu         LO         LO         LO         LO         Qu         LO         Qu         LO         Qu	89011046	rs1393350	G	A	TYR	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.999,0.001,0	0/1	0.053,0.947,0	0/0		0.999,0.001,0	0.999,0.001,0 1/1	0.999,0.001,0 1/1 0,0.141,0.858	0.999,0.001,0 1/1 0,0.141,0.858 0/0
B3832.2         cs11408         I         C         OKN         O         I         O         O         I         O <tho< th="">         O         O</tho<>	12709305	rs 683	c	A	TYRP1	0/0	1,0,0	0/0	1,0,0	0/1	0,1,0	0/1	0,0.999,0.001	0/1	0,1,0	0/0		1,0,0	1,0,0 0/1	1,0,0 0/1 0,1,0	1,0,0 0/1 0,1,0 0/1
Statana         Listona         Listona <t< td=""><td>89383725</td><td>rs3114908</td><td>٦</td><td>c</td><td>ANKRD11</td><td>1/1</td><td>0,0,1</td><td>1/1</td><td>0.004, 0.408, 0.589</td><td>1/1</td><td>0,0.001,0.999</td><td>0/1</td><td>0.002,0.989,0.009</td><td>0/0</td><td>0.993,0.007,0</td><td>1/1</td><td></td><td>0,0,1</td><td>0,0,1 0/1</td><td>0,0,1 0/1 0.061,0.932,0.006</td><td>0,0,1 0/1 0.061,0.932,0.006 1/1</td></t<>	89383725	rs3114908	٦	c	ANKRD11	1/1	0,0,1	1/1	0.004, 0.408, 0.589	1/1	0,0.001,0.999	0/1	0.002,0.989,0.009	0/0	0.993,0.007,0	1/1		0,0,1	0,0,1 0/1	0,0,1 0/1 0.061,0.932,0.006	0,0,1 0/1 0.061,0.932,0.006 1/1
1688884         rs10758819         A         G         1682         0/1 <th< td=""><td>28197037</td><td>rs1800414</td><td>٦</td><td>c</td><td>OCA2</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>1,0,0</td><td>0/0</td><td>0.996,0.004,0</td><td>0/0</td><td>0.997,0.003,0</td><td>0/0</td><td></td><td>1,0,0</td><td>1,0,0 0/0</td><td>1,0,0 0/0 0.922,0.078,0</td><td>1,0,0 0/0 0.922,0.078,0 0/0</td></th<>	28197037	rs1800414	٦	c	OCA2	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.996,0.004,0	0/0	0.997,0.003,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 0.922,0.078,0	1,0,0 0/0 0.922,0.078,0 0/0
Statestic         Statestic <t< td=""><td>16858084</td><td>rs10756819</td><td>G</td><td>A</td><td>BNC2</td><td>0/0</td><td>1,0,0</td><td>0/1</td><td>0,1,0</td><td>1/1</td><td>0,0,1</td><td>0/1</td><td>0.003,0.997,0</td><td>0/1</td><td>0.002,0.994,0.005</td><td>0/0</td><td></td><td>1,0,0</td><td>1,0,0 0/1</td><td>1,0,0 0/1 0.004,0.996,0</td><td>1,0,0 0/1 0.004,0.996,0 0/1</td></t<>	16858084	rs10756819	G	A	BNC2	0/0	1,0,0	0/1	0,1,0	1/1	0,0,1	0/1	0.003,0.997,0	0/1	0.002,0.994,0.005	0/0		1,0,0	1,0,0 0/1	1,0,0 0/1 0.004,0.996,0	1,0,0 0/1 0.004,0.996,0 0/1
SMB 282 bit 129038         C         T         HRC2 bit 1         Q1         Q	28453215	rs2238289	A	G	HERC2	0/1	0,1,0	0/0	1,0,0	0/1	0,1,0	0/0	0.752,0.247,0.001	0/0	0.999,0.001,0	0/1		0,1,0	0,1,0 0/0	0,1,0 0/0 0.998,0.002,0	0,1,0 0/0 0.998,0.002,0 0/1
Standslip         cs496135         cs406135         cs405135	92882826	rs17128291	Þ	G	SLC24A4	0/0	1,0,0	0/1	0,1,0	0/1	0,1,0	0/1	0,1,0	0/0	1,0,0	1/1		0,0.208,0.792	0,0.208,0.792 0/0	0,0.208,0.792 0/0 1,0,0	0,0.208,0.792 0/0 1,0,0 0/0
2355655         c1         HERZ         0/1	28496195	rs6497292	A	G	HERC2	0/1	0,1,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/1		0,1,0	0,1,0 0/0	0,1,0 0/0 1,0,0	0,1,0 0/0 1,0,0 0/1
S25308.2         csisters	28356859	rs1129038	c	٦	HERC2	0/1	0,1,0	0/1	0,0.985,0.015	0/0	0.982,0.018,0	0/0	0.938,0.062,0	0/0	0.92,0.08,0	0/1		0.059,0.941,0	0.059,0.941,0 0/0	0.059,0.941,0 0/0 0.94,0.059,0.001	0.059,0.941,0 0/0 0.94,0.059,0.001 0/1
S801781         rs178680         G         A         OC         100         0/1         0.10         0/1         0.00,03950         0/1	28530182	rs1667394	c	٦	HERC2	0/1	0,1,0	1/1	0,0.01,0.99	0/1	0,0.997,0.003	1/1	0.007,0.399,0.594	0/1	0.027,0.973,0	0/1		0.047,0.949,0.003	0.047,0.949,0.003 0/1	0.047,0.949,0.003 0/1 0.002,0.994,0.004	0.047,0.949,0.003 0/1 0.002,0.994,0.004 0/1
S2288121         rs4149668         G         I         O(0         1.0.0         O(1         O.1.0         O(1         O.0.1         O(1         O.1.0	89017961	rs1126809	G	A	TYR	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/1	0.001,0.999,0	0/1	0.044,0.956,0	0/0		1,0,0	1,0,0 1/1	1,0,0 1/1 0,0.141,0.858	1,0,0 1/1 0,0.141,0.858 0/0
Watches         A         G         SizeAsc         O(0         1,00	28288121	rs1470608	G	٦	OCA2	0/0	1,0,0	0/1	0,1,0	0/1	0,1,0	0/1	0,0.97,0.029	0/0	1,0,0	0/1		0,1,0	0,1,0 0/1	0,1,0 0/1 0,1,0	0,1,0 0/1 0,1,0 0/0
3785212         rs13971         C         G         AIP         Q/Q         1.00         Q/Q         1.00         Q/Q         0.00         3.00         0.00           23785212         rs13971         C         G         AIP         Q/Q         1.00         Q/Q         1.00         Q/Q         0.00         0.01         1.1         0.01         0.01         1.01         0.01         0.01         1.01         0.01         0.01         1.01         0.01         1.01         0.01         1.01         0.01         1.01         0.01         0.01         1.01         0.01         1.01         0.01         0.01         1.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01	48426484	rs1426654	A	G	SLC24A5	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	0.999,0.001,0	0/0		0.998,0.002,0	0.998,0.002,0 0/0	0.998,0.002,0 0/0 0.999,0.001,0	0.998,0.002,0 0/0 0.999,0.001,0 0/0
2187772         rs1241727         G         A         T         OCA2         0/1         0.001         0/1         0.01         0/0         0.00         0.	32785212	rs6119471	c	G	ASIP	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 1,0,0	1,0,0 0/0 1,0,0 0/0
32657148         res059655         A         G         RAY         1/1         0,025,0975         1/1         0,01         0/0         0/0         0/0         0/0         0/0         0/0         0/0	28187772	rs1545397	Þ	٦	OCA2	0/1 0	,0.991,0.009	0/0	0.999,0.001,0	0/0	1,0,0	0/0	0.768,0.217,0.015	0/0	0.959,0.041,0	0/0		0.998,0.002,0	0.998,0.002,0 0/0	0.998,0.002,0 0/0 0.561,0.439,0	0.998,0.002,0 0/0 0.561,0.439,0 0/1
32212175         Initial and Initi	32665748	rs6059655	A	G	RALY	1/1 0.	,0.025,0.975	1/1	0,0,1	1/1	0,0,1	1/1	0,0,1	1/1	0,0,1	1/1		0,0,1	0,0,1 1/1	0,0,1 1/1 0,0,1	0,0,1 1/1 0,0,1 1/1
89984378         rs3212355         C         T         MC1R         Q/0         1,0,0         Q/0         <	28271775	rs12441727	a	A	OCA2	0/0	1,0,0	0/1	0,1,0	0/1	0,1,0	0/1	0.012,0.988,0	0/0	1,0,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 1,0,0	1,0,0 0/0 1,0,0 0/0
90024206 rs8051733 A G DEF8 01 010 010 011 010 010 000 100 0530.047,0 0/0 0588.002,0 0/0	89984378	rs3212355	c	٦	MC1R	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0	1,0,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 0.998,0.002,0	1,0,0 0/0 0.998,0.002,0 0/0
	90024206	rs8051733	A	G	DEF8	0/1	0,1,0	0/1	0,1,0	0/0	1.0,0	0/0	0.953.0,047.0	0/N	0.998.0.002,0	0/0		1,0,0	1,0,0 0/0	1,0,0 0/0 1,0,0	1,0,0 0/0 1,0,0 0/0

Table S3-1. Phenotypic inference with the HIrisPlex-S system
PBlueEye PlatermediateEye PBrownEye BRE445FI 2% 8% all PBrown l og PRedHai 8 PBlackHair 72% PLightHa 14% 219 21% PDarkHair %66 79% 86% PVeryPa Skin 10% ₽ 46 30% 49%

Sample ID	Group label	HG	ANF	Yamnava
Bre445A	ER N 2500 2000 Bre	0 244	0.756	0
Bre445C	FR N 2500 2000 Bre	0.259	0,730	0
Bre445D	FR_N 2500 2000 Bre	0,217	0,783	0
Bre445E	FR_N_2500_2000_Bre	0,308	0,692	0
Bre445FK	FR_N_2500_2000_Bre	0,195	0,453	0,352
Bre445HI	FR_N_2500_2000_Bre	0,223	0,645	0,131
Bre445YY	FR_N_2500_2000_Bre	0,079	0,261	0,660
SMGB54	FR_N_2500_2000_BBC	0,158	0,484	0,358
OBE3626-1	FR_E_2200_1700_EBA	0,117	0,276	0,607
ROS45	FR_E_4700_4200_PF	0,121	0,879	0
RUS78	FR_E_4700_4200_PF	0,104	0,896	0
BERG02-2	FR_E_3800_3400_WK_WZ	0,155	0,805	0
BERG157-2	ER E 4250 3800 BORS MK	0,155	0,846	0
BERG157-7	FR E 4250 3800 BORS MK	0,191	0.809	0
Sch72-15	FR E 5300 5000 LBK	0.021	0.979	0
PSS4170	FR N 2200 1700 EBA	0,231	0,512	0,257
CBV95	FR_N_2500_2000_BBC	0,128	0,193	0,679
1H13	FR_N_3400_2900_MSOM	0,251	0,749	0
2H07	FR_N_3400_2900_MSOM	0,192	0,808	0
2H11	FR_N_3400_2900_MSOM	0,184	0,816	0
2H10	FR_N_3400_2900_MSOM	0,562	0,438	0
PSS4693	FR_N_3600_3400_PostMK	0,135	0,865	0
BUCH2	FR_N_4700_4300_C_EpiR	0,148	0,852	0
GBVPO	FR_S_1700_1200_MBA	0,135	0,557	0,308
TORTE	FR_S_2200_1700_EBA	0,140	0,524	0,335
GBVPK	FK_S_2500_2000_BBC	0,222	0,404	0,374
ROUOF	FR_S_3400_2400_LNVe	0,194	0,806	0
ROUGE	FR S 3/00 2/00 LNVA	0,109	0,011	0
ROUOH	FR S 3400 2400 LNVe	0,211	0,769	0
ROUOV	FR S 3400 2400 INVA	0,189	0,811	0
ROUOW	FR S 3400 2400 LNVe	0,237	0,763	0 0
TORTE	FR S 3400 2400 LNVe	0.219	0.781	0
CRE20D	FR S 4350 4000 CH	0,139	0,861	0
esp005	ES 2000 1200 BA	0,206	0,636	0,158
ALM017	ES_2000_1200_BA	0,179	0,700	0,122
ALM041	ES_2000_1200_BA	0,173	0,740	0,087
ALM050	ES_2000_1200_BA	0,254	0,607	0,139
CBR004	ES_2000_1200_BA	0,198	0,715	0,087
ATP16	ES_3200_2500_CA	0,121	0,879	0
ATP2	ES_3200_2500_CA	0,188	0,812	0
15838	ES_3200_2500_CA	0,193	0,807	0
11838	ES_3200_2500_CA	0,215	0,785	0
TV32032	PT_1800_1400_MBA	0,187	0,724	0,089
103631	PT_1800_1400_IVIBA	0,182	0,030	0,103
MG104	PT_1800_1400_MBA	0,223	0,072	0,103
RM127	IF Bathlin 2000 1500 FBA	0,217	0,034	0,050
RSK1	IE Rathlin 2000 1500 EBA	0.075	0.335	0,589
14071	NL 1800 1600 BA	0,146	0,319	0,535
15748	NL 2500 2000 BBC	0,099	0,246	0,655
14073	NL_2500_2000_BBC	0,123	0,252	0,626
14075	NL_2500_2000_BBC	0,152	0,245	0,603
12520	BG_3300_3000_EBA	0,139	0,691	0,171
17286	CZ_2500_2000_BBC	0,227	0,284	0,489
17278	CZ_2500_2000_BBC	0,089	0,415	0,496
17212	CZ_2500_2000_BBC	0,144	0,421	0,434
17211	CZ_2500_2000_BBC	0,104	0,314	0,582
14889	CZ_2500_2000_BBC	0,064	0,417	0,519
14000	CZ_2300_2000_BBC	0,063	0,401	0,450
17289	CZ 2500_2000_BBC	0 127	0 387	0.486
15835	DE 2500 2000 BBC	0.194	0.453	0.353
17574	GB_1400_800_BA	0,120	0,207	0,673
13130	GB_1400_800_BA	0,148	0,320	0,531
12859	GB_1400_800_BA	0,129	0,335	0,535
13255	GB_2500_2000_BBC	0,096	0,254	0,650
12445	GB_2500_2000_BBC	0,185	0,317	0,497
13132	GB_S_2100_1800_EBA	0,065	0,383	0,552
JAG78	HK_1800_1600_MBA	0,196	0,473	0,331
JAG85	HK_1800_1600_MBA	0,1/8	0,494	0,328
горзя	HIL 2000 1200 BA	0,055	0,522	0,423
BISE 170	HU 2000 1200 BA	0,137	0,360	0,203
17045	HU 2500 2000 BR	0 1 2 1	0,452	0,271
R5	IT 3500 2500 CA	0,124	0,876	0
R1014	IT_3500 2500 CA	0,140	0,860	0
R24	IT_3500_2500 CA	0,145	0,855	0
R4	IT_3500_2500_CA	0,067	0,933	0
13123	IT_Sic_2200_2000_EBA	0,076	0,724	0,200
N45	PO_2500_2300_CWC	0,119	0,209	0,672
N47	PO_2500_2300_CWC	0,225	0,375	0,400
Koszyce_3_10	PO_3000_2800_GAC	0,236	0,764	0
Koszyce_3_12	PO_3000_2800_GAC	0,203	0,797	0
Koszyce_3_1	PO_3000_2800_GAC	0,264	0,736	0
Koszyce_3_8	PO_3000_2800_GAC	0,270	0,730	0
N20	PO_3700_3400_TRB	0,211	0,789	0
N18	PO_3/00_3400_TRB	0,214	0,786	0
N25	PO_4400_4000_BKG	0,127	0,8/3	U
INZ/	FU_4400_4000_BKG	0,127	0,0/3	U U

| Table S5. Si   
   | ummary of previously pusblished   
   
  | individual:  
   | used in the s   
  | shotgun dataset  |  |  
   
   |   |   
   |   |   |  |  
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---|---|---|--
---|
| Sample ID  
   | Group label (in this study)   
   
  | tCal 20 (95  
   | 4tCal 20 (95.4  
  | Radiocarbon Date (BP)  | Radiocarbon Date (±)   | Group label (published)  
   
   | Source  | Location  
   | Country   | Sex   | MtDNA hg   | Y hg   
  |
| CBV95<br>PEI2  
   | FR_N_2500_2000_BBC  
   
  | 2575   
   | 2350  
  | 3970   | 30   | France_Bell_Beaker   
   
   | BruneIPNAS2020<br>BruneIPNAS2020  | La Bouche-a-Vesle, Liry_Salsogne  
   | France  | F   | J2a1a1<br>H1   | Kibiaiaz   
  |
| OBE3626-1  
   | FR E 2200 1700 EBA  
   
  | 1930   
   | 1701  
  | 3505   | 35   | France Bronze Age  
   
   | BrunelPNAS2020<br>BrunelPNAS2020  | Obernai   
   | France  | M   | R1b  | R1b1a1b1   
  |
| PSS4170  
   | FR_N_2200_1700_EBA  
   
  | 2197   
   | 1975  
  | 3690   | 30   | France_Bronze_Age  
   
   | BrunelPNAS2020  | Pont-sur-Seine  
   | France  | М   | H25  | R1b1a1b1   
  |
| PSS4693  
   | FR_N_3600_3400_PostMK   
   
  | 3605   
   | 3349  
  | 4650   | 45   | France_Neolithic   
   
   | BrunelPNAS2020  | Pont-sur-Seine  
   | France  | F   | U5b3b  |  
  |
| CRE20D<br>BERG02-2   
   | FR_5_4350_4000_CH   
   
  | 4350   
   | 4000  
  | 5135   | 35   | France_Neolithic   
   
   | BruneIPNAS2020<br>BruneIPNAS2020  | Le Cres, Beziers<br>Saulager, Bergheim  
   | France  | F   | H-16291<br>W5b   |  
  |
| BERG157-2  
   | FR_E_4250_3800_BORS_MK  
   
  | 4300   
   | 3900  
  | 5135   | 33   | France_Neolithic   
   
   | BrunelPNAS2020  | Saulager, Bergheim  
   | France  | F   | J1c1b  |  
  |
| BERG157-7  
   | FR_E_4250_3800_BORS_MK  
   
  | 4319   
   | 4050  
  | 5335   | 35   | France_Neolithic   
   
   | BrunelPNAS2020  | Saulager, Bergheim  
   | France  | М   | U5b1c  | I2a1a2   
  |
| BUCH2  
   | FR_N_4700_4300_C_EpiR   
   
  | 4700   
   | 4300  
  | 5000   |  | France_Neolithic   
   
   | BrunelPNAS2020  | Buchères  
   | France  | M   | U5b1-16189   | H2a1   
  |
| ROS45<br>ROS78   
   | FR_E_4700_4200_PF   
   
  | 4789   
   | 4607  
  | 5833   | 29   | France_Neolithic   
   
   | BruneIPNAS2020<br>BruneIPNAS2020  | Rosheim "Mittelfeld" "Rosenmeer"  
   | France  | M   | H5u<br>U8b1b1  | 123132   
  |
| WET370   
   | FR_E_3800_3400_MK_MZ  
   
  | 3800   
   | 3400  
  |  |  | France_Neolithic   
   
   | BrunelPNAS2020  | Wettolsheim   
   | France  | M   | H1c5a'   | H2   
  |
| Sch72-15   
   | FR_E_5300_5000_LBK  
   
  | 5466   
   | 5215  
  | 6340   | 40   | France_Early_Neolithic   
   
   | BrunelPNAS2020  | Schwindratzheim   
   | France  | м   | T2f  | C1a2   
  |
| 1H13   
   | FR_N_3400_2900_MSOM   
   
  | 3092   
   | 2921  
  | 4395   | 20   | France_Mont_Aime   
   
   | Seguin-OrlandoPNAS2021  | Mont-Aimé hypogée I   
   | France  | M   | Kla4a1   | I2a1b1b1   
  |
| 2HU7<br>2H11   
   | FR_N_3400_2900_MSOM   
   
  | 3351   
   | 3104  
  | 4540   | 20   | France_Mont_Aime   
   
   | Seguin-OrlandoPNAS2021  | Mont-Aimé hypogee II<br>Mont-Aimé hypogée II  
   | France  | M   | L1c1   | 12a1a1b1   
  |
| 2H10   
   | FR_N_3400_2900_MSOM   
   
  | 3341   
   | 3098  
  | 4495   | 20   | France_Mont_Aime   
   
   | Seguin-OrlandoPNAS2021  | Mont-Aimé hypogée II  
   | France  | M   | H3   | I2a1b1b1   
  |
| GBVPK  
   | FR_S_2500_2000_BBC  
   
  | 2461   
   | 2299  
  | 3890   | 15   | France_Basse_Vigne_Perdue  
   
   | Seguin-OrlandoPNAS2021  | Grotte Basse de la Vigne Perdue, les Monges   
   | France  | м   | J2b1a  | R1b1a1b1a1a2a1   
  |
| GBVPO  
   | FR_S_1700_1200_MBA  
   
  | 1737   
   | 1547  
  | 3360   | 15   | France_Basse_Vigne_Perdue  
   
   | Seguin-OrlandoPNAS2021  | Grotte Basse de la Vigne Perdue, les Monges   
   | France  | F   | U5b3   |  
  |
| ROUOF  
   | FR_S_3400_2400_LINVe  
   
  | 3321   
   | 2475  
  | 4015   | 15   | France_Basse_Vigne_Perdue  
   
   | Seguin-OrlandoPNAS2021<br>Seguin-OrlandoPNAS2021  | Grotte du Rouquet Moujan  
   | France  | F   | H1+152   |  
  |
| ROUQF  
   | FR_S_3400_2400_LNVe   
   
  | 3340   
   | 3096  
  | 4490   | 20   | France_Rouquet   
   
   | Seguin-OrlandoPNAS2021  | Grotte du Rouquet, Moujan   
   | France  | M   | V  | I2a1a2   
  |
| ROUQH  
   | FR_S_3400_2400_LNVe   
   
  | 3346   
   | 3101  
  | 4505   | 20   | France_Rouquet   
   
   | Seguin-OrlandoPNAS2021  | Grotte du Rouquet, Moujan   
   | France  | м   | U2e1c1   | I2a1b1b1   
  |
| ROUQV  
   | FR_S_3400_2400_LNVe   
   
  | 3354   
   | 3102  
  | 4515   | 15   | France_Rouquet   
   
   | Seguin-OrlandoPNAS2021  | Grotte du Rouquet, Moujan   
   | France  | F   | H3<br>¥2c1   | 1251b1b1   
  |
| TORTE  
   | FR S 2200 1700 EBA  
   
  | 2008   
   | 1825  
  | 3565   | 15   | France Tortues   
   
   | Seguin-OrlandoPNAS2021<br>Seguin-OrlandoPNAS2021  | Grotte des Tortues, les Monges  
   | France  | F   | H6a1a  | 12810101   
  |
| TORTE  
   | FR_S_3400_2400_LNVe   
   
  | 2839   
   | 2500  
  | 4080   | 15   | France_Tortues   
   
   | Seguin-OrlandoPNAS2021  | Grotte des Tortues, les Monges  
   | France  | F   | K1a2b  |  
  |
| 12520  
   | BG_3300_3000_EBA  
   
  | 3336   
   | 3029  
  | 4470   | 25   | Bulgaria_EBA   
   
   | MathiesonNature2018   | Veliko Tarnovo, Dzhulyunitsa  
   | Bulgaria  | M   | н  | Н  
  |
| 17286  
   | CZ_2500_2000_BBC  
   
  | 2403   
   | 2199  
  | 3830   | 20   | Czech_BellBeaker   
   
   | OlaldeNature2018  | Radosevice  
   | zech Republi  | M   | 14a  | R1b1a1b1a1a2b1<br>R1b1a1b1a1a2b1   
  |
| 17212  
   | CZ 2500 2000 BBC  
   
  | 2454   
   | 2201  
  | 3840   | 25   | Czech BellBeaker   
   
   | OlaldeNature2018  | Radosevice  
   | zech Republi  | M   | K1b1a1+199   | R1b1a1b1a1a2b1   
  |
| 17211  
   | CZ_2500_2000_BBC  
   
  | 2296   
   | 2143  
  | 3800   | 20   | Czech_BellBeaker   
   
   | OlaldeNature2018  | Radosevice  
   | zech Republi  | F   | U5b3   |  
  |
| 17045  
   | CZ_2500_2000_BBC  
   
  | 2440   
   | 2201  
  | 3835   | 20   | Hungary_EBA_BellBeaker   
   
   | OlaldeNature2018  | Szigetszentmiklós-Űdülősor  
   | Hungary   | F   | T2c1d+152  |  
  |
| 14889  
   | CZ_2500_2000_BBC  
   
  | 2284   
   | 2056  
  | 3765   | 20   | Czech_BellBeaker   
   
   | OlaideNature2018<br>OlaideNature2018  | Prague 8, Kobylisy, Ke Stirce Street<br>Prague 8, Kobylisy, Ke Stirce Street  
   | zech Republi<br>zech Republi  | M   | U4a<br>K1a2c   | R1b1a1b1a1a2<br>R1b1a1b1a1a2b1   
  |
| 17281  
   | CZ_2500_2000_BBC  
   
  | 2340   
   | 2146  
  | 3810   | 20   | Czech_BellBeaker   
   
   | OlaldeNature2018  | Prague 5 - Mala Ohrada  
   | zech Republi  | F   | H5a1g  |  
  |
| 17289  
   | CZ_2500_2000_BBC  
   
  | 2456   
   | 2209  
  | 3860   | 20   | Czech_BellBeaker   
   
   | OlaldeNature2018  | Radosevice  
   | zech Republi  | м   | U8b1b1   | R1b1a1b1a1a2b1   
  |
| 15835  
   | DE_2500_2000_BBC  
   
  | 2500   
   | 2000  
  | (24)   | 20   | Germany_BellBeaker   
   
   | OlaldeNature2018  | Irlbach LKR   
   | Germany   | M   | J1c<br>T2-1b   | R1b1a1b1a1a2b1   
  |
| eco005   
   | ES 2000 1200 BA   
   
  | 2000   
   | 1200  
  | 6240   | 30   | LBK_EN<br>Spain BA   
   
   | ValdioceraPNAS2018  | Cueva de los Lagos La Riola   
   | Snain   | M   | 12C10<br>K1a   | R1b-DE27   
  |
| ALM017   
   | ES_2000_1200_BA   
   
  | 1882   
   | 1698  
  | 3474   | 25   | Almoloya_Argar_Early   
   
   | Villalba-MoucoScienceAdvances2021   | La Almoloya, Pliego, Murcia   
   | Spain   | M   | T2b21  | R1b1a1b1a1a2a1   
  |
| ALM041   
   | ES_2000_1200_BA   
   
  | 1944   
   | 1774  
  | 3540   | 19   | Almoloya_Argar_Early   
   
   | Villalba-MoucoScienceAdvances2021   | La Almoloya, Pliego, Murcia   
   | Spain   | м   | H1e1a  | R1b1a1b1a1a2a1b  
  |
| ALM050   
   | ES_2000_1200_BA   
   
  | 2000   
   | 1750  
  | 2244   | 20   | Almoloya_Argar_Early   
   
   | Villalba-MoucoScienceAdvances2021   | La Almoloya, Pliego, Murcia   
   | Spain   | M   | H3   | R1b1a1b1a1a2a1   
  |
| ZAP002   
   | ES_2000_1200_BA   
   
  | 1750   
   | 1447  
  | 3244   | 20   | ZAP002   
   
   | Villalba-MoucoScienceAdvances2021<br>Villalba-MoucoScienceAdvances2021  | Lorca Murcia  
   | Spain   | M   | H5a  | R1b1a1b1a1a2a1   
  |
| ATP16  
   | ES_3200_2500_CA   
   
  | 3265   
   | 2913  
  | 4400   | 30   | C_Iberia_CA  
   
   | ValdioseraPNAS2018  | El Portalon Cave, Sierra de Atapuerca   
   | Spain   | F   | X2c  |  
  |
| ATP2   
   | ES_3200_2500_CA   
   
  | 2900   
   | 2675  
  | 4210   | 30   | C_Iberia_CA  
   
   | ValdioseraPNAS2018  | El Portalon Cave, Sierra de Atapuerca   
   | Spain   | м   | U5b3   | H2   
  |
| 15838  
   | ES_3200_2500_CA   
   
  | 2900   
   | 2300  
  | 1170   | 50   | Spain_C  
   
   | LipsonNature2017  | Burgos, Atapuerca, El Mirador Cave  
   | Spain   | M   | K1a+195  | I2a1b1b1a1~  
  |
| 17574  
   | GB 1400 800 BA  
   
  | 1408   
   | 1226  
  | 3055   | 30   | England MBA  
   
   | OlaldeNature2018  | England, Cambridgeshire, Trumpington, Clav Farm   
   | Great Britain   | F   | H1a3   |  
  |
| 13130  
   | GB_1400_800_BA  
   
  | 984  
   | 826   
  | 2758   | 29   | Scotland_LBA   
   
   | OlaldeNature2018  | Scotland, Covesea Caves   
   | Great Britain   | F   | U5a1c  |  
  |
| 12859  
   | GB_1400_800_BA  
   
  | 912  
   | 808   
  | 2714   | 29   | Scotland_LBA   
   
   | OlaldeNature2018  | Scotland, Covesea Caves   
   | Great Britain   | M   | K1a2c  | R1b1a1b1a1a2a  
  |
| 13255  
   | GB_2500_2000_BBC  
   
  | 2139   
   | 1947  
  | 3661   | 31   | England_BellBeaker   
   
   | OlaldeNature2018  | England, Cambridgesnire, Trumpington Meadows  
   | Great Britain   | F AA  | 12D<br>X2b6  | R1b1a1b1a1a2c1   
  |
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   |   | 101   |  |  
  |
| 13132  
   | GB_S_2100_1800_EBA  
   
  | 2126   
   | 1886  
  | 3614   | 33   | Scotland_C_EBA   
   
   | OlaldeNature2018  | Scotland, Covesea Cave 2  
   | Great Britain   | M   | T2a1b1a  | R1b1a1b1a1a2c1a5c  
  |
| 13132<br>JAG78   
   | GB_S_2100_1800_EBA<br>HR_1800_1600_MBA  
   
  | 2126<br>1800   
   | 1886  
  | 3614   | 33   | Scotland_C_EBA<br>Croatia_Jag_MBA  
   
   | OlaldeNature2018<br>FreilichScientificReports2021   | Scotland, Covesea Cave 2<br>Jagodnjak-Krcevine, Osijek,   
   | Great Britain<br>Croatia  | M   | T2a1b1a<br>T2b11   | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430  
  |
| I3132<br>JAG78<br>JAG85  
   | GB_S_2100_1800_EBA<br>HR_1800_1600_MBA<br>HR_1800_1600_MBA  
   
  | 2126<br>1800<br>1876   
   | 1505<br>1886<br>600<br>1687<br>2500   
  | 3614<br>3445   | 20   | Scotland_C_EBA<br>Croatia_Jag_MBA<br>Croatia_Jag_MBA   
   
   | OlaldeNature2018<br>FreilichScientificReports2021<br>FreilichScientificReports2021<br>EmilichScientificReports2021  | Scotland, Oxfordanie, ramon<br>Scotland, Oxfordanie, ramon<br>Jagodnjak-Krcevine, Osijek,<br>Jagodnjak-Krcevine, Osijek,<br>Reli Manartik Pengun zemila, Orijek   
   | Great Britain<br>Croatia<br>Croatia   | M<br>M<br>F   | T2a1b1a<br>T2b11<br>K2a  | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430  
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2  
   | GB_S_2100_1800_EBA<br>HR_1800_1600_MBA<br>HR_1800_1600_MBA<br>HR_2800_2500_CA<br>HI_2000_1200_BA  
   
  | 2126<br>1800<br>1876<br>2859<br>987  
   | 1305<br>1886<br>600<br>1687<br>2500<br>833  
  | 3614<br>3614<br>3445<br>4095<br>2769   | 20<br>28<br>24   | Scotland, C. EBA<br>Croatia_Jag_MBA<br>Croatia_Jag_MBA<br>Croatia_Pop_CA<br>Huneary_IBA  
   
   | FreilichScientificReports2021<br>FreilichScientificReports2021<br>FreilichScientificReports2021<br>FreilichScientificReports2021<br>GambaNatureCommunications2014   | Scotland, Covesa Cave 2<br>Jagodnjak-Krcevine, Osijek,<br>Jagodnjak-Krcevine, Osijek,<br>Beli Manastir-Popova zemlja, Osijek<br>Ludas-Variu-Dulo  
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary   | M<br>M<br>F<br>F  | T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a  | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430  
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479   
   | GB 5 2100 1800 EBA<br>HR_1800_1600_MBA<br>HR_1800_1600_MBA<br>HR_2800_2500_CA<br>HU_2000_1200_BA<br>HU_2000_1200_BA   
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000  
   | 1905<br>1886<br>600<br>1687<br>2500<br>833<br>1500  
  | 3/03<br>3614<br>3445<br>4095<br>2769   | 20<br>20<br>28<br>24   | Croatia_Jag_MBA<br>Croatia_Jag_MBA<br>Croatia_Jag_MBA<br>Croatia_Pop_CA<br>Hungary_LBA<br>Hungary_BA   
   
   | OlaldeNature2018<br>OlaldeNature2018<br>FreilichScientificReports2021<br>FreilichScientificReports2021<br>GambaNatureCommunications2014<br>AllentoftNature2015  | Lingenta, contrastine, randon<br>Scottand, Covesse Cave 2<br>Jagodnjak-Krcevine, Osijek,<br>Jagodnjak-Krcevine, Osijek,<br>Beli Manastir-Popova zemlja, Osijek<br>Ludas-Varju-Dulo<br>Erd   
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary  | M<br>M<br>F<br>F<br>M<br>M  | T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b   | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430<br>J2a1<br>J2a2  
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119  
   | GB 5 2100 1800 EBA<br>HR_1800_1600_MBA<br>HR_1800_1600_MBA<br>HR_2800_2500_CA<br>HU_2000_1200_BA<br>HU_2000_1200_BA<br>HU_3300_3000_LCA   
   
  | 2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330  
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013  
  | 3/03<br>3614<br>3445<br>4095<br>2769<br>4445   | 20<br>28<br>24<br>20<br>20   | Croatia_Jag_MBA<br>Croatia_Jag_MBA<br>Croatia_Jag_MBA<br>Croatia_POp_CA<br>Hungary_LBA<br>Hungary_LBA<br>Hungary_LateC_EBA_Baden_Yamnaya   
   
   | OlaideNature2018<br>FreilichScientificReports2021<br>FreilichScientificReports2021<br>FreilichScientificReports2021<br>GambaNatureCommunications2014<br>AllentoftNature2015<br>OlaideNature2018   | Sotolanik, Okolosnik, Janton<br>Sotolanik, Kreevine, Osijek,<br>Jagodnjak-Krcevine, Osijek,<br>Bell Manastir-Popova zemlja, Osijek<br>Ludas-Varju-Dulo<br>Erd<br>Mezőcsát-Hörcsögös   
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary   | M<br>M<br>F<br>F<br>M<br>M<br>F   | T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2   | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430<br>J2a1<br>i2a2a1a2a   
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119<br>RM127<br>PSK1   
   | GB 5,2100 1800 EBA<br>HR 1800 1600 MBA<br>HR 1800 1600 MBA<br>HR 2800 2500 CA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 300 3000 LCA<br>IE Rathlin 2000 1500 EBA  
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2035  
   | 1303<br>1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830  
  | 3705<br>3614<br>3445<br>4095<br>2769<br>4445<br>3591<br>3620   | 20<br>28<br>24<br>20<br>29<br>54   | Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia, Pop, CA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA   
   
   | Considervature2018<br>FeillichScientificReports2021<br>FreillichScientificReports2021<br>FreillichScientificReports2021<br>GambaNature2015<br>Olaidenature2015<br>Olaidenature2018<br>CassidyPNA52016   | Cingario, Okorosinie, Fantoni<br>Socialna, Covesa Cave 2<br>Jagodinjak-Kreevine, Osijek,<br>Beli Manastir-Popova zemlja, Osijek<br>Eda Vasa-Varju-Dala (Social Partice)<br>Erd<br>Mezőcát-Hörcsögös<br>Rathlin Island, County Antrim<br>Beyblin Libad, County Antrim  
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Ireland  | M<br>M<br>F<br>F<br>M<br>F<br>M<br>F<br>M   | T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e  | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430<br>J2a1<br>i2a2a1a2a<br>R1b1a1a2a1a2c1g<br>B1b1a1a2a1a2c1  
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119<br>RM127<br>RSK1<br>R5   
   | GB \$ 2100 1800 EBA<br>HR 1800 1600 MBA<br>HR 1800 1600 MBA<br>HR 2800 2500 CA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 3300 3000 LCA<br>IE Rathlin 2000 1500 EBA<br>IT 3500 2500 CA   
   
  | 22200<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902   
   | 1305<br>1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877  
  | 3/09<br>3614<br>4095<br>2769<br>4445<br>3591<br>3539   | 20<br>28<br>24<br>20<br>29<br>54   | Cingata Uertoakar<br>Socialar (C. EBA<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia, Jop, CA<br>Hungary, IBA<br>Hungary, BA<br>Hungary, BA<br>Hungary, BA<br>Ireland, BA<br>Ireland, BA<br>Italy CA   
   
   | oludevature2018<br>Olidevature2018<br>FreillichScientificReports2021<br>FreillichScientificReports2021<br>GambaNtureCommunications2014<br>AllentoftNature2015<br>OlideVature2018<br>CassidyPNA52016<br>CassidyPNA52016<br>AntonioScience2019  | cityand, Orokana F, Immon<br>Socialno, Constana Care JA,<br>Japodnijak-Kreciny, Ozijek,<br>Bell Marnatir-Popora zmrtjebila, Osijek<br>Ludar-Varje-Bolla, Osijek<br>Erd<br>Metočašt-Horscogos<br>Rathini Sland, County Antrim<br>Rathini Sland, County Antrim<br>Grota Continenza  
   | Great Britain<br>Great Britain<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy  | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>F   | T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e<br>U5b2a2<br>I1  | R1b1a1b1a1a2c1a5c<br>G2a2a1a2a2a1~-Z31430<br>J2a1<br>I2a2a1a2a<br>R1b1a1a2a1a2c1g<br>R1b1a1a2a1a2c1  
  |
| I3132<br>I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119<br>RM127<br>RSK1<br>R5<br>R1014   
   | GB 5 2100 1800 EBA     GB 5 2100 1800 EBA     HR 1800 1600 MBA     HR 1800 1600 MBA     HR 2000 2500 CA     HU 2000 1200 BA     HU 2000 1200 BA     HU 3300 3000 LCA     IE Rathlin 2000 1500 EBA     IF_Rathlin 2000 1500 EBA     IT_3500 2500 CA  
   
  | 2200<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902<br>3500  
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500  
  | 3614<br>3445<br>4095<br>2769<br>4445<br>3591<br>3539   | 20<br>20<br>28<br>24<br>20<br>29<br>54   | Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia, Jag, MBA<br>Croatia, Jop, CA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LBA<br>Hangar, Late, CAB, Baden, Yam naya<br>Ireland, BA<br>Ireland, BA<br>Italy, CA   
   
   | Onderstanding<br>FreillichScientlickeport2021<br>FreillichScientlickeport2021<br>FreillichScientlickeport2021<br>GambaNature2015<br>OlaideNature2015<br>OlaideNature2018<br>CassidyPNA52016<br>CassidyPNA52016<br>AntonioScience2019  | cigano, Gondanie, Tamionie, Tamionie, Tamionie, Sandari, Covesea, Care Z.<br>Jagodnjak-Kreevine, Osijek,<br>Jagodnjak-Kreevine, Osijek,<br>Beli Manastir-Popova zemija, Osijek<br>Ludav-Varju-Dulo<br>Editor Varju-Dulo<br>Resta Varju-Dulo<br>Rashin Island, County Antrim<br>Rashin Island, County Antrim<br>Grotta Continenza<br>Monte San Biagio  
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy   | M<br>F<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>M  | T2a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e<br>U5b2a2<br>I1<br>N1a1a1a3   | Ribia1b1a2c1a5c<br>G2a2a1a2a2a1~-231430<br>J2a1<br>I2a2a1a2a<br>Ribia1a2a1a2c1<br>H-L901   
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24   
   | 002 500 1800 EBA<br>HR 1800 1600 MBA<br>HR 1800 1600 MBA<br>HR 1800 1600 MBA<br>HR 2800 2500 CA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 3000 1200 BA<br>HU 3000 1200 EBA<br>HE Rathlin 2000 1500 EBA<br>IE Rathlin 2000 1500 CBA<br>IT 3500 2500 CA<br>IT 3500 2500 CA  
   
  | 2200<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902<br>3500<br>3626<br>2026  
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>3374  
  | 3739<br>3614<br>4095<br>2769<br>4445<br>3591<br>3539   | 20<br>33<br>20<br>28<br>24<br>20<br>29<br>54   | Section (CEBA)<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Croatia Jag, MBA<br>Hungary, IBA<br>Hungary, LBA<br>Hungary, LBA<br>Hungary, LateC, EBA, Baden, Yamnaya<br>Ireland, BA<br>Italard, GA<br>Italay, CA<br>Italay, CA  
   
   | ObideNature2018<br>Freilic5d-entificReports2021<br>Freilic5d-entificReports2021<br>Freilic5d-entificReports2021<br>GambaNatureCommunications2014<br>AllentoffMature2018<br>CassidyPNA52016<br>CassidyPNA52016<br>Antonio5cience2019<br>Antonio5cience2019<br>Antonio5cience2019   | Sotland Coversi Core 3<br>Jagodijak-Krozvico, Ovijek,<br>Jagodijak-Krozvico, Ovijek,<br>Bel Mansis-Krozvico, Ovijek,<br>Editori Coversi Coversi Coversionali Coversionali<br>Erd<br>Metočsi:h Horscoges<br>Ratilin Island, County Antrim<br>Rathlin Island, County Antrim<br>Grota Continenza<br>Monte San Bisgio<br>Su Corcefisu   
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy<br>Italy   | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>F<br>M<br>F   | T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e<br>U5b2a2<br>I1<br>N1a1a1a3<br>U8b1b1  | Ribiaibaia2c1a5c<br>G2a2aia2a2ai~231430<br>J2a1<br>i2a2aia2a<br>Ribiaia2aia2c1<br>Ribiaia2aia2c1<br>H-1901   
  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24<br>R4<br>I3123  
   | GB 5 2100 1800 EBA<br>HT 1800 1800 MBA<br>HT 1800 1800 MBA<br>HT 1800 2500 CA<br>HT 1800 2500 CA<br>HT 2000 1200 BA<br>HT 2000 1200 BA<br>HT 1300 3000 LCA<br>HT 3300 3000 LCA<br>HT 3500 2500 CA<br>HT 3500 2500 CA<br>HT 3500 2500 CA<br>HT 3500 2500 CA<br>HT 3500 2500 CA   
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902<br>3500<br>3626<br>2950<br>2287  
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>3374<br>2880<br>2041  
  | 3769<br>3614<br>3445<br>4095<br>2769<br>4445<br>3591<br>3539<br>3539   | 20<br>33<br>20<br>28<br>24<br>20<br>29<br>54<br>54   | Social de Jeniesen<br>Social de Jenie de Jenie<br>Croata Jas, Méñ<br>Croata Jas, Méñ<br>Croata Jas, Méñ<br>Croata Jenie<br>Hangar, Lan<br>Hangar, Hangar, Han<br>Hangar, Hangar, Hangar, Hangar, Hangar, Hangar, Hangar, H   
   
  | Onladenta 2018<br>Onladenta 2018<br>PrelickSenttifkeports201<br>PrelickSenttifkeports201<br>FreikkSenttifkeports201<br>FreikkSenttifkeports201<br>Onladenta ture 2018<br>Castady PMA3016<br>Castady PMA3016<br>Antonościence2019<br>Antonościence2019<br>Antonościence2019<br>Antonościence2019<br>Antonościence2019  | cigand, Gottanite, Tamitonie, Tamitonie, Tamitonie, Soliej A.<br>Jagodnjak-Kreciviko, Goljek,<br>Jagodnjak-Kreciviko, Goljek,<br>Beld Manustir-Posov zemlja, Goljek<br>Ludas-Varju-Dalo<br>Metočask-Norcolges<br>Rabitin siland, County-Antrim<br>Rabitin siland, County-Antrim<br>Rabitin siland, County-Antrim<br>Monte San Biagio<br>Su Orcerlissu<br>Grotta Continenza<br>Sirviko Raffo   | Croatia<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy  
  | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>M<br>M<br>M<br>M<br>M   | T2a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e<br>U5b2a2<br>I1<br>N1a1a1a3<br>U8b1b1<br>K1a+195<br>U8b1b1  | Ribiaibiaia2cia5c<br>62a2aia2a2ai~231430<br>12a1<br>12a2aia2a<br>Ribiaia2aia2cig<br>Ribiaia2aia2ci<br>H-1901<br>G-F1193<br>Ribiaibiaia2a  |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>I5119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24<br>R4<br>I3123<br>I4071   
   | 68 5 1101 1800 EAA<br>141, 1800 1500 MBA<br>141, 1800 1500 MBA<br>141, 1800 1500 MBA<br>141, 2000 1200 BA<br>141, 2000 1200 BA<br>141, 2000 1200 BA<br>141, 3000 1500 EBA<br>17, 3500 2500 CA<br>17, 3500 2500 CA   
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902<br>3500<br>3626<br>2902<br>3500<br>3626<br>2950<br>2287<br>1883  | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>3374<br>2880<br>2041<br>1634  
   
  | 3614<br>3445<br>2769<br>4445<br>3591<br>3539<br>3760<br>3760<br>3450   | 20<br>33<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>30<br>40   | Scaland C, EBA<br>Coata Jag, MBA<br>Coata Jag, MBA<br>Coata Jag, MBA<br>Coata Jag, MBA<br>Coata Jag, MBA<br>Hungary, LBA<br>Hungary, Lator, EBA, Baden vannaya<br>Ireland BA<br>Ireland BA   
   
   | Dialdebature2018<br>FreilicKseintik deport2021<br>FreilicKseintik deport2021<br>FreilicKseintik deport2021<br>GanbakaureCommunication2014<br>Allenchtkrure2018<br>Cassid/PMA2016<br>Cassid/PMA2016<br>Antonsiscience2019<br>Antonsiscience2019<br>Antonsiscience2019<br>Fermandebature2018<br>Olaidebature2018  | Scotland, Choese Care 2<br>Jagodnjak-Krennico, Doljek,<br>Jagodnjak-Krennico, Doljek,<br>Bell Manasi-Popova zemlja, Osljek<br>Ludav-Varju-Dulo<br>Erd<br>Merčecist-Hörzegisk<br>Rathini Island, County Antrim<br>Groto: Continenza<br>Su Crocellisu<br>Groto: Continenza<br>Su Crocellisu<br>Groto: Continenza<br>Sicily, Buffa   | Sreat Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands   
   | M<br>M<br>F<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>F  | T2a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>USa1b1e<br>USb2a2<br>I1<br>N1a1a1a3<br>U8b1b1<br>K1a+195<br>U8b1b1<br>H6a1a   | Ribialbia2cla5c<br>G2a2aia2azai~231430<br>J2a1<br>I2a2aia2a<br>Ribiaia2aia2clg<br>Ribiaia2aia2clg<br>H-1901<br>G-F1193<br>Ribiaibiaia2a   |
| I3132<br>JAG78<br>JAG85<br>Pop39<br>BR2<br>RISE479<br>IS119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24<br>R4<br>I3123<br>I4071<br>I5748  
   | GB         5 2100         1500         HS           HB         1200         1500         MBA           HR         1200         1500         MBA           HR         2000         CA         HI           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           H         300         3000         ICA           F_         Rathlin, 2000         1500         BA           T_         5500         CA         T           T_         Sto00         CA         T           NL         2500         CA         T           NL         2500         CB         T  
   
  | 2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2006<br>2902<br>3500<br>3626<br>2950<br>2287<br>1883<br>2579  
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>3374<br>2880<br>2041<br>1634<br>22211   
  | 3614<br>3445<br>4095<br>2769<br>3591<br>3539<br>3539<br>3760<br>3450<br>3450<br>3945   | 20<br>33<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>30<br>30<br>40<br>55   | Contrar C E BA<br>Contrar C E BA<br>Contra Jag, MBA<br>Contra Jag, MBA<br>Contra Jag, MBA<br>Contra Jag, MBA<br>Contra Jag, MBA<br>Hungary LBA<br>Hungary LBA<br>Hungary Later, EBA Baden Yannaya<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Iraly, CA<br>Italy, CA<br>Italy, CA<br>Italy, CA<br>Italy, CA<br>Italy, CA<br>Italy, CA<br>Italy, CA<br>Italy, CA   
   
   | Oildehitute203<br>FreilikSontlickgont2021<br>FreilikSontlickgont2021<br>FreilikSontlickgont2021<br>Gambakture2018<br>Oildehature2018<br>Casid/PMAS2016<br>Casid/PMAS2016<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>Caldehature2018<br>Oildehature2018<br>Oildehature2018   | cityands, Corosanda Santa Santa<br>Jagodhia K-corona, Osijak,<br>Jagodhia K-corona, Osijak,<br>Jagodhia K-corona, Osijak,<br>Belf Manatsir Popoza remija, Osijak<br>Erd<br>Metočask-Horosagas<br>Rathin Island, County Antrim<br>Rathin Island, County Antrim<br>Grotta Continenza<br>Monte San Biagio<br>Su Corcefissu<br>Grotta Continenza<br>Grotta Continenza<br>Grotta Continenza<br>Grotta Continenza<br>Grotta Continenza<br>Grotta Continenza<br>Grotta Continenza  
   | Great Britain<br>Croatia<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands  | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>M<br>F<br>M   | T2a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e<br>U5b2a2<br>I1<br>N1a1a1a3<br>U8b1b1<br>K1a+195<br>U8b1b1<br>H6a1a<br>X2b4   | Ribialbala2cla5c<br>G2a2ala2ca1~231430<br>i2a1<br>i2a2ala2a<br>Ribiala2ala2c1g<br>Ribiala2ala2c1<br>H-1901<br>G-F1193<br>Ribialbala2a<br>Ribialbala2a  
  |
| 13132<br>13132<br>13678<br>13685<br>Pop39<br>BR2<br>RISE479<br>IS119<br>RM127<br>RSK1<br>R5<br>R1014<br>R4<br>R4<br>13123<br>14071<br>IS748<br>14073   
   | GB 5 2100 1500 F8A<br>HR 1800 1500 H8A<br>HR 1800 1500 M8A<br>HR 2800 2500 A<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 2000 1500 BA<br>HI 2000 1500 BA<br>HI 2000 1500 BA<br>HI 2000 1500 BA<br>HI 2000 A<br>HI 2500 2500 A<br>HI 25  
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2000<br>3330<br>2031<br>2026<br>2902<br>3500<br>3626<br>2950<br>2287<br>1883<br>2579<br>2197<br>2127  | 2500<br>1886<br>600<br>833<br>1500<br>833<br>1500<br>2877<br>2500<br>2877<br>2500<br>2877<br>2500<br>3374<br>2880<br>2041<br>1634<br>2211<br>1897<br>2211   
   
  | 3014<br>3445<br>4095<br>2769<br>4445<br>3591<br>3539<br>3339<br>3760<br>3760<br>3450<br>3455<br>3455<br>3665   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>30<br>40<br>55<br>55<br>55   | Cognito Jentesta<br>Sociand C. EBA<br>Croata Jag, MBA<br>Croata Jag, MBA<br>Croata Jag, MBA<br>Croata Jag, MBA<br>Croata Jag, MBA<br>Hungary LBA<br>Hungary LBA<br>Hu  
   
  | Unidentitaz2018<br>Prelitőkörtitőkepets2018<br>Prelitőkörtitőkepets2021<br>Prelitőkörtitőkepets2021<br>Prelitőkörtitőkepets2021<br>Ambahatarcennomizations2013<br>Didiofeture2018<br>Antonisőkere2019<br>Antonisőkere2019<br>Antonisőkere2019<br>Antonisőkere2019<br>Antonisőkere2019<br>Antonisőkere2019<br>Benandekture2018<br>Otidiofeture2018<br>Otidiofeture2018<br>Otidiofeture2018   | cigenic, Gridenic, Temini, Temini<br>Socialind, Covena Care I<br>Jagodijak-Krevine, Osijek<br>Jagodijak-Krevine, Osijek<br>Bell Manusti-Popou zemija, Osijek<br>Metročak-Varju-Dalo<br>Metročak-Hisrcadgis<br>Rathin Island, County Antrim<br>Grista Contrienza<br>Motrić San Bilgio<br>Su Graefisaa<br>Grista Contrienza<br>Sicily, Mafa<br>Su Graefisaa<br>Grista Contrienza<br>Noord-Holland, Ostwad, De Tuitboorn<br>Noord-Holland, Ostwad, De Tuitboorn<br>Noord-Holland, Ostwad, De Tuitboorn   | Scat Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands   | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>M<br>F<br>M<br>M<br>F<br>M<br>M<br>S<br>C   |
72a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>T2b11<br>K2a<br>T2b<br>J1c2<br>USa1b1e<br>USa1b1e<br>USa1b1e<br>USa2a21<br>I1<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a3<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a<br>N1a1a1a   | Ribialbala2cla5c<br>G2a2ala2aza1231430<br>J2a1<br>I2a21a2a<br>Ribiala2ala2ci<br>H-1901<br>G-f1193<br>Ribialbala2a<br>Ribialbala2a<br>Ribialbala2a<br>Ribialbala2  |
| 13132<br>13132<br>13678<br>13678<br>13678<br>13678<br>13678<br>13123<br>13113<br>RM127<br>RS1<br>RM127<br>RS1<br>R1014<br>R24<br>R4<br>13123<br>14073<br>14073<br>14075<br>N45   
   | GB 5 2100 1500 150<br>HR 1800 1500 MBA<br>HR 1800 1500 MBA<br>HR 2800 2500 CA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 2000 1200 BA<br>HU 2000 1500 EBA<br>F atbilin 2000 1500 EBA<br>HT 3500 2500 CA<br>TT 3500 2500 CA<br>TT 3500 2500 CA<br>HI 1500 CA<br>HI 1500 2500 CA<br>HI 1500 CA<br>HI 1   
   
   | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>2031<br>2026<br>2902<br>3500<br>3626<br>2950<br>2287<br>1883<br>2579<br>2197<br>2197<br>2570  | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>3374<br>2880<br>2041<br>1634<br>2280<br>2041<br>1634<br>2211<br>1897<br>1933<br>2340   
   
   | 2014<br>3614<br>4095<br>2769<br>4445<br>3591<br>3539<br>3539<br>3550<br>3260<br>3260<br>3635   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>30<br>40<br>40<br>55<br>50<br>50<br>20   | Costina C, EBA<br>Costia Jag, MBA<br>Costia Jag, MBA<br>Costia Jag, MBA<br>Costia Jag, MBA<br>Costia Jag, MBA<br>Costia Jag, MBA<br>Hungary, LBA<br>Hungary, LateC, EBA, Bader, Yannaya<br>Ireland, BA<br>Ireland, BA   
   
   | Ouldehkrute-2018<br>FreilickSoentlickgont2021<br>FreilickSoentlickgont2021<br>FreilickSoentlickgont2021<br>GambakaureCommunication2014<br>AllenentHarue2015<br>Olaldehature2018<br>CasidyPhAS2016<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>FernandekstaureCogRedulation2020<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018  | Sortiang Covers (are 3)     Sortiang Covers (are 3)     Iagodial-Kreenis, Osijek,     Iagodial-Kreenis, Osijek,     Iagodial-Kreenis, Osijek,     Iudar-Varir-Dado     Erd     Mesőcsát-Hőrsöges     Rathin Island, County Antrim     Rathin Island, County Antrim     Grotta Continenza     Monte San Biagio     Sur Cocefisu     Grotta Continenza     Solv, Buffa     Gottado, De Tulfborn Noord-Holland, Costewad, De Tul   | Scat Britain<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands  | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>M<br>F<br>M<br>F<br>F<br>M<br>F<br>F  | 72a1b1a<br>72a1b1a<br>72b11<br>K2a<br>HV9<br>K1a1a<br>72b<br>J1c2<br>USa1b1e<br>USb2a2<br>I1<br>N1a1a1a3<br>USb1b1<br>K1a+195<br>USb1b1<br>H6a1a<br>X2b4<br>USa2b1<br>H5a1<br>H5a1  
  | Ribialbiala2cla5c<br>G2a2ala2ara-231430<br>I2a1<br>I2a2ala2a<br>Ribiala2ala2clg<br>Ribiala2ala2cl<br>H-L901<br>G-F193<br>Ribialbiala2<br>Ribialbiala2<br>Ribialbiala2<br>Ribialbiala2   |
| 13132<br>13132<br>13678<br>13678<br>13678<br>13678<br>13678<br>13123<br>13113<br>RM127<br>RS1<br>RM127<br>RS1<br>R1014<br>R24<br>R4<br>13123<br>14071<br>15748<br>14073<br>14075<br>N47  
   | GB         5 2100         1500         H50           HE         1200         1500         MBA           HE         1200         1500         MBA           HE         2000         1200         MA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         3000         1200         BA           H         3000         1200         BA           H         3000         1500         BA           H         3500         2500         CA           H         3500         2500         CA           H         3500         2500         CA           H         3500         2500         CA           H         2500         000         BB           NL         2500         000         BC   
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>2031<br>2026<br>2902<br>3500<br>3626<br>2950<br>2287<br>1883<br>2579<br>2197<br>2197<br>2570<br>2570  
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>3374<br>2880<br>2041<br>1634<br>2211<br>1897<br>1933<br>2340  
  | 2003<br>2014<br>2015<br>2016<br>2016<br>2016<br>2016<br>2016<br>2016<br>2016<br>2016   | 20<br>20<br>28<br>24<br>24<br>29<br>54<br>54<br>30<br>40<br>55<br>50<br>20<br>20   | Cognito Januaria<br>Social Carlos Alexan<br>Conta Jag MBA<br>Conta Jag MBA<br>Conta Jag MBA<br>Conta Pop CA<br>Hangay LBA<br>Hangay LBA<br>Hangay Late, EBA Baden Yamaya<br>Ireland BA<br>Ireland BA<br>Irelay CA<br>Italy, CA   
   
   | OblideNture2039<br>FreilikSeintifekpont2021<br>FreilikSeintifekpont2021<br>FreilikSeintifekpont2021<br>Gambakaure20mmunizations2014<br>OblideNature2018<br>OblideNature2018<br>OblideNature2018<br>AntonisGere2019<br>AntonisGere2019<br>AntonisGere2019<br>AntonisGere2019<br>FrandenStaureEcoglysolution22018<br>OblideNature2018<br>OblideNature2018<br>OblideNature2018<br>OblideNature2018<br>OblideNature2018   | Cliquid, Groups, Tamino, Tamino, Sandari, Karania, Sandari, Karania, Oajak, Jagodhak-Karania, Oajak, Jagodhak-Karania, Oajak, Beil Manstir-Papora zemija, Gojak, Beil Manstir-Papora zemija, Gojak, Erd Metöcak-Hországos Artim, Rathlin Island, County Antrim, Rathlin Island, County Antrim, Grotta Continenza Siloy, Buffa Grotta Continenza Siloy, Buffa Grotta Continenza Siloy, Buffa Octvad, De Tuthoorn Noord-Holland, Ocstwad, De Tuthoorn Pikutkowo Pikutkowo Pikutkowo Karania   | Scenat Britain<br>Croatia<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Ireland<br>Itely<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands<br>Poland  | M<br>M<br>F<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M  |
72a1b1a<br>72a1b1a<br>72b11<br>K2a<br>HV9<br>K1a1a<br>72b<br>J1c2<br>USa12a<br>USa12a<br>USa12a<br>USa221<br>HSa1<br>HGa1a<br>X2b4<br>HGa1a<br>X2b4<br>HGa1a<br>X2b4<br>HSa1<br>HSa1<br>HSa2<br>HSa2<br>HSa2   | Riblaibialactis<br>Gaaalaazati-33140<br>Jaal<br>Izaalaza<br>Riblaiazatactig<br>Riblaiazatactig<br>Riblaiazatacti<br>H-1001<br>G-f1193<br>Riblaibialaza<br>Riblaibialaza<br>Riblaibialaza<br>Riblaibialaza   |
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   | GB         5.2100         18800         F500         MBA           HR         1800         1500         MBA         HB         1800         1500         MBA           HR         2800         2500         AA         HU         2000         1200         BA           HU         2000         1200         BA         HU         2000         1200         BA           HU         3000         1200         BA         HU         2000         1500         EBA           HS         8400         2500         GA         17         3500         2500         GA           T         3500         2500         GA         17         3500         2500         GA         17         3500         2500         GA         17         3500         2500         GA         17         3500         2500         GA         N         1,500         2500         GA         N         1,500         2500         GA         N         1,500         2500         GB         N         1,500         2500         GB         N         1,500         2500         GB         N         1,500         2500         GB         GB         1,500   
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902<br>3500<br>3626<br>2950<br>2287<br>1883<br>2579<br>2197<br>2127<br>2570<br>2570<br>2570  
   | 1886<br>600<br>1887<br>2500<br>3013<br>1500<br>3013<br>1500<br>2877<br>2500<br>3374<br>2877<br>2500<br>3374<br>2880<br>1700<br>2877<br>2500<br>3374<br>2880<br>1634<br>2211<br>1634<br>2211<br>1634<br>2211<br>1933<br>2340<br>2576   
  | 2014<br>3614<br>4095<br>2769<br>4445<br>33991<br>3399<br>3559<br>3760<br>3365<br>3365<br>3365<br>3660<br>3665<br>3665<br>3665<br>36  | 20<br>28<br>24<br>20<br>29<br>54<br>54<br>55<br>50<br>20<br>20<br>36   | Cottinu C, EBA<br>Cottia Jag, MBA<br>Crottia Jag, MBA<br>Crottia Jag, MBA<br>Crottia Jag, MBA<br>Crottia Jag, MBA<br>Crottia Jag, MBA<br>Hungary, LIAC, EBA, Baden Yannaya<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Italy, CA<br>Italy,  
   
  | Dialdekture2018<br>FreilickSeintlickSeport2021<br>FreilickSeintlickSeport2021<br>FreilickSeintlicksport2021<br>GambaRaureCommunications2014<br>AllenotMarue2015<br>Otaldekature2018<br>CassidyPMAS2016<br>AntonisSeiner2019<br>AntonisSeiner2019<br>AntonisSeiner2019<br>Fernandeskeiner2019<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Otaldekature2018<br>Fernandeskeintlickgeport2019<br>Fernandeskeintlickgeport2018  | Sotland, Covera Care 2<br>Jagodijak-Kravino, Osijek,<br>Jagodijak-Kravino, Osijek,<br>Bell Marais-Popova zemlja, Osijek<br>Eddas-Varje-Dulo<br>Erd<br>Merčećak-Hörcsöges<br>Rathin Island, County Antrim<br>Rathin Island, County Antrim<br>Grota Continenza<br>Most San Bisglo<br>Grota Continenza<br>Sicily, Buffa<br>Nood-Holland, Ostwoud, De Tuithoom<br>Nood-Holland, Ostwoud, De Tuithoom  | Sceat Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Poland<br>Poland  
  | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>M<br>F<br>M<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F<br>F  | 72a1b1a<br>72a1b1a<br>72b11<br>K2a<br>HV9<br>K1a1a<br>72b<br>J1c2<br>USa1b1e<br>USb2a2<br>II<br>N1a1a1a3<br>USb2b1<br>USb2b1<br>USb1b1<br>H6a1a<br>X2b4<br>USa2b1<br>H5a1<br>H5a1<br>H5a2<br>H5a2<br>H5a2  | Riblabilaitais<br>Gazalazair-31300<br>12a1<br>12a21a2a<br>Riblaizzia2<br>Riblaizzia2<br>Riblaitazia2<br>Riblaitaza<br>Riblaitaiza<br>Riblaitaiza<br>Riblaitaiza<br>Riblaitaiza<br>Riblaitaiza<br>Riblaitaiza<br>Riblaitaiza   |
| 13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>13132<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312<br>1312   
   | GB         5.2100         1880         F500           HB         1890         1500         MBA           HR         1890         1500         MBA           HR         2800         CA         HH           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           H         2000         1200         BA           H         2000         1500         BA           T         3500         2500         CA           NL         1500         2500         CA           NL         2500         2000         BA           NL         2500         2000         BC           D         2500         2000         BC           D         2500         2000         CA  
   
  | 2126<br>2126<br>1800<br>2859<br>987<br>2000<br>3330<br>2031<br>2026<br>2902<br>2902<br>2902<br>2902<br>2902<br>2902<br>2902  
   | 2500<br>1886<br>600<br>1687<br>2500<br>833<br>1500<br>1500<br>2870<br>2800<br>2870<br>2800<br>2800<br>2201<br>1634<br>2211<br>1837<br>2340<br>2241<br>2340<br>2340<br>2340<br>23578<br>2578<br>2578   
  | 2014<br>3014<br>4095<br>2769<br>3351<br>3353<br>3353<br>3550<br>3455<br>3660<br>3045<br>3660<br>3035<br>4126<br>4126<br>4130   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>30<br>40<br>40<br>55<br>54<br>30<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | Costina C, E BA<br>Costia JG, E BA<br>Costia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Hungary, IBA<br>Hungary, IBA<br>Hungary, IBA<br>Hungary, LateC, EBA Baden Yannaya<br>Ireland, BA<br>Ireland, BA<br>Italy, CA<br>Italy, CA   
   
  | Oildehitute 2018<br>Freilikksentik depott2021<br>Freilikksentik depott2021<br>Freilikksentik depott2021<br>Gambakature2018<br>Oildehature2018<br>Casid/PNAS2016<br>Casid/PNAS2016<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Franckettaute/2018<br>Oildehature2018<br>Oildehature2018<br>Oildehature2018<br>Oildehature2018<br>Oildehature2018<br>Oildehature2018<br>Oildehature2018<br>Fernandeksientificitiopat.2019<br>Fernandeksientificitiopat.2019<br>Fernandeksientificitiopat.2019<br>Fernandeksientificitiopat.2019<br>SchwederPNAS2019  | Cliquid, Constraint, Ten 21     Jagodhal, Constraint, Ten 21     Jagodhal, Koroniko, Oujak,     Jagodhal, Krozniko, Oujak,     Jagodhal, Krozniko, Oujak,     Jagodhal, Krozniko, Oujak,     Ludav. Varjv-Dalo     Erd     Mescást-Hörsságes     Rathin Island, County Antrim     Rathin Island, County Antrim     Rathin Island, County Antrim     Grotta Continenza     Monte San Biggio     Su Crecefisu     Grotta Continenza     Grotta     Gr   | Sceat Britain<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Iteland<br>Itely<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Poland<br>Poland<br>Poland  | M<br>M<br>F<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>F<br>M<br>F<br>F<br>M<br>F<br>F<br>M<br>F<br>F<br>F<br>F<br>F   |
72a1b1a<br>72a1b1a<br>72b11<br>K2a<br>HV9<br>K1a1a<br>72b<br>USa1b1e<br>USa1b1e<br>USa1b1e<br>USa1b1e<br>USa1b1e<br>USb1b1<br>H6a1a<br>X2b4<br>H5a1<br>H5a8<br>USb22<br>HV0a<br>K1a1b1e<br>T2b   | Riblabialacts<br>Gazalazat-23486<br>(2azalazat-23487)<br>Izaalazata<br>Riblabiazatazta<br>Riblabiazatazt<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza  |
| 13132<br>13132<br>13678<br>Pop39<br>BR2<br>RISE479<br>15119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24<br>R4<br>R4<br>R32<br>I3123<br>I4073<br>I5748<br>I3123<br>I4073<br>I5748<br>I3123<br>I4073<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I578<br>I57   
   | GB         5.2100         15800         PEA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         HU           HU         2000         1200         BA           H         1401         2000         1500         BA           T         3500         2500         CA         T           T         3500         2500         CA         T           T         3500         2500         CA         T           T         3500         2500         CA         T         S         2000         CB         T         S         2000  
   
  | 2126<br>2126<br>2126<br>2126<br>2859<br>987<br>2000<br>2033<br>2031<br>2026<br>2902<br>2802<br>2950<br>2857<br>2950<br>2883<br>2579<br>2197<br>2127<br>2570<br>2570<br>2872<br>2872<br>2900<br>2887  |
1886<br>600<br>1887<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>2877<br>2500<br>2874<br>2800<br>2041<br>1634<br>2201<br>1897<br>1933<br>2340<br>2241<br>1897<br>2340<br>22540<br>2540<br>2540<br>2550<br>2696<br>2671<br>2588  
   | 3614<br>3614<br>4055<br>2769<br>4445<br>3391<br>3339<br>3750<br>3455<br>3345<br>3345<br>3345<br>3345<br>3345<br>3345<br>33   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>50<br>40<br>55<br>50<br>20<br>20<br>20<br>26<br>26<br>22<br>34   | - costand C, EBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Hungary, LBA<br>Hungary, LIAC, EBA Baden Yannaya<br>Ireland BA<br>Italy, CA<br>Italy, CA  
   
  | Dialdebiture2018<br>FreilickSentifickBeport2021<br>FreilickSentifickBeport2021<br>FreilickSentifickBeport2021<br>GanbalkaureCommunication2014<br>Allenchfure2015<br>Olaldehature2018<br>Olaldehature2018<br>AntonsSiere2019<br>AntonsSiere2019<br>AntonsSiere2019<br>AntonsSiere2019<br>Chaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldehature2018<br>Olaldeha  | Sotland, Conseas Care 2<br>Jagodnjak-Krewnice, Osijek,<br>Jagodnjak-Krewnice, Osijek,<br>Beil Manash-Fopgova zemlja, Osijek<br>Ludav-Varju-Dalo<br>Erd<br>Meršočait-Hörsögös<br>Rathin Island, County Antrim<br>Rathin Island, County Antrim<br>Control San Biagio<br>Su Orcerlisau<br>Grotta Continenza<br>Sioly, Birfa<br>Noord-Holland, Osttwoud, De Tuitheorn<br>Noord-Holland, Osttwoud, De Tuitheorn  | Sceat Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Poland<br>Poland<br>Poland<br>Poland   | M<br>M<br>F<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>M<br>F<br>F<br>M<br>F<br>F<br>F<br>F<br>F<br>F   
  | 12a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>USa1b1e<br>USab2e<br>USab2e<br>USab2e<br>USab2e<br>USab2e<br>USab2e<br>USab2e<br>HGa1a<br>S2b4<br>USa22<br>HSa8<br>USa22<br>HSa8<br>USa22<br>HSa8<br>USa22<br>HSa8<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1a1b1e<br>T2b<br>J1c3<br>S2b22<br>HV0<br>K1ab1e<br>S2b22<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSa8<br>HSA8<br>HSA8<br>HSA8<br>HSA8<br>HSA8<br>HSA8<br>HSA8<br>HSA  | Riblabilaidaida<br>Gazalazazi-23130<br>12a1<br>12a21aza<br>Riblaidaziazi<br>Riblaidaziazi<br>Riblaidaziazi<br>Riblaidazi<br>Riblaidaizza<br>Riblaibialaz<br>Riblaibialaz<br>Riblaibialaz<br>Riblaibialaz  |
| 13132<br>13132<br>131625<br>Pop39<br>BR2<br>RISE479<br>15119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24<br>R4<br>R3<br>R4<br>R3<br>R4<br>R4<br>R4<br>R4<br>R4<br>R4<br>R4<br>R4<br>R5<br>R479<br>R5<br>R1014<br>R5<br>R0127<br>R5<br>R1014<br>R5<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R0278<br>R02   
   | GB         5.2100         1880         1580           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         2500         AA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         3000         1200         BA           H         3000         1500         BA           IF         3800         1500         CA           T         3500         2500         CA           T         3500         2500         CA           T         3500         2500         CA           T         3500         2500         CA           N         1500         2500         CA           N         1500         2500         CA           N         1500         2500         CA           N         2500         2000         BC           N         2500         2000         BC           N         2500         2000         BC  
   
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   | Ouldehisture 2018<br>Freilik/Scientific#gorts2021<br>Freilik/Scientific#gorts2021<br>Freilik/Scientific#gorts2021<br>Gamba/sure/Communication2014<br>Allentofik/arue/2015<br>Ouldehature/2018<br>Cassid/pHAS2016<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Fernandes/Scientific#gorts2018<br>Ouldehature/2018<br>Ouldehature/2018<br>Ouldehature/2018<br>Fernandes/Scientific#gorts2018<br>SchroederPMAS2019<br>SchroederPMAS2019<br>SchroederPMAS2019   | Sortiang Covers Leve 3     Sortiang Covers Leve 3     Jagodigiak-Krzenie, Osijek,     Jagodigiak-Krzenie, Osijek,     Jagodigiak-Krzenie, Osijek,     Jagodigiak-Krzenie, Osijek,     Ludar-Variz-Dado     Erd     Mezőcsát-Hőrszögös     Rathin Island, County Antrim     Rathin Island, County Antrim     Rathin Island, County Antrim     Grotta Continenza     Monte San Biagio     Su Orceefissa     Grotta Continenza     Monde Holland, Ostwoud, De Tuitheom     Noord-Holland, Ostwoud, De Tuitheom  | Seat
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| 13132<br>13132<br>13132<br>134G85<br>Pop39<br>BR2<br>RISE479<br>15119<br>RM127<br>RSK1<br>R5<br>R1014<br>R24<br>R4<br>14075<br>N47<br>N47<br>N45<br>N47<br>N45<br>N47<br>Soryce 3.1<br>Soryce 3.1  
   | GB         5 2100         11800         1500           HB         11800         1050         MBA           HB         11800         1050         MBA           HB         2800         1050         MBA           HB         2800         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           H         3000         3000         LGA           F         Rathin, 2000         1500         BA           T         3500         2500         GA           T         5300         2500         GA           T         5300         2500         GA           T         5300         2500         GA           NL         3500         2500         GA           NL         2500         2000         BC           NL         2500         2300         CW           P         5000         2300         CW           P         3000         2800         GA           P         3000         2800  
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2859<br>987<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2007<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>20 | 2580<br>1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>2877<br>2500<br>3374<br>2880<br>2877<br>2500<br>2877<br>2500<br>2877<br>2500<br>2877<br>2500<br>2877<br>2500<br>2871<br>2880<br>22578<br>2578<br>2578<br>2578<br>2578<br>2671<br>2889<br>3389<br>3389   
   
  | 2003<br>2014<br>3045<br>4095<br>2269<br>2269<br>3391<br>3539<br>3359<br>3350<br>3350<br>3360<br>3365<br>3365<br>3425<br>4213<br>4125<br>4125   | 20<br>28<br>24<br>29<br>29<br>54<br>30<br>40<br>55<br>50<br>20<br>20<br>36<br>26<br>22<br>34   | Cognition of CEAN<br>Section of CEAN<br>Contral Jag, MBA<br>Contral Jag, MBA<br>Contral Jag, MBA<br>Contral Jag, MBA<br>Contral Jag, MBA<br>Hingary, Late, EBA Baden Yannaya<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Irelay, CA<br>Italy, CA  
   
   | Oblidenture.2039<br>Freiliki-Sonetlickeport.2021<br>Freiliki-Sonetlickeport.2021<br>Freiliki-Sonetlickeport.2021<br>Gamba Nature-Communications.2014<br>Allenter/Marce2015<br>OblideNature.2018<br>Casid/pPNAS2016<br>Casid/pPNAS2016<br>Antonois-Gene2019<br>Antonois-Gene2019<br>Antonois-Gene2019<br>Antonois-Gene2019<br>Antonois-Gene2019<br>Antonois-Gene2019<br>Frenden-Matter-Gogy-Noulino-2018<br>OblideNature.2018<br>OblideNature.2018<br>OblideNature.2018<br>OblideNature.2018<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019<br>Schnoeder/MAS2019  | chigand, On Conserve, Tamiton<br>Sciencial K-received, Osjak,<br>Jagodhak-Kreceived, Osjak,<br>Jagodhak-Kreceived, Osjak,<br>Belf Manstein-Popora Ernelji, Osjak<br>Belf Manstein-Popora Ernelji, Osjak<br>Kathin Island, County, Antrim<br>Rathin Island, County, Antrim<br>Grotta Continenza<br>Monte San Biagio<br>Su Coccefissu<br>Grotta Continenza<br>Grotta  | Screat Britain<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland  | M<br>M<br>F<br>F<br>M<br>M<br>F<br>M<br>M<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>F<br>F  | T2a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>USa1b1e<br>USb2a2<br>II<br>USb1b1<br>USb2a2<br>II<br>USb1b1<br>K1a+195<br>USb2a2<br>H6a1a<br>X2b4<br>USa2b11<br>H6a1a<br>X2b4<br>H5a8<br>H5a8<br>H5a8<br>H5a8<br>H5a8<br>H5a8<br>H5a8<br>H5a8  
  | Ribalabilabilabi<br>Gazalabilabi<br>Izal<br>Izalabi<br>Ribalabalacig<br>Ribalabalacig<br>Ribalabalabi<br>G-F1193<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi<br>Ribalabilabi  |
| 13132<br>13132<br>131628<br>Pop39<br>BR2<br>RISE479<br>15119<br>RM127<br>RS1<br>R014<br>R24<br>R4<br>R4<br>R32<br>14071<br>15749<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R073<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R014<br>R5<br>R02<br>R015<br>R02<br>R05<br>R05<br>R015<br>R02<br>R04<br>R04<br>R04<br>R04<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R04<br>R05<br>R04<br>R04<br>R04<br>R04<br>R04<br>R04<br>R04<br>R04  
   | GB         5.2100         1880         F500           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         2500         AA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         3000         1200         BA           H         3000         1200         BA           H         3000         1500         BA           T         3500         2500         CA           N         3800         1600         BA           N         2500         200         CA           Po         2500         200         CA           Po         3000         2800         CA  
   
   | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>2031<br>2031<br>2031<br>2026<br>2902<br>2550<br>2287<br>2579<br>2570<br>2570<br>2570<br>2570<br>2570<br>2872<br>2872<br>2872<br>2884<br>3636<br>3636   
  | 2000<br>1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2500<br>2877<br>2500<br>2877<br>2500<br>2877<br>2500<br>2877<br>2880<br>2041<br>1634<br>2241<br>1634<br>2241<br>1897<br>1933<br>2340<br>2340<br>2340<br>2340<br>2340<br>2340<br>2340<br>23   
   | 2014<br>3614<br>4095<br>2769<br>3591<br>3599<br>3760<br>3450<br>3450<br>3455<br>3660<br>3655<br>4125<br>4131<br>4130<br>4130   | 20<br>28<br>24<br>29<br>54<br>54<br>50<br>50<br>29<br>54<br>50<br>50<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | Costand C, EBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Costa Jag, MBA<br>Hungary, LBA<br>Hungary, LBA<br>H   
   
  | Oildekinture2018<br>FreilickSeintlickgent2021<br>FreilickSeintlickgent2021<br>FreilickSeintlickgent2021<br>GambaNatureCommunication/2014<br>Allentottkare2015<br>OlaldeNature2018<br>CassidyPNAS2016<br>AntonioScienc2019<br>AntonioScienc2019<br>AntonioScienc2019<br>FremankesCience2019<br>FremankesCience2019<br>FremankesCience2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>OlaldeNature2018<br>FremankesCientlicReport2018<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019<br>FermankesCientlicReport2019   | Sortland, Coversa, Care 3     Sortland, Coversa, Care 3     Jagednjak-Krzevne, Ovijek,     Jagednjak-Krzevne, Ovijek,     Jagednjak-Krzevne, Ovijek,     Ludav-Varje-Dalo     Erd     Meršecšak-Hörzsögas     Rathin Island, County Antrim     Rathin Island, County Antrim     Gratica Continenza     Monte San Biagio     Sort Accords and County Antrim     Sortland, County Antrim     Noord-Holland, Costwaud, De Tuithoorn     Plautionvo     Dilonki     Otlonki   | Screat Britain<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Ireland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland   | M<br>M<br>F<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>F<br>F<br>F   
  | 12a1b1a<br>T2a1b1a<br>T2a1b1a<br>T2b11<br>K2a<br>HV9<br>K1a1a<br>T2b<br>J1c2<br>U5a1b1e<br>U5a1b1e<br>U5a1b1e<br>U5a2b1<br>K1a+195<br>U8b1b1<br>H6a1a<br>X2b4<br>H5a8<br>U5a2b1<br>H5a8<br>U5a2b1<br>H5a8<br>K1a1a<br>H5a8<br>K1a1a<br>H5a8<br>K1a1a<br>K2a<br>V14<br>K2a<br>V14<br>K2a<br>V14<br>K2a<br>V14<br>K2a<br>K1a1a<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K2a<br>K14<br>K14<br>K14<br>K2a<br>K14<br>K14<br>K14<br>K14<br>K14<br>K14<br>K14<br>K14  | Riblabilaizids<br>Gozalazata-23130<br>12a1<br>12a21a2a<br>Riblaizids21a2cig<br>Riblaizids21a2cig<br>Riblaizids21a2cig<br>Riblaizids21a2cig<br>Riblaizids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids22<br>Riblaibids23  |
| 13132<br>JAG378<br>JAG378<br>JAG378<br>Pop39<br>BR2<br>RISE479<br>ISE479<br>ISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479<br>RISE479   
   | GB         5.2100         11800         1500           HE         11800         1500         MBA           HE         11800         1500         MBA           HR         12800         1500         MBA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1500         BA           IF         8300         1500         BA           T         3500         2500         CA           T         7500         2500         CA           T         5500         CA         T           T         5500         CA         T           NL         1500         DAO         LBA           NL         2500         2000         LBA           NL         2500         2000         BC           PO         2500         2000         BC           PO         2500         2000         BC           PO         3000         2800  
   
  | 2126<br>2126<br>1800<br>1876<br>2859<br>987<br>2000<br>2031<br>2031<br>2026<br>2900<br>3500<br>2031<br>2026<br>2900<br>3500<br>2287<br>1883<br>2579<br>2197<br>2197<br>2197<br>2570<br>2570<br>2570<br>2570<br>2570<br>2570<br>2570<br>257   
   | 1886<br>600<br>1687<br>2500<br>850<br>3013<br>1830<br>1700<br>2877<br>2500<br>3013<br>1830<br>1700<br>2877<br>2500<br>2800<br>2041<br>1634<br>2241<br>1634<br>2241<br>1637<br>2340<br>2241<br>2340<br>22578<br>2340<br>2578<br>2578<br>2578<br>2578<br>2578<br>2578<br>2578<br>2578   
  | 2014<br>3445<br>4095<br>2769<br>4445<br>3351<br>3353<br>3550<br>3450<br>3450<br>3660<br>3055<br>4126<br>413<br>4180<br>4330  | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>30<br>40<br>55<br>55<br>50<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | Costina C, EBA<br>Scatian C, EBA<br>Costia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Crostia Jag, MBA<br>Hungary, LIAC, EBA, Bader, Yannaya<br>Ireland, BA<br>Ireland, BA<br>Italy, CA<br>Italy, CA<br>Ita   
   
  | Osladekinter-2038<br>Freilik-Scientifick-gont2021<br>Freilik-Scientifick-gont2021<br>Freilik-Scientifick-gont2021<br>CambaNatureCommunication2014<br>Allenterfitk-are-2015<br>Osladekinter-2018<br>CassidyPNA52016<br>CassidyPNA52016<br>Antonic6/cere2019<br>Antonic6/cere2019<br>Antonic6/cere2019<br>Antonic6/cere2019<br>Frandekinter/2018<br>Osladekinter-2018<br>Osladekinter-2018<br>Frandekinter(Regental)<br>Osladekinter-2018<br>Osladekinter-2018<br>Frandekinter(Regental)<br>SchroderPNA52019<br>SchroderPNA52019<br>SchroderPNA52019<br>SchroderPNA52019<br>SchroderPNA52019<br>SchroderPNA52019<br>FerandekiscentReg0208<br>FerandekiscentReg0208<br>FerandekiscentReg0208<br>FerandekiscentReg0208<br>FerandekiscentReg0208<br>FerandekiscentReg0208<br>FerandekiscentReg0208   | Sorting Coverses 1 or 21     Sorting Coverses 1     Sorting Coverses 1     Sorting Coverses 2     Sorting Cov   | Sceat Britain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Iteland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Itala<br>Italy<br>Itala<br>Italy<br>Itala<br>Italy<br>Itala<br>Italy<br>Itala<br>Italy<br>Itala<br>Italy<br>Itala<br>Itali<br>Italy<br>Itali<br>Italy<br>Itali<br>Italy<br>Itali<br>Italy<br>Itali<br>Italy<br>Itali<br>Italy<br>Itali<br>Italy<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>Itali<br>It | M<br>M<br>M<br>F<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>F<br>F  | T2a1b1a           T2a1b1a           T2a1b1a           T2b11           K2a           K2a           K1a1a           T2b           J1c2           USa1b1a           USb2a2           H1           Nia1a1a3
          U8b1b1           Kla+105           U8b1b1           U8b2b1           H5a1           V2b4           H5a1           V2b22           HV0a           K1a1b1a           K2b4           V3b224           HV0a           K1a1b1a           K2b4           V3b224  | Riblabilačis<br>Gožalažati-23140<br>1231<br>1232137<br>Riblabilažata<br>Riblabilažata<br>Riblabilaža<br>Riblabilaža<br>Riblabilaža<br>Riblabilaža<br>Riblabilaža<br>Riblabilaža<br>Riblabilaža<br>Riblaža   |
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2018<br>FreilikScientifickgents2021<br>FreilikScientifickgents2021<br>FreilikScientifickgents2021<br>GambaNatureCommunication2014<br>Allenentifickgents2021<br>OsladeNature2018<br>CassidyPNAS2016<br>CassidyPNAS2016<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>FernandesGener02018<br>OsladeNature2018<br>OsladeNature2018<br>OsladeNature2018<br>OsladeNature2018<br>FernandesGenerficReports2018<br>FernandesGenerficReports2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>SchroederPNAS2019<br>S  | Sortland, Coversa, Care 2:     Agednala-Krzenie, Dujek,     Jagednala-Krzenie, Dujek,     Jagednala-Krzenie, Dujek,     Jagednala-Krzenie, Dujek,     Jagednala-Krzenie, Dujek,     Erd     Merzőcsit-Hörzsögés     Rathin Island, County Antrim     Rathin Island, County Antrim     Grotto: Continenza     Monte San Biagio     Surocefissa     Gortosz, De Tuthoom     Noord-Holland, Costewad, De Tuthoom     Ocideal     Torre Velha 3     Torre Velha 3     Monte do Sato de Cuna 3   | Sceat Brittain<br>Croatia<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Itreland<br>Itreland<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Netherlands<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Poland<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Portugal<br>Potad<br>Potad<br>Potad<br>Potad<br>Potad<br>Potad<br>Potad<br>Potad<br>Potad<br>Potad<br>P                               
   | M<br>M<br>F<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>M<br>M<br>F<br>F<br>F<br>F<br>F  | T2a1b1a           T2a1b1a           T2a1b1a           T2b11           K2a           K1a1a           T2b1           K1a1a           T2b1           K1a1a           T2b           USa1b1a           USa1b1a           VB1b1           K1a1a           VB1b1           K1a1a           VB1b1           H6a1a           X2b4           USa2b1           H5a1           H3a1           H3a1           K1a1b1e           K1a1b1e           K2a           V14           V5b3           V5b3   | Riblabilacids<br>Gozalazati-23140<br>12a1<br>12a21a2a<br>Ribla1a2a1a21g<br>Ribla1a2a1a21g<br>Ribla1a2a1a21<br>Ribla1a2a1a21<br>Ribla1b2a1a2<br>Ribla1b2a1a2<br>Ribla2b1a2a<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2  |
| 1322           JAG 78           JAG  
  | GB         2,2101         1800         P500           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         HU           HR         2800         CA         HU           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1200         BA           H         1300         2900         LA           T         3500         2900         CA           P0         3000         2900         CA  
   
   | 2126<br>1800<br>1807<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>3330<br>2005<br>2005   | 1886<br>1886<br>2500<br>2500<br>2500<br>3301<br>1500<br>2800<br>2800<br>2800<br>2800<br>2800<br>2800<br>2800<br>2  
   
   | 2003<br>2014<br>3445<br>4405<br>2769<br>2769<br>3531<br>3539<br>3539<br>3539<br>3550<br>3450<br>3450<br>3450<br>3450<br>3450<br>3450<br>3450   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>30<br>40<br>55<br>50<br>20<br>20<br>26<br>26<br>26<br>26<br>26<br>26<br>26<br>26<br>26<br>26<br>26<br>26<br>26   | Control C. EAA<br>Control C. EAA<br>Control C. EAA<br>Control Jag, MBA<br>Control Jag, MBA<br>Control Jag, MBA<br>Control Jag, MBA<br>Control Jag, MBA<br>Hangary LBA<br>Hangary LBA<br>Hangary LBA<br>Hangary LLTC, EAA Baden Yannaya<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland BA<br>Ireland, CA<br>Ireland, Ireland, Ireland<br>Ireland, Ireland<br>Ireland<br>Ireland, Ireland<br>Ireland, Ireland<br>Irelan   
   
   | Osidekinare.2039<br>FreilickSentifickgont.2021<br>FreilickSentifickgont.2021<br>FreilickSentifickgont.2021<br>Gambakture.2018<br>Osidekinare.2018<br>Osidekinare.2018<br>Casid/PNAS2016<br>Casid/PNAS2016<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>Antonis/Gene2019<br>FrandeksLaure/GogKoluti-20218<br>Osidekinare.2018<br>Osidekinare.2018<br>Osidekinare.2018<br>Osidekinare.2018<br>Osidekinare.2018<br>Osidekinare.2018<br>Fernades/Gene2019<br>Schwoder/PNAS2016<br>Fernades/Gene2019<br>Schwoder/PNAS2019<br>Fernades/Gene2019<br>Schwoder/PNAS2019<br>Fernades/Gene2019<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018<br>Fernades/Gene102018  | <ul> <li>Ligandy, Groving, Tare Start, Tare Start, Sta</li></ul>  | Sreat Britain<br>Croatia<br>Croatia<br>Croatia<br>Croatia<br>Croatia<br>Croatia<br>Indigary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy<br>Italy       | M           M           M           F           F           M           M           M           F           M           M           F           M           F           M           F           M           F           M           F           F           F           F           F           F           F           F           F           M           M           M           M           M           M           M           M           M           M   | Taabba<br>Taabba<br>Tabba<br>Tabba<br>Tabba<br>Tabba<br>Tab<br>Tab  
  | Riblabilabilabi<br>Gazalazazi-Zailab<br>Izai<br>Izaziazazi<br>Riblabzaiazi<br>Riblabizaiazi<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza<br>Riblabilaiza   |
| 1132<br>JAG78<br>JAG85<br>JAG85<br>JAG85<br>BR2<br>R15479<br>F5119<br>RM127<br>R5k1<br>R5k1<br>R4<br>R4<br>R4<br>R3<br>R3<br>R1014<br>R24<br>R4<br>R4<br>R3<br>R1014<br>R24<br>R4<br>R3<br>R3<br>R1014<br>R24<br>R4<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3<br>R3  
   | GB         5.2100.1580.1580.           HR         1800.1500.0MBA           HR         1800.1500.0MBA           HR         2800.2500.6A           HU.2000.1200.BA         HU.2000.1200.BA           HU.2000.1200.BA         HU.2000.1200.BA           HU.2000.1200.BA         HU.2000.1500.BA           Fathin.200.1500.BA         HS           H.2000.1200.BA         HS           H.2000.1200.BA         HS           H.2000.1200.BA         HS           H.2000.1200.BA         HS           H.300.1500.BA         HS           H.2000.0200.0500.BA         HL.2000.000.BB           NL.2000.000.8BC         HL.2000.000.8BC           NL.2000.000.8BC         HS           HO.2000.2800.064C         HO.2000.000.BC           HO.2000.2000.08C         HC           HO.2000.2000.04C         HO.2000.000.060C           HO.2000.2000.04C         HO.2000.000.06C           HO.2000.2000.04C         HO.2000.000.06C           HO.2000.2000.04C         HO.2000.000.04C           HO.2000.2000.04C         HO.2000.000.04C           HO.2000.2000.04C         HO.2000.04C           HO.2000.2000.04C         HO.2000.04C           HO.2000.2000.04C         HO.2000.04C   
   
  | 2126<br>1126<br>1800<br>2859<br>2000<br>2001<br>2001<br>2001<br>2002<br>2005<br>2005<br>2005   
   | 1886<br>600<br>1687<br>2500<br>833<br>1500<br>3013<br>1830<br>1700<br>2877<br>2877<br>2877<br>2877<br>2877<br>2877<br>2888<br>2880<br>2240<br>2240<br>2240<br>2240<br>2240<br>2240  
  | 2014<br>3614<br>4095<br>2769<br>3391<br>3399<br>3390<br>3360<br>3360<br>3365<br>3653<br>4125<br>4131<br>4130<br>4130<br>4130<br>4130<br>4130<br>4130<br>4130   | 20<br>20<br>28<br>24<br>29<br>54<br>54<br>50<br>50<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | <ul> <li>Costin J. C. EAA</li> <li>Costin J. ag, MBA</li> <li>Costin Jag, MBA</li> <li>Lang, Ma</li> <li>Hungary, IBA</li> <li>Hungary, IBA</li> <li>Hungary, IBA</li> <li>Hungary, LatC, EBA, Bader, Yannaya</li> <li>Ireland, BA</li> <li>Netherlands, BellBeaker</li> <li>Netherlands, BellBeaker</li> <li>Netherlands, BellBeaker</li> <li>Rehard, SeilBeaker</li> <li>Roland, CWC</li> <li>Poland, CwC</li> <li>Poland, CwC</li> <li>Poland, CwC</li> <li>Poland, TBB</li> <li>Poland, FBB</li> <li>Poland, FBB</li> <li>Poland, BKG</li> <li>Potrugal, MBA</li> <li>Potrugal, MBA</li> <li>Potrugal, MBA</li> <li>Turkey, N</li> <li>Turkey, N</li> </ul>  
   
  | Ouldehature-2018<br>FreilickSeinettikegonst2021<br>FreilickSeinettikegonst2021<br>Gambakaure/Communication/2014<br>Alletenttikegonst2021<br>Ouldehature-2018<br>CassidyPMAS2016<br>CassidyPMAS2016<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Antonios/Gene2019<br>Caladehature-2018<br>Ouladehature-2018<br>Ouladehature-2018<br>Ouladehature-2018<br>Ouladehature-2018<br>Ouladehature-2018<br>Ouladehature-2018<br>Fernandes/GenettificReport-2018<br>Schroeder/PMAS2019<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/GenettificReport-2018<br>Fernandes/Genettic-2017<br>Martinian/PLGS/Genetic-2017<br>Hofmanon/PMAS2016  | Bortland, Coversa, Tare 3     Sortland, Coversa, Tare 3     Jagodnjak-Krzevine, Ovijek,     Jagodnjak-Krzevine, Ovijek,     Jagodnjak-Krzevine, Ovijek,     Bel Manastr-Popova zemlja, Ovijek,     Erd     Retrikova, Sortave Sortave,     Rathin Island, County Antrim     Rathin Island, County Antrim     Rathin Island, County Antrim     Grata Continenza     Monte San Biagio     Survey, Buffa     Sortave, De Tarboom     Noord-Holland, Oostwoud, De Turboom     Noord-Holland, Dostwoud, De Turboom     Noord-Holland, Dostwoud   | Creat
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Osladekhute-2018<br>Freilik-Scientifick-gont2021<br>Freilik-Scientifick-gont2021<br>Freilik-Scientifick-gont2021<br>CambaNature-Communication/2014<br>Allentofitk-are-2018<br>CasidyPNA52016<br>CasidyPNA52016<br>Antonic6cene2019<br>Antonic6cene2019<br>Antonic6cene2019<br>Antonic6cene2019<br>Antonic6cene2019<br>Antonic6cene2019<br>Antonic6cene2019<br>Antonic6cene2019<br>Fernandes-katertui-Regenvalue-<br>Cogliadekhute-2018<br>Osladekhute-2018<br>Guidekhute-2018<br>Fernandes-GenethicRegon219<br>SchrooderPNA52019<br>SchrooderPNA52019<br>SchrooderPNA52019<br>SchrooderPNA52019<br>Fernandes-GenethicRegon219<br>Fernandes-GenethicRegon219<br>SchrooderPNA52019<br>SchrooderPNA52019<br>Fernandes-GenethicRegon218<br>Fernandes-GenethicRegon218<br>Fernandes-GenethicRegon218<br>Fernandes-GenethicRegon218<br>Fernandes-GenethicRegon218<br>Fernandes-GenethicRegon218<br>Fernandes-GenethicRegon318<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fernandes-Genethic2018<br>Fer 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| 13122           1AG28           1AG85           1AG85           1AG85           1AG85           Pop39           BR2           RISE479           IS119           RM127           RSK1           R2           R4           13123           Id071           IS748           Id073           Id074           R1           R1 </td <td>GB         5.2100         15800         H580           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         2500         AA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1500         BA           H         3000         1500         BA           H         3500         2500         CA           T         3500         2500         CA           H         3500         2500         CA           H         2500         2500         CA           H         2500         2500         CA           H         2500         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C, EBA</li> <li>Conta Jag, MBA</li> <li>Lang, Ma</li> <li>Hungary, LBA</li> <li>Hungary, MAA</li> <li>Horingary, MBA</li> <li>H</li></ul></td><td>Dialdektuture2018<br/>FreilickSeintlickEgent20201<br/>FreilickSeintlickEgent20201<br/>FreilickSeintlickEgent20201<br/>GambaRaureCommunications2014<br/>Allentoftkarure2018<br/>Olaldekature2018<br/>CassidyPMAS2016<br/>CassidyPMAS2016<br/>AntonisSeirenc2019<br/>AntonisSeirenc2019<br/>AntonisSeirenc2019<br/>AntonisSeirenc2019<br/>AntonisSeirenc2019<br/>AntonisSeirenc2019<br/>AntonisSeirenc2019<br/>Dialdekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>FernandesGeentlicReport2019<br/>FernandesGeentRep2019<br/>FernandesGeentRep2019<br/>FernandesGeentRep2019<br/>FernandesGeentRep2019<br/>FernandesGeentRep2019<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>FernandesGeentRep2018<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLGSGeentScu017<br/>Martinian/PLG</td><td>Sotland, 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   | 2014<br>3614<br>3445<br>4095<br>2769<br>3391<br>3399<br>3399<br>3399<br>3350<br>3350<br>3355<br>33660<br>3355<br>4113<br>4130<br>4130<br>4130<br>4130<br>4130<br>4130<br>4130  | 20<br>20<br>28<br>24<br>24<br>29<br>54<br>50<br>50<br>20<br>36<br>20<br>20<br>36<br>20<br>20<br>36<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | <ul> <li>Scalard C, EBA</li> <li>Scalard C, EBA</li> <li>Conta Jag, MBA</li> <li>Lang, Ma</li> <li>Hungary, LBA</li> <li>Hungary, MAA</li> <li>Horingary, MBA</li> <li>H</li></ul>  
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  | Riblabilaizids<br>Gazalazazai-z3130<br>J2a1<br>Izazlaza<br>Riblaizalazi<br>Riblaizalazi<br>Riblaizalazi<br>Riblaizalazi<br>Riblaizalazi<br>Riblaibialaz<br>Riblaibialaz<br>Iza-1801<br>Riblaiza<br>Riblaizalazi<br>Riblaizalazi<br>Riblaiza<br>Riblaiza<br>Riblaizalazi   |
| 19.12           11.0678           1.4678           1.4678           1.4678           1.4678           1.4678           1.4678           1.4678           1.4678           1.4678           1.815479           1.815479           1.815479           1.815479           1.815479           1.815479           1.815478           1.8123           1.8123           1.8124           1.8125           1.8124           1.8125           1.8124           1.8125           1.8127           1.8127           1.8127           1.81280           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128           1.9128  
   | GB         5.2100         1880         F50.00           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         HH           HR         2800         CA         HH           HR         2800         CA         HH           HL         2000         IZA         BA           HU         2000         IZA         BA           HU         2000         IZA         BA           HU         2000         IZA         BA           H         3000         IZA         BA           H         2000         ISO         BA           IF         3500         ISO         CA           T         3500         ISO         CA           T         ISO         ISO         CA           M         1500         ISO         CA           N         1500         ISO         CA           N         1500         ISO         CA           N         1500         ISO         CA           N         1500         ISO         CA <t< td=""><td>2125<br/>1126<br/>18000<br/>2859<br/>2859<br/>2000<br/>2011<br/>2012<br/>2012<br/>2012<br/>2012<br/>2012<br/>201</td><td>1886           600           600           1687           2500           333           1500           3013           1830           2877           2877           2877           2877           2877           2877           2877           2877           2877           2877           2877       
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E.B.A.</li> <li>Costina Jag, MBA.</li> <li>Ireland, BA.</li> <li>Netherlands, Bellieaber</li> <li>Netherlands, Bellieaber</li> <li>Netherlands, Bellieaber</li> <li>Netherlands, Bellieaber</li> <li>Poland, Coxyree, GAC.</li> <li>Poland, Coxyree, GAC.</li> <li>Poland, Kosyree, G</li></ul></td><td>Osladekture 2018<br/>Freilik-Scientifickeports2021<br/>Freilik-Scientifickeports2021<br/>Freilik-Scientifickeports2021<br/>Gambakaure/Communication/2014<br/>Allentofikaure/2015<br/>Osladekaure/2018<br/>Cassid/pHAS2016<br/>Cassid/pHAS2016<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Antonis6/erre/2019<br/>Cassid/pHAS2016<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2019<br/>SchroderPMAS2019<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2018<br/>Fernandes/centificeport/2019<br/>Mathieson/Nature/2015<br/>Mathieson/Nature/2015</td><td><ul> <li>Sottiang Coversit Lee 21</li> <li>Sottiang Coversit Lee 21</li> <li>Jagodijak-Krzeviso, Dijek,</li> <li>Jagodijak-Krzeviso, Dijek,</li> <li>Jagodijak-Krzeviso, Dijek,</li> <li>Belf Mansitz-Popoza zemlja, Onljek</li> <li>Erd</li> <li>Kotski Coversit, Popoza zemlja, Onljek</li> <li>Erd</li> <li>Metščašt-Horzoga zemlja, Onljek</li> <li>Erd</li> <li>Metščašt-Horzoga Zemlja, Onljek</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Noord-Holland, Onstroud, De Tuitheorn</li> <li>Noord-Holland, Ostiswud, De Tuitheorn</li> <li>Noord-Holland, Nethwest Anatola, Marmara, Barcin, Northwest Anatolia, Marmara, Barcin, Northwest Anatolia, Marmara, Barcin, Northwest Anatolia, Marmara, Barcin</li> </ul></td><td>Creat 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          T2a1b1a           T2a1b1a           K2a           KV9           K1a1a           T2b           J1c2           USa1b1e           USa1b1e           USb2a2           II           Minia1a3           U8b1b1           U8b1b1           U8b1b1           U8b1b1           U5a21           H5a1           H5a2           U5b2a2           J1c3f           H31           K2a           V32           V32           V32           V34           V35b3           V2m           Kla2           V38b11           V38b151</td><td>Riblabilacids<br/>Gazalazatar-23430<br/>12a1<br/>12a21a2a<br/>Ribla1a2a1a2clg<br/>Ribla1a2a1a2clg<br/>Ribla1a2a1a2cl<br/>Ribla1a2a1a2cl<br/>Ribla2a1a2c<br/>Ribla1b1a1a2<br/>Ribla1b1a1a2<br/>Ribla1b1a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2<br/>Ribla2a1a2</td></t<>  
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   | 2004<br>3045<br>4095<br>2769<br>2769<br>3359<br>3539<br>3539<br>3559<br>3760<br>3550<br>3845<br>3845<br>3845<br>3845<br>3845<br>3860<br>3833<br>4126<br>4130<br>4130<br>4130<br>4330   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>50<br>29<br>50<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | <ul> <li>Costina G. E.B.A.</li> <li>Costina Jag, MBA.</li> <li>Ireland, BA.</li> <li>Netherlands, Bellieaber</li> <li>Netherlands, Bellieaber</li> <li>Netherlands, Bellieaber</li> <li>Netherlands, Bellieaber</li> <li>Poland, Coxyree, GAC.</li> <li>Poland, Coxyree, GAC.</li> <li>Poland, Kosyree, G</li></ul>   
   
   | Osladekture 2018<br>Freilik-Scientifickeports2021<br>Freilik-Scientifickeports2021<br>Freilik-Scientifickeports2021<br>Gambakaure/Communication/2014<br>Allentofikaure/2015<br>Osladekaure/2018<br>Cassid/pHAS2016<br>Cassid/pHAS2016<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Antonis6/erre/2019<br>Cassid/pHAS2016<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2019<br>SchroderPMAS2019<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2018<br>Fernandes/centificeport/2019<br>Mathieson/Nature/2015<br>Mathieson/Nature/2015  | <ul> <li>Sottiang Coversit Lee 21</li> <li>Sottiang Coversit Lee 21</li> <li>Jagodijak-Krzeviso, Dijek,</li> <li>Jagodijak-Krzeviso, Dijek,</li> <li>Jagodijak-Krzeviso, Dijek,</li> <li>Belf Mansitz-Popoza zemlja, Onljek</li> <li>Erd</li> <li>Kotski Coversit, Popoza zemlja, Onljek</li> <li>Erd</li> <li>Metščašt-Horzoga zemlja, Onljek</li> <li>Erd</li> <li>Metščašt-Horzoga Zemlja, Onljek</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Grotta Continenza</li> <li>Noord-Holland, Onstroud, De Tuitheorn</li> <li>Noord-Holland, Ostiswud, De Tuitheorn</li> <li>Noord-Holland, Nethwest Anatola, Marmara, Barcin, Northwest Anatolia, Marmara, Barcin, Northwest Anatolia, Marmara, Barcin, Northwest Anatolia, Marmara, Barcin</li> </ul>  | Creat 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  | Riblabilacids<br>Gazalazatar-23430<br>12a1<br>12a21a2a<br>Ribla1a2a1a2clg<br>Ribla1a2a1a2clg<br>Ribla1a2a1a2cl<br>Ribla1a2a1a2cl<br>Ribla2a1a2c<br>Ribla1b1a1a2<br>Ribla1b1a1a2<br>Ribla1b1a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2<br>Ribla2a1a2   |
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  | Dialdebature2018<br>Dialdebature2018<br>FreilickSeintlickBeport2021<br>FreilickSeintlickBeport2021<br>GambaRaureCommunication2014<br>Allenchtrarbitave2015<br>Olaldebature2018<br>Olaldebature2018<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>Chaldebature2018<br>Olaldebature2018<br>Olaldebature2018<br>Olaldebature2018<br>Olaldebature2018<br>Olaldebature2018<br>Olaldebature2018<br>Olaldebature2018<br>SchwaderPMA2019<br>SchwaderPMA2019<br>SchwaderPMA2019<br>FernandesSeienRe2019<br>FernandesSeienRe2019<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>FernandesSeienRe2018<br>Fernand  | Sotland, Coxesa Care 2<br>Jagodnjak-Krewnice, Ocijek,<br>Jagodnjak-Krewnice, Ocijek,<br>Beil Manash-Foepox arenija, Osijek<br>Ludav-Varju-Dalo<br>Erd<br>Meročasti-Höresögaš<br>Ratini Island, County Antrim<br>Ratini Island, County Antrim<br>Cortas San Biaso<br>Grotta Continenza<br>Grotta Continenza<br>Grotta Continenza<br>Sicily, Birfa<br>Mord-Holland, Ostwaud, De Tuthoorn<br>Noord-Holland, Nathoorn<br>Noord-Holland, Nathoorn<br>Noord-Hol   | Sorat 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Benard<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>H 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   | GB         2100         15800         F5A           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         HU           HR         2800         CA         HU           HU         2000         1500         MBA           HU         2000         1500         BA           HU         2000         1500         BA           H         1300         2500         CA           T         3500         2500         CA   
   
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   | GB         5.2100         1800         P5A           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         HU           HR         2800         CA         HU           HU         2000         1200         BA           HU         2000         1500         BA           H         3000         1500         BA           N         1300         1000         BA   
   
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MAA</li> <li>Costin J. Jag. MBA</li> <li>Lender J. MBA</li> <li>Poland J. Konzee, GAC</li> <li>Poland J. KBA</li> <li>Portugal, MBA</li> <li></li></ul></td> <td>Dialdektuture2018<br/>FreilickSeintlickEgent2021<br/>FreilickSeintlickEgent2021<br/>FreilickSeintlickEgent2021<br/>GambaRature2017<br/>Dialdekature2018<br/>Olaldekature2018<br/>Casid;0HAS2016<br/>Casid;0HAS2016<br/>Casid;0HAS2016<br/>Atomosicene2019<br/>Atomosicene2019<br/>Atomosicene2019<br/>Atomosicene2019<br/>Atomosicene2019<br/>Dialdekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>FernandesCeintlicRegon2019<br/>FernandesCeintlicRegon2019<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintlicRegon2018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>FernandesCeintReg018<br/>Fernande</td> <td><ul> <li>Sotling Covers 1 and 2</li> <li>Sotling Covers 1 and 2</li> <li>Jagodijak-Krzwine, Osijek, Jagodijak-Krzwine, Osijek, Jagodijak-Krzwine, Osijek, Ludav-Varje-Dalo</li> <li>Erd</li> <li>Beil Mansich-Popoza zemlja, Osijek</li> <li>Ludav-Varje-Dalo</li> <li>Erd</li> <li>Merčećak-Hörzegges</li> <li>Rathin Island, County Antrim</li> <li>Gratica Continenza</li> <li>Motte San Biglio</li> <li>Gratu Contribution</li> <li>Gratu Contribution</li> <li>Gratu Contribution</li> <li>Gratu Continenza</li> <li>Sicily, Buffa</li> <li>Noord-Holland, Costwaud, De Tuithoorn</li> <li>Nord-Neet, Anatolla,</li></ul></td> <td>Sorat 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   | 2014<br>3014<br>3445<br>4095<br>2769<br>3391<br>3399<br>3359<br>3360<br>3365<br>3365<br>3365<br>3365<br>3365<br>3365<br>3365   | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>50<br>50<br>20<br>70<br>70<br>70<br>70<br>70<br>70<br>70<br>70<br>70<br>70<br>70<br>70<br>70   | <ul> <li>Costin J. C. EAA</li> <li>Costin J. E. EAA</li> <li>Costin J. E. M. MAA</li> <li>Costin J. Jag. MBA</li> <li>Lender J. MBA</li> <li>Poland J. Konzee, GAC</li> <li>Poland J. KBA</li> <li>Portugal, MBA</li> <li></li></ul>  
   
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Dialdektuture2018<br>FreilickSeintlickEgent2021<br>FreilickSeintlickEgent2021<br>FreilickSeintlickEgent2021<br>GambaRature2017<br>Dialdekature2018<br>Olaldekature2018<br>Casid;0HAS2016<br>Casid;0HAS2016<br>Casid;0HAS2016<br>Atomosicene2019<br>Atomosicene2019<br>Atomosicene2019<br>Atomosicene2019<br>Atomosicene2019<br>Dialdekature2018<br>Olaldekature2018<br>Olaldekature2018<br>Olaldekature2018<br>Olaldekature2018<br>Olaldekature2018<br>Olaldekature2018<br>Olaldekature2018<br>Olaldekature2018<br>FernandesCeintlicRegon2019<br>FernandesCeintlicRegon2019<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintlicRegon2018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>FernandesCeintReg018<br>Fernande | <ul> <li>Sotling Covers 1 and 2</li> <li>Sotling Covers 1 and 2</li> <li>Jagodijak-Krzwine, Osijek, Jagodijak-Krzwine, Osijek, Jagodijak-Krzwine, Osijek, Ludav-Varje-Dalo</li> <li>Erd</li> <li>Beil Mansich-Popoza zemlja, Osijek</li> <li>Ludav-Varje-Dalo</li> <li>Erd</li> <li>Merčećak-Hörzegges</li> <li>Rathin Island, County Antrim</li> <li>Gratica Continenza</li> <li>Motte San Biglio</li> <li>Gratu Contribution</li> <li>Gratu Contribution</li> <li>Gratu Contribution</li> <li>Gratu Continenza</li> <li>Sicily, Buffa</li> <li>Noord-Holland, Costwaud, De Tuithoorn</li> <li>Nord-Neet, Anatolla,</li></ul>   | Sorat Beniary<br>Croatia<br>Croatia<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary<br>Hangary 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  | Riblabilabilabi<br>Gazalazazi-23130<br>J2a1<br>Izaziaza<br>Riblaizatazi<br>Riblaizatazi<br>Riblaizatazi<br>Riblaizatazi<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza<br>Riblabiaza<br>Riblabiaz<br>Riblabiaz<br>Riblabiaz<br>Riblazatazi<br>Riblazatazi<br>Riblazatazi<br>Riblazatazi<br>Riblazatazi<br>Riblazatazi<br>Riblazatazi   |
| 1932           194678           1AG78           1AG78           1AG78           1AG78           1AG78           1AG78           1B32           1AG78           1S109           BR2           1S19           RS121           RS121           RS121           RS121           RS121           RS121           R31           R4011           1574           R421           R401           1574           R421           R421 <td< td=""><td>GB         2100         1800         FAA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         MH           HR         2800         CA         MH           HR         2800         CA         MH           HU         2000         IZA         MA           HU         2000         IZA         MA           HU         2000         IZA         MA           HU         2000         IZA         MA           HI         2000         IZA         MA           H         3000         1500         BA           IF         3500         2500         CA           T         3500         2500         CA           N         1500         2500         CA</td><td>2 1212<br/>2 1212<br/>2 1212<br/>2 1215<br/>2 1257<br/>9 657<br/>2 657<br/>2 657<br/>2 657<br/>2 657<br/>2 657<br/>2 757<br/>2 7570<br/>2 757</td><td>1886<br/>600<br/>1667<br/>2500<br/>833<br/>3013<br/>2500<br/>833<br/>3013<br/>2500<br/>2607<br/>2607<br/>2607<br/>2607<br/>2607<br/>2607<br/>2607<br/>26</td><td>2014<br/>3014<br/>3045<br/>4095<br/>2769<br/>3351<br/>3353<br/>3539<br/>3539<br/>3539<br/>3559<br/>3559<br/>3650<br/>3653<br/>3653<br/>3653<br/>3653<br/>4126<br/>4126<br/>4126<br/>4126<br/>4128<br/>4130<br/>4128<br/>4130<br/>4128<br/>4128<br/>4129<br/>7025<br/>7025<br/>7025<br/>7025<br/>7025<br/>7025<br/>7025<br/>7025</td><td>20<br/>20<br/>28<br/>24<br/>20<br/>29<br/>54<br/>54<br/>54<br/>55<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20<br/>20</td><td><ul> <li>Localizati C, EBA</li> <li>Costia Jag, MBA</li> <li>Lag, MBA</li> <li>Lest, Baden, Yannaya</li> <li>Italy, CA</li> <li>Italy, A</li> <li>Italy, A</li> <li>Italy, A</li> <li>Italy, A</li> <li>Italy, A</li> <li>I</li></ul></td><td>Osladekture 2018<br/>Osladekture 2018<br/>Freilik-Scientifickgont 2021.<br/>Freilik-Scientifickgont 2021.<br/>Freilik-Scientifickgont 2021.<br/>Gamba Nature Communication 2014<br/>Allenet Mittare 2015<br/>Osladekture 2018<br/>CasidyPNA 52016<br/>CasidyPNA 52016<br/>CasidyPNA 52016<br/>Antonis6 Gene 2019<br/>Antonis6 Gene 2019<br/>Antonis6 Gene 2019<br/>Antonis6 Gene 2019<br/>Casidy PNA 52016<br/>Casidy PNA 52016<br/>Fernandekture 2018<br/>Osladekture 2018<br/>Osladekture 2018<br/>Osladekture 2018<br/>Schweder PNA 52019<br/>Schweder PNA 52019<br/>Schweder PNA 52019<br/>Fernandekture 2018<br/>Fernandekture 2018<br/>Fernandekture 2018<br/>Schweder PNA 52019<br/>Schweder PNA 52019<br/>Schweder PNA 52019<br/>Fernandekture 2018<br/>Fernandekture 2018<br/>Mathieson Nature 2015<br/>Mathieson Nature</td><td>sotiang Covers Care 2<br/>Jagodijak-Krzenie, Osijek,<br/>Jagodijak-Krzenie, Osijek,<br/>Jagodijak-Krzenie, Osijek,<br/>Belf Mansich-Popoz arenija, Osijek<br/>Erd<br/>Metočsák-Hörcsöges<br/>Rathin Island, County Antrim<br/>Rathlin Island, County Antrim<br/>Grotta Continenza<br/>Su Corcefissu<br/>Grotta Continenza<br/>Su Corcefissu<br/>Bistonov<br/>Pikutkowo<br/>Oslonk<br/>Oslonk<br/>Oslonk<br/>Grotta Bisto<br/>Monte do Vale do Duo 2<br/>Monte do Gato de Cina 3<br/>Barcin, Marmara Region, Northwest Anatolia,<br/>Northwest Anatolia, Marmara, Barcin<br/>Northwest Anatolia, Marmara, Barcin</td><td>Sonat Benards<br/>Croatia<br/>Croatia<br/>Croatia<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary<br/>Hangary</td><td>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м<br/>м</td><td>T231013           YZ21013           YZ21           YZ21           YZ20           YZ20</td></td<> <td>Riblabilabilabi<br/>Gazalabzai-zilsé<br/>Gazalabzai-zilsé<br/>Riblabzaizeg<br/>Riblabzaizeg<br/>Riblabzaizeg<br/>Riblabzaizeg<br/>Riblabi<br/>Riblabilabi<br/>Riblabilabi<br/>Riblabilabi<br/>Riblabilabi<br/>Riblabilabi<br/>Riblabi<br/>Riblabi<br/>Riblabi<br/>Riblabi<br/>Riblabi<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz<br/>Riblaz</td>  
  | GB         2100         1800         FAA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         MH           HR         2800         CA         MH           HR         2800         CA         MH           HU         2000         IZA         MA           HU         2000         IZA         MA           HU         2000         IZA         MA           HU         2000         IZA         MA           HI         2000         IZA         MA           H         3000         1500         BA           IF         3500         2500         CA           T         3500         2500         CA           N         1500         2500         CA   
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  | 2014<br>3014<br>3045<br>4095<br>2769<br>3351<br>3353<br>3539<br>3539<br>3539<br>3559<br>3559<br>3650<br>3653<br>3653<br>3653<br>3653<br>4126<br>4126<br>4126<br>4126<br>4128<br>4130<br>4128<br>4130<br>4128<br>4128<br>4129<br>7025<br>7025<br>7025<br>7025<br>7025<br>7025<br>7025<br>7025 | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>54<br>55<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | <ul> <li>Localizati C, EBA</li> <li>Costia Jag, MBA</li> <li>Lag, MBA</li> <li>Lest, Baden, Yannaya</li> <li>Italy, CA</li> <li>Italy, A</li> <li>Italy, A</li> <li>Italy, A</li> <li>Italy, A</li> <li>Italy, A</li> <li>I</li></ul>  
   
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| 2014<br>3614<br>3445<br>4095<br>2769<br>3391<br>3399<br>350<br>3350<br>3350<br>3350<br>3355<br>410<br>4133<br>4130<br>4130<br>4130<br>4130<br>4130<br>4130   | 20<br>20<br>28<br>24<br>24<br>29<br>54<br>50<br>50<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | <ul> <li>Costin J. C. EAA</li> <li>Costin J. R. MAA</li> <li>Costin J. Jag. MBA</li> <li>Lingary, IBA</li> <li>Hungary, LEAC, EBA, Baden Yunnaya</li> <li>Ireland BA</li> <li>Rebreardand, BellBeaker</li> <li>Netherlands, BellBeaker</li> <li>Netherlands, BellBeaker</li> <li>Netherlands, BellBeaker</li> <li>Netherlands, BellBeaker</li> <li>Poland Coxyce GAC</li> <li>Poland Coxyce GAC</li> <li>Poland TIBB</li> <li>Poland TIBB</li> <li>Poland TIBB</li> <li>Poland TIBB</li> <li>Poland BKG</li> <li>Portugal MBA</li> <li>Portugal
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   | 2014<br>3014<br>3045<br>4095<br>2769<br>3359<br>3359<br>3359<br>3350<br>3450<br>3450<br>3450<br>3660<br>3653<br>3653<br>4126<br>4126<br>413<br>4130<br>4330<br>3650<br>7425<br>7425<br>7425<br>7425<br>7425<br>7425<br>7425<br>7425  | 20<br>20<br>28<br>24<br>20<br>29<br>54<br>54<br>50<br>50<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | <ul> <li>Costin J. C. EAA</li> <li>Costin J. E. EAA</li> <li>Costin Jag, MBA</li> <li>Longary, LBA</li> <li>Hungary, LBA</li> <li>Hungary, LBA</li> <li>Hungary, LBA</li> <li>Lead, EAA</li> <li>Ireland, BA</li> <li>Netheriands, BellBeaker</li> <li>Netheriands, BellBeaker</li> <li>Netheriands, BellBeaker</li> <li>Netheriands, BellBeaker</li> <li>Netheriand, State, GAC</li> <li>Peinad, Kostree, GAC</li> <li>Peinad, Kostree, GAC</li> <li>Peinad, Kostree, GAC</li> <li>Peinad, MBA</li> <li>Portugal, MBA</li></ul>  
   
   | Oildeistute 2018<br>Oildeistute 2018<br>FreilickSeinettinkegonst2021<br>FreilickSeinettinkegonst2021<br>Gambakature2018<br>Oildeistute 2018<br>Oildeistute 2018<br>Oildeistute 2018<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>AntonisGene2019<br>Colladeitute 2018<br>Oiladeitute 2018<br>Schroeder PNA52019<br>Schroeder PNA52019<br>Schroeder PNA52019<br>Schroeder PNA52019<br>Schroeder PNA52019<br>Marttinander Genetics2017<br>Marttinander Genetics2017<br>Marttinander Genetics2017<br>Marttinander Genetics2017<br>Marttinander Genetics2018<br>Marthieson Kature 2015<br>Mathieson Kature 2015<br>Math  | <ul> <li>Sottiang Coversit Lee 21</li> <li>Sottiang Coversit Lee 21</li> <li>Jagodijak-Krzevice, Ovijek,</li> <li>Jagodijak-Krzevice, Ovijek,</li> <li>Jagodijak-Krzevice, Ovijek,</li> <li>Jagodijak-Krzevice, Ovijek,</li> <li>Belf Manster Popoza remlja, Ovijek,</li> <li>Belf Manster Popoza remlja, Ovijek,</li> <li>Erd</li> <li>Metščašt-Horszagos</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Gratot Continenza</li> <li>Monte San Biagio</li> <li>Su Goverlsson</li> <li>Gortot Continenza</li> <li>Grotot Continenza</li> <li>Grotot Continenza</li> <li>Grotot Continenza</li> <li>Grotot Continenza</li> <li>Noord-Holland, Costrewad, De Tuithoorn</li> <li>Noord-Holland, Rostrewad, De Tuithoorn</li> <li>Noord-Holland, Rostrewad, De Tuithoorn</li> <li>Nord-Holland, Rostrewad, De Tuithoorn</li> <li>Nord-Holland, Rostrewad, De Tuithoorn</li> <li>Nord-Holland, Rostrewad, Namara, Barcin</li> <li>Northwest Anatolla, Marmara, Barcin</li></ul>  | Sorat Beniza<br>Croatia<br>Croatia<br>Hungary<br>Hungary<br>Heland<br>Heland<br>Heland<br>Heland<br>Heland<br>Heland<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber<br>Helber  | т.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м  
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| 1932           1946/18           1AG78           1S104           1S104           1B2           1B104           1B2           1B105           1B107           1B108           1B12           1B138           1B205           1D108           1B12           1B138           1B205           1B138           1B1380           1B205  
   | GB         2100         1580         F5A           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         CA         HU           HR         2800         CA         HU           HR         2800         CA         HU           HU         2000         1200         BA           HU         2000         1500         EBA           Hattim         2000         1500         EBA           Ti         3500         2500         CA           NL         2500         2000         BA           NL         2500         2000         BA           NL         2500         2000         BA           NL         2500         2000         BA           P0         3000         2800 <t< td=""><td>2 1226<br/>2 1226<br/>2 1226<br/>1800<br/>1876<br/>2 859<br/>9 87<br/>2 859<br/>9 87<br/>2 859<br/>9 87<br/>2 859<br/>9 87<br/>2 859<br/>9 87<br/>2 859<br/>2 800<br/>2 800</td><td>1886           600           1667           2500           2501           1500           1501           1501           1502           2503           2503           2501           2501           2502           2503           2504           2505           2507           2507           2508           2509           2678           2509           2678           3389           2600           2601           2602           2678           3389           2608           2610           2628           3389           2609           2601           1600           1600           1601           1602           2608           6036           6037           6037           2608           2609           2609           2601           2602           2603    
&lt;</td><td>2014<br/>3614<br/>3645<br/>4095<br/>2769<br/>4445<br/>3591<br/>3339<br/>3760<br/>3455<br/>3660<br/>3655<br/>4213<br/>4126<br/>4213<br/>4126<br/>4330<br/>4330<br/>4330<br/>4330<br/>4330<br/>4330<br/>4330<br/>433</td><td>20<br/>20<br/>28<br/>24<br/>20<br/>29<br/>54<br/>30<br/>40<br/>55<br/>50<br/>20<br/>20<br/>26<br/>26<br/>22<br/>20<br/>20<br/>26<br/>26<br/>26<br/>22<br/>34<br/>34<br/>34<br/>30<br/>34<br/>30<br/>34<br/>30<br/>30<br/>30<br/>34<br/>30<br/>30<br/>30<br/>30<br/>30<br/>34<br/>33<br/>34</td><td><ul> <li>Cotland C, EBA</li> <li>Cotala JG, EBA</li> <li>Cotala Jag, MBA</li> <li>Lag, MLA</li> <li>Hungary, LBA</li> <li>Hungary</li></ul></td><td>Dialdebiture2018<br/>Dialdebiture2018<br/>FreilickSeintlickBeport2021<br/>FreilickSeintlickBeport2021<br/>GambaRaureCommunication2014<br/>Allenchtrace2015<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>AntonsSeiene2019<br/>ErenandesSeiene2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>Olaldebiture2018<br/>FernandesSeieneR2019<br/>SchroederPNA52019<br/>SchroederPNA52019<br/>SchroederPNA52019<br/>SchroederPNA52019<br/>SchroederPNA52019<br/>SchroederPNA52019<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>FernandesSeientRep2018<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2017<br/>MartinandPusGeientEcc2018<br/>MartineandPusGeientEcc2018<br/>MartineandPusGeientEcc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>MartineandPusceitecc2018<br/>Martine</td><td>Sotland, Conseas Care 2<br/>Jagodnjak-Krewnice, Ocijek,<br/>Jagodnjak-Krewnice, Ocijek,<br/>Bell Mansich-Popova zemlja, Osijek<br/>Erd<br/>Meročasti-Hörosoga zemlja, Osijek<br/>Ludas-Varju-Dalo<br/>Erd<br/>Meročasti-Hörosoga<br/>Antonia Sland, County Antrim<br/>Rathini Sland, County Antrim<br/>Grotov San Biasa<br/>Grota Cantinenza<br/>Sicily, Bifa<br/>Grota Cantinenza<br/>Monte do Gato de Cina 3<br/>Monte do Gato de Cina 3<br/>Monte do Gato Grota Sa<br/>Nortwest Antolla, Marmara, Barcin<br/>Northwest Antolla, Marmara, Barcin</td><td>Sinci Brinish<br/>Sinci Brinish<br/>Oratili<br/>Coatia<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hang<br/>Hungary<br/>Hang<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>H</td><td>m 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   | Dialdebiture2018<br>Dialdebiture2018<br>FreilickSeintlickBeport2021<br>FreilickSeintlickBeport2021<br>GambaRaureCommunication2014<br>Allenchtrace2015<br>Olaldebiture2018<br>Olaldebiture2018<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>AntonsSeiene2019<br>ErenandesSeiene2018<br>Olaldebiture2018<br>Olaldebiture2018<br>Olaldebiture2018<br>Olaldebiture2018<br>Olaldebiture2018<br>Olaldebiture2018<br>Olaldebiture2018<br>Olaldebiture2018<br>FernandesSeieneR2019<br>SchroederPNA52019<br>SchroederPNA52019<br>SchroederPNA52019<br>SchroederPNA52019<br>SchroederPNA52019<br>SchroederPNA52019<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>FernandesSeientRep2018<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2017<br>MartinandPusGeientEcc2018<br>MartineandPusGeientEcc2018<br>MartineandPusGeientEcc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>MartineandPusceitecc2018<br>Martine  | Sotland, Conseas Care 2<br>Jagodnjak-Krewnice, Ocijek,<br>Jagodnjak-Krewnice, Ocijek,<br>Bell Mansich-Popova zemlja, Osijek<br>Erd<br>Meročasti-Hörosoga zemlja, Osijek<br>Ludas-Varju-Dalo<br>Erd<br>Meročasti-Hörosoga<br>Antonia Sland, County Antrim<br>Rathini Sland, County Antrim<br>Grotov San Biasa<br>Grota Cantinenza<br>Sicily, Bifa<br>Grota Cantinenza<br>Monte do Gato de Cina 3<br>Monte do Gato de Cina 3<br>Monte do Gato Grota Sa<br>Nortwest Antolla, Marmara, Barcin<br>Northwest Antolla, Marmara, Barcin   | Sinci Brinish<br>Sinci
Brinish<br>Oratili<br>Coatia<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hang<br>Hungary<br>Hang<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>Hungary<br>H   | m         m           M         M           F         F           M         M           F         M           M         M           M         M           M         M           M         M           M         M           M         M           F         F           F         F           F         F           F         F           M         M           F         F           M         M           F         F           M         M           F         F           M         M           F         F           M         M           F         F           M         M           F         F           M         M           M         F           M         M | 723103           723013           72301  | Riblabilabilabi<br>Gazalazazi-zilke<br>Gazalazazi-zilke<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblabi<br>Riblaz<br>Riblabi<br>Riblaz<br>Riblabi<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz<br>Riblaz  
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EAA</li> <li>Costin Jag, MBA</li> <li>Longary, LBA</li> <li>Hungary, LBA</li> <li>Hungary, LBA</li> <li>Hungary, LBA</li> <li>Head A</li> <li>Ireland BA</li> <li>Reheranda, BellBeaker</li> <li>Poland CWC</li> <li>Poland CWC</li> <li>Poland CWC</li> <li>Poland CWC</li> <li>Poland CWC</li> <li>Poland TBB</li> <li>Poland TBB</li> <li>Poland FBA</li> <li>Portugal, MBA</li> <li>Portuga</li></ul></td> 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<td><ul> <li>Botting Covers Tee 21</li> <li>Sotting Covers Tee 21</li> <li>Jagodijak-Krzwine, Osijek,</li> <li>Jagodijak-Krzwine, Osijek,</li> <li>Jagodijak-Krzwine, Osijek,</li> <li>Bel Mansich-Popoz zemlja, Osijek,</li> <li>Erd</li> <li>Erd</li> <li>Erd</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Grato Continenza</li> <li>Morte San Biajio</li> <li>Su Coordina</li> <li>Sirik, Buff</li> <li>Noord-Holland, Oostwaud, De Tuitheorn</li> <li>Noord-Holland, Rostwaud, De Tuitheorn</li> <li>Noord-Holland, Rostwaud, De Tuitheorn</li> <li>Noord-Holland, Rostwaud, De Tuitheorn</li> <li>Noord-Holland, Rostwaud, De Tuitheorn</li> <li>Pikufkowo</li> <li>Oslonki</li> <li>Oslonki</li> <li>Torre Velha 3</li> <li>Torre Velha 3</li> <li>Torre Velha 3</li> <li>Northwest Anatolia, Marmara, Barcin</li> <li></li></ul></td> <td>Sonat 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   | GB 5 2100 1500 1540<br>HR 1800 1500 MBA<br>HR 1800 1500 MBA<br>HR 1800 1500 MBA<br>HR 2800 2500 A<br>HU 2000 1200 BA<br>HU 2000 1500 BA<br>HU 2500 2000 CA<br>HU 2500 2000 CA<br>HU 2500 2000 BA<br>HU 2500 2000 CA<br>HU 2500 2500 CA<br>HU 2500 CA<br>HU 2500 CA<br>HU 2500 CA<br>HU 2500 CA<br>HU 2500 CA<br>HU 2500 LA<br>HU  
   
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Covers Lee 21</li> <li>Sottiang Covers Lee 21</li> <li>Jagodijak-Krzenie, Ocijek,</li> <li>Jagodijak-Krzenie, Ocijek,</li> <li>Jagodijak-Krzenie, Ocijek,</li> <li>Bel Mansich-Popoz aremija, Orijek,</li> <li>Bel Mansich-Popoz aremija, Orijek,</li> <li>Erd</li> <li>Metocást-Hörzogas</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Gratica Continenza</li> <li>Monte San Bisgio</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Monte San Bisgio</li> <li>Grota Continenza</li> <li>Monte San Bisgio</li> <li>Noord-Holland, Ostwud, De Tuitheorn</li> <li>Noord Holland, Ostwud, De Tuitheorn</li> <li>Noord Holland, Ostwud, De Tuitheorn</li> <li>Noord Holland, Region, Northwest Anatola, Marmara, Barcin</li> <li>Northwest Anatolia, Marmara, Barcin</li> <li>Northwest Anato</li></ul></td><td>Sorat Benard<br/>Constitu-<br/>Constitu-<br/>Constitu-<br/>Nonational<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany<br/>Hungany</td><td>т.<br/>м.<br/>м.<br/>м.<br/>м.<br/>м.<br/>м.<br/>м.<br/>м.<br/>м.<br/>м</td><td>723103<br/>723103<br/>72601<br/>72601<br/>72601<br/>72601<br/>7260<br/>7270<br/>7270<br/>7270<br/>7270<br/>7270<br/>7270<br/>7270</td><td>Riblabilacids<br/>Gazalazat-zitké<br/>Gazalazat-zitké<br/>Gazalazat-zitké<br/>Riblabizatazóg<br/>Riblabizatazóg<br/>Riblabizatazóg<br/>Riblabiataza<br/>Riblabiataza<br/>Riblabiataza<br/>Riblabiataz<br/>Riblabiataz<br/>Riblabiataz<br/>Riblabiataz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz<br/>Riblabiz</td></l<></ul>  
   | Osladekture 2018<br>Osladekture 2018<br>Freilik-Scientifiel gepts2021<br>Freilik-Scientifiel gepts2021<br>Science 2017<br>Osladekture 2018<br>Osladekture 2018<br>Osladekture 2018<br>Atomis Gene 2019<br>Atomis Gene 2019<br>Colladekture 2018<br>Osladekture 2018<br>Osladekture 2018<br>Osladekture 2018<br>Schweder PNA52016<br>Schweder PNA52019<br>Schweder PNA52019<br>Mathieson Schwertze 2015<br>Mathieson Stature 2015<br>Mathieson Stature 2015<br>Mathieson Stature 2015<br>Mathieson Stature 2013<br>Mathieson Stature 2015<br>Mathieson Stature 2013<br>Mathieson Stature 2014<br>Dem page Atsignment Stature 2018<br>Dem pa  | <ul> <li>Sottiang Covers Lee 21</li> <li>Sottiang Covers Lee 21</li> <li>Jagodijak-Krzenie, Ocijek,</li> <li>Jagodijak-Krzenie, Ocijek,</li> <li>Jagodijak-Krzenie, Ocijek,</li> <li>Bel Mansich-Popoz aremija, Orijek,</li> <li>Bel Mansich-Popoz aremija, Orijek,</li> <li>Erd</li> <li>Metocást-Hörzogas</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Gratica Continenza</li> <li>Monte San Bisgio</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Grota Continenza</li> <li>Monte San Bisgio</li> <li>Grota Continenza</li> <li>Monte San Bisgio</li> <li>Noord-Holland, Ostwud, De Tuitheorn</li> <li>Noord Holland, Ostwud, De Tuitheorn</li> <li>Noord Holland, Ostwud, De Tuitheorn</li> <li>Noord Holland, Region, Northwest Anatola, Marmara, Barcin</li> <li>Northwest Anatolia, Marmara, Barcin</li> <li>Northwest Anato</li></ul>  | Sorat
Benard<br>Constitu-<br>Constitu-<br>Constitu-<br>Nonational<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany<br>Hungany  | т.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м.<br>м   | 723103<br>723103<br>72601<br>72601<br>72601<br>72601<br>7260<br>7270<br>7270<br>7270<br>7270<br>7270<br>7270<br>7270   | Riblabilacids<br>Gazalazat-zitké<br>Gazalazat-zitké<br>Gazalazat-zitké<br>Riblabizatazóg<br>Riblabizatazóg<br>Riblabizatazóg<br>Riblabiataza<br>Riblabiataza<br>Riblabiataza<br>Riblabiataz<br>Riblabiataz<br>Riblabiataz<br>Riblabiataz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz<br>Riblabiz  
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   | GB         2100         1500         F500           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         1800         1500         MBA           HR         2800         2500         AA           HU         2000         1200         BA           HU         2000         1200         BA           HU         2000         1500         EBA           H         3000         1500         EBA           H         3000         1500         EBA           H         3000         1500         EBA           H         1500         2500         CA           T         3500         2500         CA           T         3500         2500         CA           H         13500         2500         CA         CA           N         12500         2000         BA         CA           H         2500         2000         CA         CA           H         2500         2000         BA         CA           H         12500         2000         BA         CA </td <td>2 12126<br/>2 12126<br/>2 1216<br/>2 1216<br/>2 1800<br/>1870<br/>9 87<br/>9 87</td> <td>188         600           1667         5500           600         1667           2500         833           1500         1500           3013         1500           2800         2800           2810         2800           2911         1830           2021         1830           2031         2800         
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C. EAA</li> <li>Costin J. E. EAA</li> <li>Costin J. Jag., MBA</li> <li>Lingary, LBA</li> <li>Hingary, LBA</li> <li>Holand, BellBeaker</li> <li>Poland, BAB</li> <li>Poland, BKG</li> <li>Poland, B</li></ul></td> <td>Dialdeksture2013<br/>FreilickSeintlickSport2021<br/>FreilickSeintlickSport2021<br/>FreilickSeintlickSport2021<br/>GambaRaureCommunication2014<br/>Allentoftkarue2015<br/>Olaldekature2018<br/>CassidyPMA2016<br/>CassidyPMA2016<br/>CassidyPMA2016<br/>AntonoidSeine2019<br/>AntonoidSeine2019<br/>AntonoidSeine2019<br/>AntonoidSeine2019<br/>FernandesCaentlickSport2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>FernandesCaentlicksport2019<br/>FernandesCaentlicksport2019<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>FernandesCaentlicksport2018<br/>MathiesonNature2015<br/>MathiesonNature2015<br/>MathiesonNature2015<br/>MathiesonNature2015<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018<br/>MathiesonNature2018</td> <td><ul> <li>Sotlind, Covera Care 2</li> <li>Jagodijak-Kravino, Osijek,</li> <li>Jagodijak-Kravino, Osijek,</li> <li>Jagodijak-Kravino, Osijek,</li> <li>Bell Maraistr-Popoz zemlja, Osijek</li> <li>Eida - Vajez Dulo</li> <li>Erd</li> <li>Kativi Popoz zemlja, Osijek,</li> <li>Ludav-Vajez Dulo</li> <li>Erd</li> <li>Merčećak-Hörzogisk</li> <li>Rathin Island, County Antrim</li> <li>Rathin Island, County Antrim</li> <li>Gratic Continenza</li> <li>Grati Continenza</li> <li>Si Cran Biello</li> <li>Grati Continenza</li> <li>Si Cran Biello</li> <li>Grati Continenza</li> <li>Si Cran Biello</li> <li>Nord-Holland, Ocstwoud, De Tuitboorn</li> <li>Nood-Holland, Satorn</li> <li>Nood-Holland, Namara, Baron</li> <li>Northwest Anatolla, Marmara, Baron</li> <li>Northw</li></ul></td> <td>Sorat Beniary<br/>Croatia<br/>Croatia<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary<br/>Hungary</td> <td>m         m           M         M           F         F           M         M           F         M           M         M           M         M           M         M           M         M           M         M           M         M           F         M           M         M           F         F           F         F           F         F           M         M           M         M           F         F           M         M           M         M           M         M           F         F           M         M           M         M           M         M           M         M</td> <td>T231013           T230113           K2a           HV9           K1a           USA           USA    
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EBA</li> <li>Steppe, EBA<!--</td--><td>Osladeshute 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Britland<br>Croatia<br>Croatia<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary<br>Hurgary 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   | GB 5 2100 1500 15A<br>HR 1800 1500 MBA<br>HR 1800 1500 MBA<br>HR 2800 2500 A<br>HD 2000 MBA<br>HR 2800 2500 A<br>HD 2000 1500 BA<br>HU 2000 1200 BA<br>HU 2000 1500 BA<br>HU 2000 A<br>HU 2000 A<br>H   
   
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<td>Dialdektutue2018<br/>FreilickSeintlickSport2021<br/>FreilickSeintlickSport2021<br/>FreilickSeintlickSport2021<br/>GambaRaureCommunication2014<br/>Allenchtrue2015<br/>Olaldekature2018<br/>CassidyPNA2016<br/>CassidyPNA2016<br/>CassidyPNA2016<br/>AntonsScience2019<br/>AntonsScience2019<br/>AntonsScience2019<br/>AntonsScience2019<br/>FermandekScience2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>Olaldekature2018<br/>FermandekScientlickgort2019<br/>FermandekScientlickgort2019<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgort2018<br/>FermandekScientlickgor</td> <td>Sotland, Conseas Care 2<br/>Jagodnjak-Krewnio, Ocijek,<br/>Jagodnjak-Krewnio, Ocijek,<br/>Bell Mansir-Popova zemlja, Osijek<br/>Erd<br/>Merčecit-Hörzogaše<br/>Rathin Island, County Antrim<br/>Rathin Island, County Antrim<br/>Grota: Continenza<br/>Sich, Biand, County Antrim<br/>Grota: Continenza<br/>Sich, Buffa<br/>Grota Continenza<br/>Buffaboro<br/>Pikutkowo<br/>Pikutkowo<br/>Pikutkowo<br/>Osionki<br/>Grore Velha 3<br/>Torre Velha</td> <td>Sorat Beniary<br/>Coatai<br/>Orastia<br/>Coatai<br/>Diagany Coatai<br/>Hangany 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Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Hangany<br>Han 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Table S6. Sur	mmary of previously pusblished individua Group label (in this study)	Is used in the 1240k dataset	Country	a High OxC	a low OxCa	acarbon Date	ocarbon Dat	Sex	MtDNA be	Y be	Group label (published)	Source
MX188	CH_2800_2200_CWC	Spreitenbach CWC	Switzerland	2495	2399	oon odt		M	U2e2a1d	12a1a2	Spreitenbach CWC	FurtwanglerNatureCommunications2020
NX191 MX196	CH_2800_2200_CWC CH_2800_2200_CWC	Spreitenbach CWC Spreitenbach CWC	Switzerland Switzerland	25/0 2580	2190 2290			M F	ns+16189 J1c3	128182	Spreitenbach CWC	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020
MX197	CH_2800_2200_CWC	Spreitenbach CWC	Switzerland	2490	2294			F	H11a+152		Spreitenbach CWC	FurtwanglerNatureCommunications2020
MX198 MX199	CH_2800_2200_CWC	Spreitenbach CWC	Switzerland	2900	2300			F	J2b1a		Spreitenbach CWC	FurtwanglerNatureCommunications2020
MX195 MX192	CH_2800_2200_CWC	Spreitenbach CWC	Switzerland	2470	2050			M	H11a+152 H11a+152	12a1a2 12a1a2	Spreitenbach CWC Spreitenbach CWC	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020
MX190	CH_2800_2200_CWC	Spreitenbach CWC	Switzerland	2860	2460			M	U2e2a1d	IZa1a2	Spreitenbach CWC	FurtwanglerNatureCommunications2020
Aesch25 MX298	CH_2800_2200_CWC CH_2800_2200_CWC	Aesch Wartau	Switzerland	2864 2620	2501			M	X2b+22b X2b4	G2a2b2a	Wartau	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020
SX21 SX26	CH_2800_2200_FN CH_2800_2200_FN	Wartau Wartau	Switzerland Switzerland	2462 2461	2299 2295			F	H3 K2b1		Wartau Wartau	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020
SX17	CH_2800_2200_FN	Wartau	Switzerland	2470	2336			F	U4a2f		Wartau	FurtwanglerNatureCommunications2020
SX10 KNE002	CH_2800_2200_FN CZ_2200_1700_Unetice_EBA	Kapperswii Zurichstrasse Bohemia	Czechia	2695	2481 1979	3705	34	F	U3a1 T2a1b1a1	G2a2a1a2a1a	Bohemia_Unetice_preClassical	PapacScienceAdvances2021
KNE003 KNE005	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2131	1946	3648	19	F	J1c K2a11		Bohemia_Unetice_preClassical Bohemia_Unetice_preClassical	PapacScienceAdvances2021 PapacScienceAdvances2021
KNE007	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2133	1947	3651	20	F	T1a1		Bohemia_Unetice_preClassical	PapacScienceAdvances2021
KO1005 KO1007	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	2020	1780	3570 3460	25	F M	H17 R1b1	R1a - Z645	Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
KO1008	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2026	1883	3589	24	M	U2e2a1c	R1b - P312	Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
KO1000	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2027	1890	3599	24	F	H1b		Bohemia_Unetice_Classical	PapacScienceAdvances2021
KO1011 KO1013	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2136	1950	3660	25	F	W1c H3d		Bohemia_Unetice_preclassical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
KO1014 KO1015	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	1018	1745	3509	24	M	HV USa1i1	R1a - Z645	Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
KO7001	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2135	1947	3655	24	M	l4a	R1a - Z645	Bohemia_Unetice_preClassical	PapacScienceAdvances2021
MIB001	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	1919	1751	3516	20	M	H24 T2b	R1b - P312	Bohemia_Unetice_preclassical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
MIB002 MIB003	CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia	1884	1749	3494	19	F	U4b1b1 K1a1b7a		Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
MIB004	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	1888	1751	3503	18	M	R1b1	R1b - P312	Bohemia_Unetice_Classical	PapacScienceAdvances2021
MIB005 MIB024	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	1886	1749 1827	3498	19 22	F	H2a1b H1b		Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
MIB028 MIB034	CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia	2013	1779	3562 3416	22	F	U5b2a2c H7b		Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
MIG010	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2135	1951	3659	23	F	T2e		Bohemia_Unetice_preClassical	PapacScienceAdvances2021
MIG011 MIG012	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	2136	1949	3658	24	F	R1b J1c1b1a	G2a2b2a	Bohemia_Unetice_preClassical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
MIS001	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2026	1892	3601	19	M	U5b1c1a	R1b - P312	Bohemia_Unetice_Classical Rohemia_Unetice_Classical	PapacScienceAdvances2021
MIS004	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	1959	1773	3550	23	M	H17	12a2a	Bohemia_Unetice_Classical	PapacScienceAdvances2021
MIS006 PMI003	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	2452 2192	2152	3833 3670	27 35	F	L1'2'3'4'5'6 N1a1a1a2	R1b - P312	Bohemia_Unetice_preClassical Bohemia_Unetice_preClassical	PapacScienceAdvances2021 PapacScienceAdvances2021
PMI004 PMI006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	2141 2284	1956 2037	3675 3750	30 30	M	H2a2b U5a1e1	12a2 12a1	Bohemia_Unetice_preClassical Bohemia_Unetice_preClassical	PapacScienceAdvances2021 PapacScienceAdvances2021
PMI009	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	2021	1773	3560	35	M	T2b	R1b*	Bohemia_Unetice_Classical	PapacScienceAdvances2021
PMI010 PMI012	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	2033 1877	1831 1564	3595 3410	30 40	F	н13а1а J2b1a		Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
ROU001 ROU006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia		-			F	U5a1g2 H74		Bohemia_Unetice_preClassical Bohemia_Unetice_preClassical	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI039	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia					F	T2b		Bohemia_Unetice_preClassical	PapacScienceAdvances2021
VLI042 VLI045	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	1940 2194	1696 1778	3504 3623	41 58	M F	U5a1g2 J1c1b1a	12a2	Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI046 VI I047	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Rohemia	Czechia	1958	1748	3536	34	F	H3 T2c1d1+		Bohemia_Unetice_Classical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI050	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	1950	1745	3526	36	F	H7a1		Bohemia_Unetice_Classical	PapacScienceAdvances2021
VLI058 VLI060	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	Bohemia Bohemia	Czechia Czechia	2203	2032	3725	28	F	W1i T1a1		Bohemia_Unetice_preClassical Bohemia_Unetice_Classical	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI061	CZ_2200_1700_Unetice_EBA	Bohemia	Czechia	31.40	1700	2610	53	F	V	-	Bohemia_Unetice_preClassical	PapacScienceAdvances2021
14885	CZ_2200_1700_01letibe_EBA	Bohemia	Czechia	2291	2142	3790	20	M	U5a1i	R1b - P312	Bohemia_BB_Late	OlaldeNature2018
14886 14887	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia	2270 2201	2039 2037	3740 3730	20	M	H6a K1a2c	R1b - P312 R1b - P312	Bohemia_BB_Late excluded (kinship)	OlaldeNature2018 OlaldeNature2018
14888	CZ 2500 2000 BBC	Bohemia	Czechia	2195	2027	3700	20	M	K1a2c	R1b - P312	Bohemia_BB_Late	OlaldeNature2018
14889	CZ_2500_2000_BBC	Bohemia	Czechia	2284	2056	3765	20	M	J2a1a2	R10 - P312 R1b - P312	Bohemia_BB_Late	OlaldeNature2018 OlaldeNature2018
14895	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia	2276	2042	3750	20	M F	H1+16189 U5a2+16294	R1b - P312	Bohemia_BB_Late Bohemia_BB_Late	OlaldeNature2018 OlaldeNature2018
15514	CZ_2500_2000_BBC	Bohemia Bohemia	Czechia	2287	2140	3780	20	M	T2b+152	R1b - P312	Bohemia_BB_Late	OlaldeNature2018
17205	CZ_2500_2000_BBC	Bohemia	Czechia	2201	2037	3730	20	M	H10+(16093) H6a1b4	R1b - P312 R1b - P312	Bohemia_BB_Late	OlaldeNature2018
17211	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia	2296 2454	2143 2201	3800 3840	20	F	U5b3 K1b1a1+199	R1b - P312	Bohemia_BB_Late excluded (kinship)	OlaldeNature2018 OlaldeNature2018
17213	CZ_2500_2000_BBC	Bohemia	Czechia	2440	2201	3835	20	F			Bohemia_BB_Late	OlaideNature2018
1/214 17249	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia	2138	1973	3670	20	M	12	R1b - P312	Bohemia_BB_Late	OlaldeNature2018 OlaldeNature2018
17251	CZ_2500_2000_BBC	Bohemia	Czechia					M	U2e1h T2e	R1b - P312 R1b - P312	Bohemia_BB_Late Bohemia_BB_Late	OlaldeNature2018 OlaldeNature2018
17275	CZ_2500_2000_BBC	Bohemia	Czechia					M	U5b2c	R1b - P312	Bohemia_BB_Late	OlaldeNature2018
17278	CZ_2500_2000_BBC	Bohemia	Czechia	2462	2298	3890	20	M	U4a	R10 - P312 R1b - P312	Bohemia_BB_Late	OlaldeNature2018
17281	CZ_2500_2000_BBC	Bohemia Bohemia	Czechia	2340	2146	3810	20	F	H5a1g K1a3a3	R1b - P312	Bohemia_BB_Late Bohemia_BB_Late	OlaldeNature2018 OlaldeNature2018
17283	CZ_2500_2000_BBC	Bohemia	Czechia	2465	2201	3860	45	F	K1a3a3	R10-P312	excluded (kinship)	OlaldeNature2018
17286	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia	2403 2456	2199 2209	3830 3860	20	M	I4a U8b1b1	R1b - P312 R1b - P312	Bohemia_BB_Late Bohemia BB Late	OlaldeNature2018 OlaldeNature2018
17290 KO1003	CZ_2500_2000_BBC	Bohemia Bohemia	Czechia	2294	2136	3783	25	F	V3 HV	P1h - P317	Bohemia_BB_Late	OlaldeNature2018 PanacScienceAdvances 2021
KO1003	CZ_2500_2000_BBC	Bohemia	Czechia	2291	2140	3787	24	M	T2b11	R1b - P312	Bohemia_BB_Late	PapacScienceAdvances2021
KO1005 KOP001	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia	2463	2296	3892	24	F	H1 U3a1		Bohemia_BB_Late Bohemia_BB_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
KOP002 KOP003	CZ_2500_2000_BBC	Bohemia Bohemia	Czechia	2468	2299	3907	24	M	U5a2b HV15	R1b - P312 R1b - P312	Bohemia_BB_Late Bohemia_BB_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
PRU001	CZ_2500_2000_BBC	Bohemia	Czechia	2464	2296	3893	25	F	HV9		Bohemia_BB_Late	PapacScienceAdvances2021
PRU002 PRU003	CZ_2500_2000_BBC	Bohemia Bohemia	Czechia	2574	2466	3995	23	F	K1a3a T2b		Bohemia_BB_Early Bohemia_BB_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
PRU004 PRU005	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia	2455	2204	3848	24	M F	H4a1a1a N1a1a1a2	R1b - P312	Bohemia_BB_Late Bohemia_BB_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI022	CZ 2500 2000 BBC	Bohemia	Czechia	2455	2204	3848	26	F	U4b1b1	P1b 0212	Bohemia_BB_Late	PapacScienceAdvances2021
VLI024 VLI026	CZ_2500_2000_BBC	Bohemia	Czechia					F	X2b	R10-F312	Bohemia_BB_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI029 VLI030	CZ_2500_2000_BBC CZ_2500_2000_BBC	Bohemia Bohemia	Czechia Czechia					M	W3a1c U2e1b	R1b - P312 R1b - P312	Bohemia_BB_Late Bohemia BB Late	PapacScienceAdvances2021 PapacScienceAdvances2021
17279	CZ_2900_2200_CWC	Bohemia	Czechia					M	H7d	R1a - M417 (xZ645)	Bohemia_CW_Late	OlaldeNature2018
KO1002	CZ_2900_2200_CWC	Bohemia	Czechia	2838	2474	4055	29	M	X2b4	R1b - L151	Bohemia_CW_Early	PapacScienceAdvances2021
KO1004	CZ_2900_2200_CWC	Bohemia	Czechia Czechia	28/4 2291	2627 2140	4147 3787	24 24	M	T2b1	R1b - P312	Bohemia_CW_Early Bohemia_BB_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
OBR001 OBR003	CZ_2900_2200_CWC	Bohemia	Czechia	2841	2490 2786	4064	23	F	HV6	R1b - 1151	Bohemia_CW_Early Bohemia_CW_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
OBR004	CZ_2900_2200_CWC	Bohemia	Czechia	2831	2472	4048	26	F	K2a5	Dat There	Bohemia_CW_Early	PapacScienceAdvances2021
OHROU1 OHRO02	CZ_2900_2200_CWC	Bohemia	Czechia	25/3	2403	396/ 4016	25	F	R1a1a	n10 - 22103	Bohemia_CW_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
PNL001 PNL002	CZ_2900_2200_CWC CZ_2900_2200_CWC	Bohemia Bohemia	Czechia Czechia	2919 2869	2875 2505	4271 4110	25 35	M	U5a2a1 H3b	R1b - U106 R1a - M417 (xZ645)	Bohemia_CW_Early Bohemia_CW_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
RDV001	CZ_2900_2200_CWC	Bohemia Rohemia	Czechia	2849	2496	4080	25	M	W6a	R1a - M417 (xZ645) R1a - M417 (xZ645)	Bohemia_CW_Early Bohemia_CW_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
STD002	CZ_2900_2200_CWC	Bohemia	Czechia	2885	2668	4177	24	M	11a	R1b - L151	Bohemia_CW_Early	PapacScienceAdvances2021
VLI007	CZ_2900_2200_CWC	Bohemia	Czechia Czechia	2853 2890	2501 2677	4093 4196	25	F	Hiq U5a2a1		Bohemia_CW_Early Bohemia_CW_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI010 VII016	CZ_2900_2200_CWC	Bohemia Rohemia	Czechia	2621	2470	4027	25 26	F	H5a1 K1b1a1	R1a - M417 (x7645)	Bohemia_CW_Late Bohemia_CW_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI017	CZ_2900_2200_CWC	Bohemia	Czechia	2467	2297	3902	28	F	X2b	D10 54447 (-2043)	Bohemia_CW_Late	PapacScienceAdvances2021
VLI019 VLI020	CZ_2900_2200_CWC	Bohemia Bohemia	Czechia Czechia	2572	2351	3966	25	M F	H5c I4a	к1а - M417 (xZ645)	Bohemia_CW_Late Bohemia_CW_Late	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI067 VLI071	CZ_2900_2200_CWC CZ_2900_2200_CWC	Bohemia Bohemia	Czechia Czechia	2883 2882	2636 2635	4172 4171	24 26	F	T1a1 H		Bohemia_CW_Early Bohemia_CW_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI076	CZ_2900_2200_CWC	Bohemia	Czechia	3018	2898	4339	25	F	N1a1a1a2	p16 0310	Bohemia_CW_Early	PapacScienceAdvances2021
VLIU81 VLI085	CZ_2900_2200_CWC	Bohemia Bohemia	Czechia	2865	2573	4109	27	M	J1c2m	K10 - P310 R1b - L151	Bohemia_CW_Early Bohemia_CW_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI088 VLI090	CZ_2900_2200_CWC CZ_2900 2200 CWC	Bohemia Bohemia	Czechia Czechia	3081 3087	2497 2576	4217 4241	92 84	F	HV J1b1a1		Bohemia_CW_Early Bohemia CW Early	PapacScienceAdvances2021 PapacScienceAdvances2021
VLI092	CZ_2900_2200_CWC	Bohemia Rohemia	Czechia	2884	2637	4175	25	M E	N1a1a1a2	R1b - L151	Bohemia_CW_Early	PapacScienceAdvances2021 PapacScienceAdvances2021
AITI_119	DE_2000_1500_EBA	Kleinaitingen – Gewerbegebiet Nord	Germany	1883	1695	3470	27	M	U4a1a	R1b1a2a1a	Lech_EBA	MittnikScience2019
AITI_2 AITI_33	DE_2000_1500_EBA DE_2000_1500_EBA	Kleinaitingen – Gewerbegebiet Nord Kleinaitingen – Gewerbegebiet Nord	Germany Germany	1885 1740	1696 1542	3477 3364	28	M	H6a H2a2a1	R1b1a2a1a2*	Lech_EBA Lech_EBA	MittnikScience2019 MittnikScience2019
AITI_43	DE_2000_1500_EBA	Kleinaitingen – Gewerbegebiet Nord	Germany	1888	1700	3486	27	M	X2b+226	R1b1a2a1a2*	Lech_EBA	MittnikScience2019 MittnikScience2010
AITI_70	DE_2000_1500_EBA	Kleinaitingen – Gewerbegebiet Nord	Germany	2116	1742	3594	33	M	J1c2c2	R1b1a2a1a2*	Lech_EBA	MittnikScience2019
AITI_72 AITI_98	DE_2000_1500_EBA DE_2000_1500_EBA	Kleinaitingen – Gewerbegebiet Nord Kleinaitingen – Gewerbegebiet Nord	Germany Germany	1931 1742	1742 1544	3508 3370	34 27	M	J1c2c2 H49	R1b1a2a1a2* R1b1a2a1a2*	Lech_EBA Lech_EBA	MittnikScience2019 MittnikScience2019
OBKR_80	DE_2000_1500_EBA	Königsbrunn – Obere Kreuzstraße (Baugebiet 110) Haumstetten – Doctillionsten Po	Germany	2136	1955	3664	24	M	K1a3 K7a5	R1b1a2a1a2* R1b1a2a1a2*	Lech_EBA	MittnikScience2019 MittnikScience2010
POST_6	DE_2000_1500_EBA	Haunstetten – Postillionstraße	Germany	2027	1830	3574	19	M	U5a1a1+16362	R1b1a2a1a2*	Lech_EBA	MittnikScience2019
PUST_99 EHR_1415ad	DE_2000_1500_EBA	Haunstetten – Postillionstraße Wehringen – Hochfeld	Germany Germany	2133 2014	1931 1830	3641 3573	25 19	F	к1а4а1 H13a2b2a		Lech_EBA Lech_EBA	MittnikScience2019 MittnikScience2019
WEHR_1586	DE_2000_1500_EBA	Wehringen – Hochfeld Singer (D)	Germany	1952	1776	3550	19	F	V H23	R1h1a1h1a1e3h1	Lech_EBA Singen (D)	MittnikScience2019
MX252 MX254	DE_2000_1500_EBA DE_2000_1500_EBA	Singen (D) Singen (D)	Germany	1941	1//4			M	H#16129	R1b1a1b1a1a2b1	Singen (D)	FurtwanglerNatureCommunications2020
MX257 MX286	DE_2000_1500_EBA DE_2000_1500_EBA	Singen (D) Singen (D)	Germany Germany	1879 2029	1696 1892		L	M	U4a1a N1b1b	R1b1a1b1a1a2b1 R1b1a1b1a1a2b1	Singen (D) Singen (D)	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020
MX270 MX279	DE_2000_1500_EBA DE_2000_1500_EBA	Singen (D) Singen (D)	Germany	1887	1705	-		M	W3a1 H76a	R1b1a1b1a1a2b1 R1b1a1b1a1a2b1	Singen (D)	FurtwanglerNatureCommunications2020
MX280	DE_2000_1500_EBA	Singen (D)	Germany	2035	1910			F	U5a1		Singen (D)	FurtwanglerNatureCommunications2020
MX275 MX283	DE_2000_1500_EBA	Singen (D) Singen (D)	Germany Germany	2135 2116	1961 1926	L	L	M	W3a1 H+16129	кіріа1b1a1a2b1 R1b1a1b1a1a2b1	Singen (D) Singen (D)	FurtwanglerNatureCommunications2020 FurtwanglerNatureCommunications2020
MX277 HUGO 168	DE_2000_1500_EBA DE_2500_2000_BBC	Singen (D) Augsburg – Hugo–Eckener–Straße	Germany	1926 2291	1770 2140	378R	23	F	H5a1 H1		Singen (D) Lech BBC	FurtwanglerNatureCommunications2020 MittnikScience2019
NTA58_685k	DE_2500_2000_BBC	Haunstetten – Unterer Talweg 58–62	Germany	2468	2305	3910	20	F	Kla	D11-4-3-4-7*	Lech_BBC	MittnikScience2019
EHR_11925	DE_2500_2000_BBC	maunstetten – Unterer Tälweg 85 I (northern group) Wehringen – Hochfeld	Germany	2401 2339	2146 2147	3819 3810	24 19	M	J1c2 K1a4a1	R1b1a2a1a2*	Lech_BBC	MittnikScience2019 MittnikScience2019
10108	DE_2500_2000_BBC DE_2500_2000_BBC	Rothenschirmbach Quedlinburg	Germany Germany	2396 2455	2034 2141	3953 3820	47	F	H5a3 H13a1a7		Beaker Central Europe Beaker Central Furone	OlaldeNature2018 OlaldeNature2018
10113	DE 2500 2000 BBC	Quedlinburg	Germany	2575	2297	3773	47	F	J1c5	Bibiatabat-	Beaker Central Europe	OlaldeNature2018
13589	DE_2500_2000_BBC	Alburg-Lerchenhaid, Spedition Haring, Stkr. Straubing, Bavaria Alburg-Lerchenhaid, Spedition Häring, Stkr. Straubing, Bavaria	Germany	L	2	1ð	L	M	U4d1	R1b1a1a2a1a2b1	Beaker Central Europe	OlaldeNature2018 OlaldeNature2018
13590	DE_2500_2000_BBC	Alburg-Lerchenhaid, Spedition Häring, Stkr. Straubing, Bavaria	Germany	2341	2141	3802	26	F	H1 TH		Beaker Central Europe	OlaldeNature2018

13601 15519	DE_2500_2000_BBC DE_2500_2000_BBC	Alburg-Lerchenhaid, Spedition Häring, Stkr. Straubing, Bavaria Augsburg Sportgelände, Augsburg, Bavaria	Germany Germany					F	H10e 14a	R1b1a1a2a1a2b1	Beaker Central Europe Beaker Central Europe	OlaldeNature2018 OlaldeNature2018
15521	DE_2500_2000_BBC DE_2500_2000_BBC	Augsburg Sportgelände, Augsburg, Bavaria Irlbach, County of Straubing-Bogen, Bavaria	Germany Germany					F	J1b1a1 J1c	R1b1a1a2a1a2b1	Beaker Central Europe Beaker Central Europe	OlaldeNature2018 OlaldeNature2018
15834 16590 16591	DE_2500_2000_BBC DE_2500_2000_BBC DE_2500_2000_BBC	Irlbach, County of Straubing-Bogen, Bavaria Irlbach, County of Straubing-Bogen, Bavaria Irlbach, County of Straubing-Bogen, Bavaria	Germany Germany					F	X2c1 U5b2c		Beaker Central Europe Beaker Central Europe Beaker Central Europe	OlaldeNature2018 OlaldeNature2018 OlaldeNature2018
15835 112208	DE_2500_2000_BBC ES_2000_1200_BA	Irlbach, County of Straubing-Bogen, Bavaria La Requejada, San Román de Hornija, Valladolid, Castilla y León	Germany Spain					M	J1c K1a1b1	R1b1a1a2a1a2b1	Beaker Central Europe C Iberia BA Cogl	OlaldeNature2018 OlaldeScience2019
ALM001 ALM002	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1960 1943	1769 1769	3544 3532	27 24	F M	X2b+226 K1b1a1c	 R1b1a1b1a1a2	Almoloya_Argar_Early Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM003 ALM006	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1919	1770	3520	14	F	X2b+226 H	R1b1a1b1a1a2a1	Almoloya_Argar_Late Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM007 ALM008	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1000	1746	2507	24	F	H1 V K1a4a1	Ribiaibiaia2	Almoloya_Argar_Early Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM015 ALM016	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pilego, Murcia La Almoloya, Pilego, Murcia	Spain	1898	1746	3534	24	M	H1+16189 T2b21	R1b1a1b1a1a2a1	Almoloya_Argar_Early Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM019 ALM020	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	2127	1901	3631	24	F	K1b1a1c K1a3a		Almoloya_Argar_Early Almoloya Argar Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM021 ALM025	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					F M	U5b3 H3	 R1b1a1b1a1a2	Almoloya_Argar_Early Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM026 ALM028	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					F M	K1a1b1 K1a+195	 R1b1a1b1a1a2a1	Almoloya_Argar_Early Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM029 ALM032	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					F	H1bd T2b3+151	 R1b1a1b1a1a2a1	Almoloya_Argar_Late Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM035 ALM036	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	4744	45.44	2266	22	F M	K1a+195 U5b3	 R1b1a1b1a1a2a1	Almoloya_Argar_Early Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM038 ALM039	ES_2000_1200_BA ES_2000_1200_BA FS_2000_1200_BA	La Almoloya, Pilego, Murcia La Almoloya, Pilego, Murcia La Almoloya, Pilego, Murcia	Spain	1741 1739 2012	1541 1535 1775	3354 3555	32	M	J1c2 U5b2b3a	R1b1a1b1a1a2a1 R1b1a1b1a1a2	Almoloya_Argar_Late Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM041 ALM042	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain	1944	1774	3540	19	M	H1e1a H4a1a	R1b1a1b1a1a2a1b	Almoloya_Argar_Early Almoloya Argar Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM044 ALM047	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1896	1750	3512	19	F	H3 H6a1b	Ribiaibiaia2	Almoloya_Argar_Early Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM050 ALM051	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					M F	H3 V	Ribiaibiaia2ai	Almoloya_Argar_Early Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM053 ALM055	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					F	H1 K1a4a1e		Almoloya_Argar_Early Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM057 ALM053	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain	18/4	1642	3436	19	M	H1 K1a+195	Ribiaibiaia Ribiaibiaia2ai Ribiaibiaia2ai	Almoloya_Argar_Late Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM064 ALM067	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Piego, Murcia La Almoloya, Piego, Murcia	Spain					F	U5b1f1a K1a4b		Almoloya_Argar_Late Almoloya_Argar_Early Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM069 ALM071	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					M	H1q1 K1a1b1	R1b1a1b1a1a2	Almoloya_Argar_Early Almoloya Argar Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM075 ALM076	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					F	U5b1e H1+16189		Almoloya_Argar_Early Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM078 ALM081	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain					M	K1a U5b3	Ribiaibiaia2 Ribiaibiaia2ai	Almoloya_Argar_Late Almoloya_Argar_Late	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM084 ALM086	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1932	1767	3524	21	F	K2a U5b1f1		Almoloya_Argar_Late Almoloya_Argar_Early	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALMU87 ALM088 BAS002	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia Ja Bactida Totana Murcia	Spain Spain Spain	1620	1504	3300	77	F	XZ V H1e10	  Riktatkia1+7	Aimoioya_Argar_Late Almoloya_Argar_Early Bastide_Argar	virializa-moucoscienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
BAS022 BAS073	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	La Bastida, Totana, Murcia La Bastida, Totana, Murcia La Bastida, Totana, Murcia	Spain Spain	2130	1941	3647	20	M	K1a+195 U5b2b3	Ribiaibiaia2 Ribiaibiaia2	Bastida_Argar Bastida Argar	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
BAS024 BAS025	ES_2000_1200_BA ES_2000_1200_BA	La Bastida, Totana, Murcia La Bastida, Totana, Murcia	Spain	2192 2134	1980 1947	3688 3653	23	M	K1a+195 H105a	R1b1a1b1a1a2 E1b1b1a1b1	Bastida_Argar Bastida_Argar	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
BAS027 CBR004	ES_2000_1200_BA ES_2000_1200_BA	La Bastida, Totana, Murcia Cabezo Redondo, Villena, Alicante	Spain Spain	1538	1447	3244	20	F	V3a H4a1a		Bastida_Argar SE_CabezoRedondo_BA	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
CM0001 EFA011	ES_2000_1200_BA ES_2000_1200_BA	Cerro del Morrón, Moratalla, Murcia Forat de ses Aritges, Gutadella, Menorca	Spain Spain	1881	1687	3455	28	F	T2c1d+152 U5b2a		SE_Iberia_BA_Argar Aritgues_LBA	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
LH0001 LH0003	ES_2000_1200_BA ES_2000_1200_BA	Aspe, Alicante Aspe, Alicante Villuea Alicante	Spain Spain	1611 1669	1441 1504	3250 3310	30 30	F F	K1a+195 U5b1b1g	R1b1a1b1a1a2a1 	SE_Iberia_BA_Valencian SE_Iberia_BA_Valencian	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
PUC001 PUC002	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	Villena, Alicante Villena, Alicante Villena, Alicante	Spain Spain	1879	1693	3461	19	F	K18+195 H3		SE_IDENIA_BA_Valencian SE_IDENIA_BA_Valencian SE_IDENIA_BA_Valencian	virialba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2022
PUC002 PUC003 PUC004	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	Villena, Alicante Villena, Alicante	Spain	1882	1746	3486	20	F	U5b2a+@16192 V		SE_Iberia_BA_Valencian SE_Iberia_BA_Valencian	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM031 ALM034	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1954	1772	3544	24	F	J2b1a K1a+195		Almoloya_Argar_1stdegree_relative Almoloya Argar 1stdegree relative	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM058 ALM050	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia La Almoloya, Pliego, Murcia	Spain Spain	1878	1644	3444	23	M F	U5b1f1 U5a1+@16192	R1b1a1b1a1a2a1 	Almoloya_Argar_1stdegree_relative Almoloya_Argar_1stdegree_relative	Villalba-MoucoScienceAdvances2021 Villalba-MoucoScienceAdvances2021
ALM080 esp005	ES_2000_1200_BA ES_2000_1200_BA	La Almoloya, Pliego, Murcia Cueva de los Lagos, La Rioja	Spain Spain					M	U5b3 K1a	R1b1a1b1a1a2 R1b-DF27	Almoloya_Argar_1stdegree_relative ES_2000_1200_BA	Villalba-MoucoScienceAdvances2021 ValdioseraPNAS2018
EHU001 EHU002	ES_2500_2000_CA ES_2500_2000_CA	El Hundido, Monasterio de Rodilla, Burgos, Castilla y León El Hundido, Monasterio de Rodilla, Burgos, Castilla y León	Spain Spain	2287 2564	2041 2299	3760 3933	30 32	M	USa1b1 K1a4a1	R1b1a1a2a1(xR1b1a1a2a1a2a5) R1b1a1a2a1a2(xR1b1a1a2a1a2a5)	C_Iberia_CA_Stp C_Iberia_CA_Stp	OlaldeScience2019 OlaldeScience2019
10459 10460	ES_2500_2000_CA ES_2500_2000_CA	Arroyal I, Alfoz de Quintanadueñas, Burgos, Castilla y León Arroyal I, Alfoz de Quintanadueñas, Burgos, Castilla y León	Spain Spain	2460	2206	3860	30	F M	U5b2b H45	 12a2a	C_Iberia_CA C_Iberia_CA	OlaideNature2018 OlaideNature2018
13238	ES_2500_2000_CA ES_2500_2000_CA ES_2500_2000_CA	Cueva de la Paloma, Soto de las Regueras, Asturias Cueva de la Paloma, Soto de las Regueras, Asturias Camino de las Veseras. San Estenando de Henares communito of Madrid	Spain	2453	2201	3870	30	M	H3+152 T2h3	R1b1a1a2a	NW_lberia_CA_Stp	OlaldeScience2019 OlaldeNature2018
15665	ES_2500_2000_CA ES_2500_2000_CA	Virgazal, Tablada de Rudrón, Burgos, Castilla y León Humanejos, Parla, Community of Madrid	Spain Spain	2283	1983	3730	40	M	K1a24a T2b3+151	R1b1a1a2a1a2 R1b1a1a2a1a2(xR1b1a1a2a1a2c)	C_Iberia_CA_Stp C_Iberia_CA_Stp	OlaldeNature2018 OlaldeNature2018
16623 BIS130	ES_2500_2000_CA FR_2200_1200_BA	Camino de las Yeseras, San Fernando de Henares, Community of Madrid Muehlacker, Grand-Est (East), Bischwihr	Spain France					F M	U5b1f1a K2b1b	 R1b1a1a2	C_Iberia_CA_Stp France Bronze Age A2a	OlaldeNature2018 BruneIPNAS2020
BIS385 NIED	FR_2200_1200_BA FR_2200_1200_BA	Muehlacker, Grand-Est (East), Bischwihr Innere Allmende, Grand-Est (East), Niederergheim	France					F	T2c1d2a U5b2b		France Bronze Age A2a France Bronze Age IIIb	BrunelPNAS2020 BrunelPNAS2020
OBE3626-1 OBE3722	FR_2200_1200_BA FR_2200_1200_BA	PAEI, Grand-Est (East), Obernai PAEI, Grand-Est (East), Obernai	France	1930	1701	3505	35	F	R1b 15	Ribiaiaz	France Early Bronze Age France Early Bronze Age	BruneIPNAS2020 BruneIPNAS2020
PSS41/0 GBVPO 110342	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	Pont-sur-Seine, Grand-tst (East), Pont-sur-Seine Grotte Basse de la Vigne Perdue, les Monges	France	1737	19/5	3690	30	F	H25 U5b3 W6	Ribialazaza	France Early Bronze Age France Middle Bronze Age	Seguin-OrlandoPNAS2020 PattersonNature2021
110343 110344	FR_2200_1200_BA FR_2200_1200_BA	Lauzet-Ubaye, Villard Lauzet-Ubaye, Villard	France					F	J1c5 H3+152		France_LN_EBA France_LN_EBA	PattersonNature2021 PattersonNature2021
110345 110347	FR_2200_1200_BA FR_2200_1200_BA	Lauzet-Ubaye, Villard Lauzet-Ubaye, Villard	France					F M	H1e1a T1a	G2a2b2a1a1b	France_LN_EBA_OEEF France_LN_EBA	PattersonNature2021 PattersonNature2021
PIR3037AB PIR3116B	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	Rec de Ligno, Occitanie (South), Valros Rec de Ligno, Occitanie (South), Valros	France	2196 2340	1903 2064	3663 3790	43 30	M	U4c1 H2a1e	Ribiaia2 Ribiaia2 Ribiaia2	France Early Bronze Age France Early Bronze Age	BrunelPNAS2213 BrunelPNAS2212
TORTF PIR6	FR_2200_1200_BA FR_2200_1200_BA	Grotte des Tortues, les Monges Le Pirou, Occitanie (South), Valros	France	2008 1744	1825 1519	3565 3356	15 43	F	H6a1a V		France Early Bronze Age France Middle Bronze Age	Seguin-OrlandoPNAS2021 BruneIPNAS2020
QUIN234 QUIN58	FR_2200_1200_BA FR_2200_1200_BA	Quinquiris, Occitanie (South), Castelnaudary Quinquiris, Occitanie (South), Castelnaudary	France					F	H3m H1ah	R1b1a1a2	France Early/Middle Bronze Age France Early/Middle Bronze Age	BrunelPNAS2020 BrunelPNAS2020
RIX15 RIX2	FR_2200_1200_BA FR_2200_1200_BA	Zac du Petit Prince, Grand-Est (East), Rixheim Zac du Petit Prince, Grand-Est (East), Rixheim	France	4004	4745	2405	25	M	T2b19 T2c1d-152	R1b1a1a2a1a R1b1a1a2a1a	France Bronze Age A2a France Bronze Age A2a	BrunelPNAS2020 BrunelPNAS2020
115033	FR_2200_1200_BA FR_2200_1200_BA	Morbinan, Quiberon, Port Blanc Morbihan, Quiberon, Port Blanc Marlans Sur Jas Parmae, Hauta-Sauria	France	2437	2147	3825	25	F	J1c2e	R101a101a1a2	France_EBA France_N_o Beaker Southern France	PattersonNature2021 PattersonNature2021 OlaldeNature2018
11389 11381	FR_2500_2000_BBC FR_2500_2000_BBC	Sierentz, Les Villas d'Aurele, Haut-Rhin Mondelange, PAC de la Sente, Moselle	France	2553	2302	3929	23	M	X2b4a H	R1b1a1a2a1a2 R1b1a1a2a1a	Beaker Central Europe Beaker Central Europe	OlaldeNature2018 OlaldeNature2018
11382 11390	FR_2500_2000_BBC FR_2500_2000_BBC	Mondelange, PAC de la Sente, Moselle Sierentz, Les Villas d'Aurele, Haut-Rhin	France	2447 2552	2136 2238	3805 3910	35 35	M	U5a2c3a X2b4a	R1b1a1a2a1a2 R1b1a1a2a1a2	Beaker Central Europe Beaker Central Europe	OlaldeNature2018 OlaldeNature2018
11391 CBV95	FR_2500_2000_BBC FR_2500_2000_BBC	Rouffach, Haut-Rhin La Bouche-à-Vesle, Hauts-de-France (North), Ciry_Salsogne	France	2400 2575	2058 2350	3795 3970	35 30	F	J1c4 J2a1a1	R1b1a1a2	Beaker Central Europe France Campaniforme	OlaldeNature2018 BrunelPNAS2193
GBVPK PEI2	FR_2500_2000_BBC FR_2500_2000_BBC	Grotte Basse de la Vigne Perdue, les Monges Dolmen des Peirières, Occitanie (South), Villedubert	France	2461 2564	2300 2302	3890 3935	30	M	J2b1a H3	R1b1a1b1a1a2a1 G2a2b2b1a1~	Beaker Southern France France Campaniforme	Seguin-OrlandoPNAS2021 BruneIPNAS2194
13875 116247	FR_2500_2000_BBC FR_2500_2000_BBC FR_E_2800_2200_IN	Villard, Lauzet-Ubaye Villard, Lauzet-Ubaye Meurthe-et-Moselle (54), Martincourt	France France	2201 2136 2840	2035 1946 2473	3725 3655 4055	25 25 30	M	H1e U5b3h	R1b1a1a2a1a2b1 I2a1a1a1~	Beaker Southern France France GrandEst FRA	OlaldeNature2018 OlaldeNature2018 PattersonNature2021
SX32 11392	FR_E_2800_2200_LN R_E_2800_2500_BBC/FR_E_2800_2200_L	Lingolsheim (F) Hégenheim Necropole, Haut-Rhin	France	2463 2835	2208 2472	4047	29	M F	N1n1n H1+152	Ribiaibiai	Lingolsheim (F) Beaker Central Europe	FurtwanglerNatureCommunications2020 OlaldeNature2018
113710 113714	GB_2200_1200_BA GB_2200_1200_BA	England, Kent, East Kent Access Road England, Kent, East Kent Access Road	United Kingdom United Kingdom	1411 1533	1203 1417	3040 3210	35 35	M	I4a H1c8	R1b1a1b R1b1a1b1a1a2c1b1	England_MBA England_MBA	PattersonNature2021 PattersonNature2021
113716 116403	GB_2200_1200_BA GB_2200_1200_BA	England, Kent, Margetts Pit England, North Yorkshire, Cockerham, Elbolton Cave	United Kingdom United Kingdom	1391	1129	3019	31	F M	H11a K2a	R1b1a1b1a1a2c1	England_MBA_highEEF England_MBA	PattersonNature2021 PattersonNature2021
119857 119858 119850	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	England, Wittshire, Rowbarrow England, Wittshire, Rowbarrow England Wittshire, Rowbarrow	United Kingdom United Kingdom	1518 1532 1504	1425 1431	3213 3222 3172	28	M	J2b1a J2b1a H3	R1b1a1b1a1a2a2a R1b1a1b1a1a2c1	England_MBA England_MBA	PattersonNature2021 PattersonNature2021 PattersonNature2021
119860	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	England, Wiltshire, Rowbarrow England, Kent, East Kent Access Road	United Kingdom United Kingdom	1504 1503 1408	1403 1401 1226	3169	28	F	T2b21 J1c2e	128102	England_MBA England_MBA	PattersonNature2021 PattersonNature2021 PattersonNature2021
119915 12448	GB_2200_1200_BA GB_2200_1200_BA	England, Kent, East Kent Access Road England, Oxfordshire, Yarnton	United Kingdom United Kingdom	1519	1422	3210	30	F M	K1c1 U8a2	R1b1a1b1a1a2c1b1	England_MBA England_MBA	PattersonNature2021 PattersonNature2021
112776 112786	GB_2200_1200_BA GB_2200_1200_BA	England, Derbyshire, Brassington, Carsington Pasture Cave England, Gloucestershire, Lechlade-on-Thames, Lechlade Memorial Hall/Skate Parl	United Kingdom k United Kingdom	1918 2289	1750 2052	3515 3769	20 27	F M	U4a2c J1c2	R1b1a1b1a1a2c1	England_C_EBA_highEEF England_C_EBA	PattersonNature2021 PattersonNature2021
114543 114553	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	England, Sussex, Brighton, Ditchling Road England, Sussex, Brighton, Roedean Crescent England, Nucht Vorthein, Generation, 2000	United Kingdom United Kingdom	1954	1749	3535	33	F M	K1a4a1g H5c	R1b1a1b1a1a2c1	England_C_EBA England_C_EBA	PattersonNature2021 PattersonNature2021
116395 116306	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	England, North Yorkshire, Grassington, 3 Barrow Sites England, North Yorkshire, Grassington, 3 Barrow Sites England, North Yorkshire, Grassington, 3 Barrow Sites	United Kingdom United Kingdom		<u> </u>			F F	USb1 K1ada1	RID	England_C_EBA England_C_EBA England_C_FBA	PattersonNature2021 PattersonNature2021 PattersonNature2021
116400 116424	GB_2200_1200_BA GB_2200_1200_BA	England, North Yorkshire, Grassington, 3 Barrow Sites England, Cornwall, Padstow, St. Merryn, Harlyn Bay	United Kingdom United Kingdom	2285	2036	3751	32	M F	U3a1 R1b	R1b1a1b1a1a2c	England_C_EBA England_C_EBA	PattersonNature2021 PattersonNature2021
118606 119220	GB_2200_1200_BA GB_2200_1200_BA	England, East Riding of Yorkshire, Thornholme, East Coast Pipeline (field 10) England, East Riding of Yorkshire, Thornholme, East Coast Pipeline (field 10)	United Kingdom United Kingdom	1919 1894	1742 1695	3502 3486	28 32	M F	K1b1a1 H3g1	R1b1a1b1a1a2c1	England_C_EBA England_EBA	PattersonNature2021 PattersonNature2021
120997	GB_2200_1200_BA GB_2200_1200_BA	England, Cumbria, Ulverston, Birkrigg Common England, Somerset, Tickenham, Diamond Cottage	United Kingdom United Kingdom					M	X2b4a H1an1	Ribiaibiaia2cia3b Ribiaibiaia2aia2	England_C_EBA England_EBA_highEEF	PattersonNature2021 PattersonNature2021
12413	GB_2200_1200_BA GB_2200_1200_BA	Scotland, East Lothian, Innerwick, Thurston Mains England, Wiltshire, Amesbury Down England, Wiltshire, Amesbury Down	United Kingdom United Kingdom	2114 2139	1900 1950	3624	22 30	F M	H1a1 H	Ribiaibiai	Scotland_C_EBA_highEEF England_C_EBA	PattersonNature2021 PattersonNature2021
114200 11767 12417	GB_2500_2000_BBC	Windmill Fields, Stockton-on-Tees, North Yorkshire, England Ameshuru: Down, Wiltshire, England	Great Britain Great Britain	24/0	1978	3705	32	M	USa1a1 J1c	12a2a1a1a R1b1a1a2a1a2c	Beaker Britain Beaker Britain	OlaldeNature2018 MathiesonNature2015
12418	GB_2500_2000_BBC GB_2500_2000_BBC	· · · · · · · · · · · · · · · · · · ·	Great Britain	2452	2200 2139	3836 3815	25 40	F	K1a4a1 K1b1a1		Beaker Britain Beaker Britain	MathiesonNature2015 MathiesonNature2015
12440	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	Amesbury Down, Wiltshire, England Yarnton, Oxfordshire, England	Great Britain	2454		2625		M	1	R1b1a1a2a1a2c1		
12447	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	Amesbury Down, Wiltshire, England Yarnton, Oxfordshire, England Yarnton, Oxfordshire, England Abingdon Spring Road cemetery, Oxfordshire, England	Great Britain Great Britain Great Britain	2454 2120 2458	1898 2153	3625	40	F	K1a26 K1a1b1g	MUTUTUTUTUTUTUTU	Beaker Britain Beaker Britain	MathiesonNature2015 MathiesonNature2015
12447 12450 12452 12453	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	Amesbury Down, Willshire, England Yranton, Onfordshire, England Narton, Oxfordshire, England Ablrgdor, Spring Road cemetry, Odrothkre, England Dairy Farm, Willington, England West Deering, Lincofishire, England	Great Britain Great Britain Great Britain Great Britain Great Britain	2454 2120 2458 2282 2290	1898 2153 2028 2038	3625 3841 3735 3760	40 35 35	F M M	K1a2b K1a1b1g H1e1a K2a	Ribiaia2aia2ci Ribiaia2aia2ci	Beaker Britain Beaker Britain Beaker Britain Beaker Britain	MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015
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12447 12450 12452 12453 12454 13256 14950 15379 15512	GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C GB_2500_2000_88C	Ametsury Down, Wittshire, Ingland Yarnton, Ordenshire, England Alangdo Spring Boad cameters, Ordenshire, England Dairy Jarm, Willington, England West Desping, Uncohnive, England Over Narrows, Needingworth Quarry, England Cher Narrows, Needingworth Quarry, England Cher Narrows, Needingworth Charged Charge Strategy, Stock, Strategy, Strategy, Stock Charge Strategy, Stock, Strategy, Stock, England Fayles School, Networks, Wittshire, England Fayles School, Networks, Wittshire, England	Great Britain Great Britain Great Britain Great Britain Great Britain Great Britain Great Britain Great Britain Great Britain Great Britain	2454 2120 2458 2282 2290 2199 2269 2468	1898 2153 2028 2038 1982 2027 2027 2294	3625 3841 3735 3760 3703 3703 3722 3900	25 40 35 35 28 31 30	F M F M M M F	Klazb Klaibig Hiela K2a Riala T2b U5a2d1 HV0+195 J1c	Ribiala2ala2c1 Ribiala2ala2c1 Ribiala2ala2c1 Ribiala2ala2c1 Ribiala2ala2c1 Ribiala2ala2c1 Ribiala2ala2c	Beaker Britain Beaker Britain Beaker Britain Beaker Britain Beaker Britain Beaker Britain Beaker Britain Beaker Britain Beaker Britain	MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015
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12447 12452 12452 12453 12454 13256 14950 15379 15512 15513 16775 16776 16777 16777 16777 16777 16777 12443.56 12445.56 12445.56	68,200,2008,88C 68,200,2008,88C 68,200,2008,88C 69,2000,2008,88C 69,200,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,88C 60,2008,2008,2008,88C 60,2008,2008,2008,2008,2008,2008,2008,20	Ametsury Down, Wittshire, Ingland Yanton, Ordenshire, England Abingdo Spring Boad cometers, Ordenshire, England Dairy Spring Boad cometers, Ordenshire, England Dairy Farm, Willington, England West Despin, Luconshire, England Oren Narrowa, Netedirgworth Quarry, England Chem Karnowa, Netedirgworth Quarry, England Chem Karnowa, Netedirgworth Dorset, England Friengel School, Netherson Withshire, England Reing School, Netherson Withshire, England Weit Karnowa, Stognesse, Somerset, England England, Somerset, Stognesser, Wick Barrow Wildford Down, Wildford-cum-Lake G. 54 Wildford Down, Wildford-cum-Lake G. 54 Yartenco, Andresser, Somerset, England Trampolitor Mendone, England Trampolitor Mendone, England Trampolitor Mendone, School School Trampolitor Mendones, Cancinge, England	Great Britain Great Britain	2454 2120 2458 2282 2199 2269 2468 2468 2468 2468 2468 2468 2468 2468	1898 2153 2028 2038 1992 2027 2294 2294 2027 2294 2028 2028 2028 2028 2028	3645 3841 3735 3760 3703 37722 3900 3650 3650 3650 3661 3185	25 40 35 28 31 30 40 40 35 31 20	F M M M M M M M M F F F F M M	K1a2b K1a1b1g H1e1a K2a R1a1a T2b U5a2d1 HV0+195 J1c V H1 R R U4b1b2 K1a2b T2c1d+152 X2b6 T2b T2b73	Hibiala24a21 Fibiala24a21 Fibiala24a21 Fibiala24a21 Ribiala24a21 Ribiala24a21 Ribiala2a1a2 Ribiala2a1a2 Ribiala2a1a2 Fibiala2a1a22 Fibiala24a22 Fibiala24a22	Beaker Britain Beaker Britain	MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 MathiesonNature2015 Dishebature2015 Dishebature2018 Dishebature2018 Dishebature2018 Dishebature2018

126774	HR 1800 1600 MBA	Mušego/Mon Sego	Croatia					F	J1c2		Croatia MBA	PattersonNature2021
126893	HR 1800 1600 MBA	Mulego/Mon Sego	Croatia					F	U8b1b1		Croatia MBA	Patters on Nature 2021
120055	THT_1000_1000_HIDA	Middego Midir Sego	croada						000101		Croutin_INDA	
JAGOP	HR_1800_1600_MBA	Jagodnjak-Krcevine	Croatia					M	12011	G2a2a1a2a2a1	Croatia_Jag_MBA	FreilichScientificReports2021
JAG58	HR 1800 1600 MBA	Jagodnjak-Krčevine	Croatia					M	T2b11	G2a2a1a2a2a1	Croatia Jag MBA	FreilichScientificReports2021
14678	HR 1800 1600 MBA	lagodniak-Krčevine	Croatia					M	U5b1b1a	G2a2a1a2a2a1	Croatia Lag MBA	FreilichScientificReports2021
146.93	HP 1800 1600 MPA	lagadejak Kečavina	Creatia					M	UDe1e1	679791979791	Greatia Lag MRA	ExcilighEsigntificBonasts2021
JAG82	HK_1800_1600_MBA	Jagodnjak-Krcevine	Croatia					IVI	Uzeiai	628281828281	Croatia_Jag_MBA	Freilichscientifickeportszuzi
JAG85	HR_1800_1600_MBA	Jagodnjak-Krčevine	Croatia					F	K1b1b1		Croatia_Jag_MBA	FreilichScientificReports2021
14693	HR 1800 1600 MBA	lagodniak-Krčevine	Croatia					F	U5a1g		Croatia Lag MBA	FreilichScientificReports2021
17264	HU 3500 3000 BBC	Budapast Békésmaguar	Hungapy	2204	2050	2770	10	M	LIEo2b	H3	Realizer Control Europe	Mathier enNature 2015
12304	H0_2300_2000_BBC	Buuapesc-Benasillegyei	Huligally	2234	2035	3773	20	IVI	03820	Hz	Beaker Central Europe	Mathesoninature2015
12365	HU_2500_2000_BBC	Budapest-Békásmegyer	Hungary	2459	2206	3858	32	M	V3	R1b1a1a2a1a2b1	Beaker Central Europe	MathiesonNature2015
12741	HU 2500 2000 BBC	Szigetszentmiklós.Felső Ürge-hegyi dűlő	Hungary	2456	2150	3835	35	M	H1+16189	I2a1a1	Beaker Central Europe	MathiesonNature2015
12796	HU 3500 3000 BBC	Esigotezontmiklós Folső Űrao homá dűlő	Hungapy	2457	2204	2950	25	M	14	120.20	Reaker Central Europe	MathiesenNature201E
12700	10 2500 2000 000	Sugerstein mitos, eise orge nega date	Hungary	2457	2200	3050	35	141	12	0414-4-3-3	Dealer Central Carope	Mathicson Nature 2015
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13529	HU_2500_2000_BBC	Budakalász, Csajerszke (MO Site 12)	Hungary					F	I3a		Beaker Central Europe	MathiesonNature2015
14178	HU 2500 2000 BBC	Szigetszentmiklós Felső Ürge-hegyi dűlő	Hungary					м	l1c1b1a	R1b1a1a2	Beaker Central Europe	OlaldeNature2018
17044	101 3500 3000 000	Selectoreter 144: Ödülfere	i la garj			-			Urbadab	P464-4-2-2-1	Baska Gastal Surger	Lange of the Number of 2010
1/044	HU_2500_2000_BBC	Szigetszentmikios-Udulosor	Hungary					IVI	0201010	RIDIAIAZAZCI	Beaker Central Europe	Lazaridisinature2016
17045	HU_2500_2000_BBC	Szigetszentmiklós-Udülősor	Hungary					F	T2c1d+152		Beaker Central Europe	LazaridisNature2016
BRC003	IT 2200 1500 BA	Grottina dei Covoloni del Broion	Italy					м	U4a2f	R1b1'5-P312	Italy Broion BA	SaupeCurrentBiology2020
P.P.C007	IT 3300 1500 RA	Crottino dei Ceveleni del Preien	Italu					F	Klatht		Italy Broion BA	SourceCurrentBiology2020
BRCOOT	11_2200_1300_BA	Gibttilla del covolorit del Brotori	italy					-	KIGIDI		italy_biololi_bA	SaupecurrentBiology2020
BRC010	IT_2200_1500_BA	Grottina dei Covoloni del Broion	Italy					F	H+16291T		Italy_Broion_EBA	SaupeCurrentBiology2020
111442	IT_2200_1500_BA	Sicily, Buffa	Italy					M	K1a3a	R1b1a1a2a1a2 (xR1b1a1a2a1a2c)	Sicily_EBA	FernandesNatureEcologyEvolution2020
13122	IT 2200 1500 BA	Sirily Buffa	Italy					F	T2b		Sicily FBA	FernandesNatureEcologyEvolution2020
12122	IT 3300 1500 BA	Sidly Buffa	Italy		-	1			Lightht	R1b1a1a3a1a3a1	Cielly EBA	Forman doc Nature Ecology Evolution 2020
13123	11_2200_1500_BA	Sicily, Buffa	italy					M	USD101	Ribiala2a1a2a1	SICITY_EBA	FernandesivatureEcologyEvolution2020
13124	IT_2200_1500_BA	Sicily, Buffa	Italy		1	1	1	M	H1+16189!	R1b1a1a2a1a2 (xR1b1a1a2a1a2c)	Sicily_EBA	FernandesNatureEcologyEvolution2020
13125	IT 2200 1500 BA	Sicily, Buffa	Italy					м	K1a3a	G2a2b2a1a1c1	Italy Sicily MBA o2	FernandesNatureEcologyEvolution2020
13878	IT 2200 1500 BA	Sirily Marrita	Italy	1382	1134	3015	20	E	K19+195C1		Sicily LBA	EernandesNatureEcologyEvolution2020
138/8	11_2200_1500_BA	Sicily, Marcita	itary	1382	1134	3012	20	F	V19+132Ci		SICILY_LBA	remanuesivaturecologyevolution2020
18561	IT_2200_1500_BA	Sicily, Isnello	Italy	2399	2153	3825	20	M	K1b1+(16093C)	R1b1a1a2a1a2a1	Sicily_EBA8561	FernandesNatureEcologyEvolution2020
13123	IT 2200 1500 BA	Sicily, Buffa	Italy					м	U8b1b1	R1b1a1b1a1a2a	Italy Sicily EBA	FernandesNatureEcologyEvolution2020
11979	IT 2500 2000 BBC	Via Guidorossi Parma Emilia Romanna	Italy			1		F	T2h3		Beaker Northern Italy	OlaldaNatura2018
11979	11_2300_2000_BBC	Via Guidolossi, Palilia, Elililia Romaglia	italy					-	1203		Beaker Northern Italy	Glaidelvatule2018
124//	11_2200_2000_BBC	Via Guidorossi, Parma, Emilia Komagna	Italy					E .	1203+151		Beaker Northern Italy	OlaideNature2018
12478	IT 2500 2000 BBC	Via Guidorossi, Parma, Emilia Romagna	Italy	2196	1939	3671	40	M	K1a2a	R1b1a1a2a1a2	Beaker Northern Italy	OlaldeNature2018
111629	NI 1600 1100 BA	Noord-Holland Hoogkarspel-Houterpolder-West	Netherlands					F	T2e1		Netherlands MBA LBA	PattersonNature2021
114071	NU. 4000 4400 D4	Name Unland Westward Planam Pared	North code or de	1210	1015	2015	20	-	112		Notherday de 184	Detter and Materia 2021
111971	NL_1000_1100_BA	Noord-Holland, Westwood-Binnenwijzend	Netherlands	1210	1015	2915	30	F	P13		Netherlands_LBA	Pattersonnature2021
111972	NL_1600_1100_BA	Noord-Holland, Westwoud-Binnenwijzend	Netherlands	1501	1319	3155	30	M	U5b2b1	R1b1a1b1a1a1c	Netherlands_MBA	PattersonNature2021
111973	NI 1600 1100 BA	Noord-Holland, Westwoud-Rinnenwijzend	Netherlands	1415	1230	3065	30	F	H5a1		Netherlands MBA	PattersonNature2021
112081	NI 1600 1100 RA	Noord Helland, Heeskarsnel, Heuternelder West	Nothorlands	1201	1221	2040	20	Ē	LIEate		Notherlands MBA	PatterrenNature2021
112081	NC_1000_1100_BA	Noord-Honand, Hoogkarspei-Houterporder-west	Neclienatios	1391	1221	3040	20	r	UJAIC		Netilellallus_WIDA	Fattelsollivatule2021
112082	NL_1600_1100_BA	Noord-Holland, Hoogkarspel-Houterpolder-West	Netherlands					F	K1d		Netherlands_MBA	PattersonNature2021
112083	NL 1600 1100 BA	Noord-Holland, Westwoud-Markerwaardweg	Netherlands	1260	1048	2945	30	F	J2b1a1		Netherlands MBA LBA	PattersonNature2021
117010	NI 1600 1100 RA	Zuid Helland Vlaardingen Krabbonlar	Nothorlande	1421	1216	2060	40	M	T2h	B1b1a1b1a1a1c1a	Notherlands MPA	PatterrenNature 2021
117013	NL 1000_1100_BA	Zuid-Holland, Viaardinger-Krabbeplas	Netherlands	1421	1210	3000	40	191	120	Ribiaibiaiaicia	Netherlands I/DA	PattersonNature2021
120062	NL_1600_1100_BA	Noord-Holland, Bovenkarspel-Het Valkje	Netherlands	920	806	2/10	35	ŀ	H1+16189		Netherlands_LBA	PattersonNature2021
126828	NL_1600_1100_BA	Noord-Holland, Wervershoof-Zwaagdijk	Netherlands					F	H2a2		Netherlands_MBA	PattersonNature2021
126829	NI 1600 1100 BA	Noord-Holland Wervershoof-Zwaagdiik	Netherlands					м	H5b	R1b1a1b1a	Netherlands MBA	PattersonNature2021
120020	NU. 1000 1100 D1	Naced Unlined Wassenhauf Zusandille	Notherdende	4620	1211	2240	<b>CO</b>		112-140002	Daha-aha-a-2-a	Nath ordered a MADA	Petternen Network 2021
126830	NL_1000_1100_BA	Noord-Holland, Wervershoor-Zwaagdijk	Netherlands	1620	1311	3210	60	IVI	H3V+10093	RIBIBIBIBIBIBI	Netherlands_IVIBA	Pattersonnature2021
126831	NL_1600_1100_BA	Noord-Holland, Wervershoof-Zwaagdijk	Netherlands					F	U5a1a1		Netherlands_MBA	PattersonNature2021
126832	NL 1600 1100 BA	Noord-Holland, Wervershoof-Zwaagdiik	Netherlands					F	U4a3		Netherlands MBA	PattersonNature2021
112025	NI 3500 3000 BBC	Zuid Helland Melanaarraraaf	Nothorlande	2126	1907	2625	40	M	K2h1a	R1b1a1b1a1a	Nothorlands INR ERA RollReaker	PatterrenNature 2021
113023	NC_2300_2000_BBC	zulu-Hollanu, Wolenaalsgraai	Netlienands	2130	1072	3033	40	IVI	KZDIG	RIDIAIDIAIA	Nethellanus_END_EDA_BellBeaker	Fattersonwature2021
113027	NL_2500_2000_BBC	Zuid-Holland, Molenaarsgraaf	Netherlands	2197	1983	3700	25	F	T2b21		Netherlands_LNB_EBA_BellBeaker	PattersonNature2021
113028	NL 2500 2000 BBC	Zuid-Holland, Ottoland-Kromme Elleboog	Netherlands					M	H1a	R1b1a1b1a1a2	Netherlands LNB BellBeaker	PattersonNature2021
14068	NI 2500 2000 BBC	De Tuithoorn Oostword Noord-Holland	The Netherlands	2134	1950	3655	20	м	1159791	P1h1a1a7a1a7	Reaker The Netherlands	OlaldaNature2018
14000	NC_2300_2000_00C	De Faithborn, Oostwolde, Noord Homand	The rectionarias	1134	1550	3033	20	141	050201		Detrict the rectionands	Characterized to
14009	NL_2000_2000_BBC	De Tuitnoorn, Oostwoud, Noord-Holland	ine iverneriands	2192	100/	3040	50	IVI	USalai	R10131323132	beaker the wetherlands	Ulaidenature2018
14073	NL_2500_2000_BBC	De Tuithoorn, Oostwoud, Noord-Holland	The Netherlands	2197	1897	3660	50	M	U5a2b3	R1b1a1a2a1a2	Beaker The Netherlands	OlaldeNature2018
14074	NL 2500 2000 BBC	De Tuithoorn, Oostwoud, Noord-Holland	The Netherlands	2281	1899	3690	60	M	н	R1b1a1a2a1a2	Beaker The Netherlands	OlaldeNature2018
14075	NI 2500 2000 RRC	Do Tuitheore, Costuraud, Neord Holland	The Netherlands	2127	1022	2626	20	E.	LIE o 1		Reaker The Netherlands	OlaldaNatura 2018
1407.3	AL_2300_2000_BBC	De Tattioon, Costwood, Noord-Honailo	the mechenands	4147	1222	3033	20	-	11201		scaler memerialities	Gialdervature2010
14076	NL_2500_2000_BBC	De Tuithoorn, Oostwoud, Noord-Holland	The Netherlands	1883	1747	3490	20	F	K1d		Beaker The Netherlands	OlaldeNature2018
15748	NL_2500_2000_BBC	De Tuithoorn, Oostwoud, Noord-Holland	The Netherlands	2579	2211	3945	55	M	X2b4	R1b1a1a2a1a2	Beaker The Netherlands	OlaldeNature2018
16531	PO 2400 2000 BBC	Dzielnica	Poland	2288	2037	3755	35	м	U5b2b1a1	B1a1a	Poland BA	OlaldeNature2018
10553	0_1400_1000_000	Death for Charac Mills f	Deland	2202	2020	3735	35		0.5010101	DALA-1-2-1-	Deland DA	Olabel Nation 2010
16537	PO_2400_2000_BBC	Kaciborz-Stara Wies	Poland	2293	2039	3/65	35	M	1181	Kibiala2ala	Poland_BA	OlaldeNature2018
16579	PO_2400_2000_BBC	lwiny	Poland	2340	2042	3780	35	F	K1a4a1g	1	Poland_BA	OlaldeNature2018
16580	PO 2400 2000 BBC	Jordanów Śląski	Poland	-	1	1		M	K1a1b2b	R1b1a1a2a1a2b1	Beaker Central Europe	MathiesonNature2015
16581	PO 2400 2000 BBC	Komire	Poland	2454	2145	3825	35	м	H6a1a	R1h1a1a7a1a7h1	Reaker Central Europe	LazaridicNature2016
10201	.0_2400_2000_880	Notifice	Polatio	2434	2143	3023	33	IVI	FIUGIA	h i bi a la calazo i	Sealer Central Europe	Lazanuskaturezoto
16582	PO_2400_2000_BBC	Kornice	Poland	2395	2051	±790	35 J	F	USa2b		Beaker Central Europe	MathiesonNature2015
16583	PO 2400 2000 BBC	Żerniki Wielkie	Poland	2291	2047	3770	30	F	U5b1c2		Beaker Central Europe	LazaridisNature2016
pcw260	PO 2400 2000 BBC	Malonolska Linland	Poland	2455	2147	3830	35	F	T2b		Poland BBC	LinderholmScientificReports2020
200	00 3400 3000 BBC	Malazalaka Usland	Daland	2.35	-147				115-4		Paland DBC	Linded also Scientific Descents 2020
pcw280	PO_2400_2000_BBC	iviaiopolska Upland	roland			1	1	ŀ	u5a1		Poland_BBC	LindernoimScientificKeports2020
N45	PO_2800_2300_CWC	Pikutkowo	Poland		1	1	1	F	H5a8		Poland_CWC	FernandesScientificReports2018
N47	PO 2800 2300 CWC	Pikutkowo	Poland					м	U5b2a2	12a2a	Poland CWC	FernandesScientificReports2018
0400	PO 3800 3300 CM/C	Baccour Footbills	Deland	25.71	2205	2050	35		UEb3h1c*	P1b1a1a3	Poland ONC	LindorholmSciontificBonort-2020
pcw040	PO_2800_2300_CWC	RZESZÓW PODINIIS	Poland	25/1	2305	3920	30	IV1	02020191	RIDIAIAZ	Poland_CWC	cingemoimscientifickeports2020
pcw041	PO_2800_2300_CWC	Rzeszow Foothills	Poland	2571	2305	3950	35	M	J1c2c	R1b1a1a2	Poland_CWC	LinderholmScientificReports2020
pcw061	PO 2800 2300 CWC	Rzeszow Foothills	Poland	2469	2211	3890	35	F	H7a		Poland CWC	LinderholmScientificReports2020
000070	PO 3800 3300 CM/C	Baccour Footbills	Deland	2460	2211	2800	25	M	12	B1b1a1a3	Peland, ONC	Linderholm Scientific Benert - 2020
pcw070	FU_2800_2300_CWC	Rzeszów Pootnilis	Poland	2409	2211	3890	30	IV1	12	R1013132	Poland_CWC	cingemoimscientifickeports2020
pcw350	PO_2800_2300_CWC	Sokal Kidge	Poland	2462	2206	3865	35	M	1131	R1b1a1a2	Poland_CWC	LingerholmScientificKeports2020
pcw361	PO_2800_2300_CWC	Sokal Ridge	Poland		1 -	1 -	1 7	M	K1a4b	R1b1a1a2a1a	Poland_CWC	LinderholmScientificReports2020
prw362	PO 2800 2300 CWC	Sokal Bidge	Poland	2465	2209	3875	35	м	U5a1a29	R1b1a1a2a1a	Poland CWC	LinderholmScientificReports 2020
pcw302	.0_2000_2300_0440	Junai Nidge	Pulatiu	2403	2203	3073	22	IVI	UJalaza	N 1010102010	Poland_Cwc	cinactionitiscientifickeports2020
rV32032	PT_1800_1400_MBA	Torre Velha 3	Portugal		L	1		M	X2b+226	R1b1a2	Portugal_MBA	MartinianoPLoSGenetics2017
TV3831	PT_1800_1400_MBA	Torre Velha 3	Portugal		1 -	1 -	1 1	M	H1+152	R1b1a2a1a2	Portugal_MBA	MartinianoPLoSGenetics2017
VO10207	PT 1800 1400 MBA	Monte do Vale do Ouro 2	Portugal					F	U5b1		Portugal MBA	MartinianoPLoSGenetics2017
11070	PT 3500 3000 CA	Vordelles des Buisses Vialenza Lisbes	Destugal	2976	2401	4100	60	M	¥26+226		El4/ Iboria CA	OlaldeNature 2018
11310	P1_2500_2000_CA	verdeina dos kuivos, vialonga, Lisboa	Portugal	28/0	2491	4100	00	IVI	A20+220		SW_IDENA_CA	Ulaidenature2018
14229	PT 2500 2000 CA	Cova da Moura. Torres Vedras, Lisboa	Portugal	2290	2063	3775	25	M	U5a2+16362	I2a1a1	SW Iberia CA	OlaldeNature2018

Table S7. qpAdm a ID	admixture modelling of each individual Group label (in this study)	Yamnaya proportion	ANF proportion	HG proportion	Yamnaya proportion (se)	ANF proportion (se)	HG proportion (se	e) p-value	qpAdm_SNPs
Bre445YY Bre445FK Bre445HI	FR_2500_2000_Bre FR_2500_2000_Bre FR_2500_2000_Bre	0.735 0,367 0.174	0.147 0.498 0.619	0.119 0.135 0.207	0.131 0,061 0.08	0.087 0.042 0.066	0.081 0.036 0.033	0.493958023 0.58362957 0.270925153	238045 477024 344246
Bre445A Bre445B	FR_2500_2000_Bre FR_2500_2000_Bre	0	0.749 0.787	0.251 0.213	0	0.034 0.036	0.034 0.036	0.457258055	273180 280739
Bre445C Bre445D Bre445E	FR_2500_2000_Bre FR_2500_2000_Bre FR_2500_2000_Bre	0	0.779 0.758 0.808	0.221 0.242 0.192	0	0.034 0.032 0.033	0.034 0.032 0.033	0.337905812 0.440742487	319221 322096 329382
SMGB54 MX188 MX191	FR_2500_2000_BBC CH_2800_2200_CWC CH_2800_2200_CWC	0.444 0,632 0.613	0.418 0,285 0.249	0.138 0,083 0.138	0,069 0,084 0.082	0.048 0,061 0.059	0.042 0,048 0.048	0.935172686 0,080957328 0.515390131	427280 299495 284377
MX196 MX197	CH_2800_2200_CWC CH_2800_2200_CWC CH_2800_2200_CWC	0,544 0,604	0,318 0,286	0,138 0,11	0,083 0,079 0,025	0,061 0,056	0,047	0,45917524 0,536667363	272099 263483
MX198 MX199 MX195	CH_2800_2200_CWC CH_2800_2200_CWC CH_2800_2200_CWC	0,564 0,517	0,295 0,321 0,369	0,115 0,114	0,079 0,079	0,058 0,06	0,048 0,05	0,454648956 0,589765708 0,835256853	283774 250170
MX192 MX190 Aesch25	CH_2800_2200_CWC CH_2800_2200_CWC CH_2800_2200_CWC	0,504 0,703 0,829	0,358 0,283 0,079	0,138 0,014 0,093	0,078 0,084 0,08	0,06 0,064 0,059	0,045 0,052 0,05	0,825715814 0,022208856 0,197226995	240618 243155 297208
MX298 SX21	CH_2800_2200_CWC CH_2800_2200_FN	0,38	0,404	0,216	0,074	0,053 0,034 0.036	0,045	0,790575161 0,559050298 0,220561422	284599 273258
SX17 SX10	CH_2800_2200_FN CH_2800_2200_FN CH_2800_2200_FN	0	0,813	0,151 0,209	0	0,030	0,030	0,094112022 0,389196959	123745 204147
KNE002 KNE003 KNE006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,534 0,485 0,498	0,278 0,356 0,333	0,188 0,159 0,169	0,086 0,076 0,131	0,064 0,055 0,093	0,048 0,045 0,076	0,816427181 0,667834621 0,990712283	269764 351593 110177
KNE007 KO1006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,449 0,678	0,383 0,236 0,212	0,168 0,086 0.158	0,092 0,076 0.076	0,066 0,055 0.056	0,051 0,046 0.046	0,338446113 0,697532422 0,717652971	244584 332551 282081
KO1007 KO1008 KO1009	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,476 0,482	0,212 0,418 0,364	0,138 0,106 0,155	0,094 0,08	0,065	0,040 0,056 0,044	0,23140039 0,04531609	225839 289348
K01010 K01011 K01013	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,498 0,587 0,503	0,321 0,282 0,373	0,181 0,131 0,124	0,087 0,097 0,077	0,064 0,07 0,06	0,051 0,055 0,044	0,413912754 0,174115285 0,76382955	228309 225305 278995
KO1014 KO1015 KO7001	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,508 0,562 0,549	0,293 0,306 0.288	0,199 0,132 0.163	0,085 0,08 0.085	0,063 0,06 0.063	0,049 0,047 0.049	0,344304547 0,090932416 0,362672232	248868 238863 261004
KO7002 MIB001	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,623	0,312 0,269	0,065	0,093 0,087	0,067 0,061	0,054	0,14111294 0,52077908	230223 234363
MIB002 MIB003 MIB004	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,559 0,338 0,397	0,284 0,45 0,415	0,157 0,213 0,188	0,083 0,115 0,084	0,059 0,086 0,062	0,047 0,069 0,049	0,557878657 0,326046589 0,922203603	136358 236575
MIB005 MIB024 MIB028	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,421 0,285 0,615	0,335 0,416 0,302	0,244 0,299 0,083	0,096 0,134 0,074	0,072 0,087 0,053	0,051 0,08 0,045	0,28988763 0,320920972 0,780949639	202845 132256 352789
MIB034 MIG010 MIG011	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,577 0,577 0.441	0,31 0,271 0,205	0,112 0,153 0.164	0,073 0,112 0,091	0,053 0,079 0.061	0,043 0,061 0.051	0,85528646 0,587641053	364981 169314 221714
MIG011 MIG012 MIS001	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,502 0,601	0,335 0,329 0,309	0,164 0,168 0,09	0,1 0,071	0,051 0,052	0,031 0,06 0,042	0,517850044 0,480227271	170786 383648
MIS002 MIS004 MIS006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,402 0,523 0,523	0,39 0,367 0,384	0,207 0,11 0,093	0,078 0,107 0,135	0,055 0,077 0,104	0,045 0,065 0,083	0,269345615 0,4555386 0,600109823	380307 157014 96321
PMI003 PMI004 PMI006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,592 0,577 0,749	0,316 0,295 0.134	0,092 0,127 0.117	0,094 0,098 0,099	0,067 0,069 0.072	0,056 0,056 0.061	0,165137847 0,162166305 0,391170001	201288 226058 188675
PMI009 PMI010	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,611 0,577	0,341 0,286	0,048 0,138	0,14 0,083	0,1 0,063	0,083	0,554101324 0,638449406	103417 224117
ROU001 ROU006	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,73 0,452 0,594	0,25 0,354 0,26	0,01 0,194 0,146	0,087 0,079	0,061 0,059	0,049 0,046	0,723883614 0,548885792 0,46526554	286826 297974
VLI039 VLI042 VLI045	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,539 0,618 0,452	0,371 0,276 0.351	0,09 0,107 0,196	0,074 0,11 0.084	0,051 0,078 0.06	0,047 0,069 0.048	0,281523806 0,80945077 0.062872709	303721 135435 299775
VLI046 VLI047	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,387 0,762	0,503 0,164	0,11 0,075 0.377	0,174 0,092 0.074	0,123 0,067 0.054	0,097 0,055 0.046	0,018818312 0,638139398	95952 242464 221182
VLI050 VLI058 VLI060	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA	0,536 0,507 0,526	0,307	0,212 0,084	0,074 0,087 0,093	0,066 0,064	0,040 0,048 0,055	0,742549549 0,449164582	228441 217106
VLI061 VLI065 I4885	CZ_2200_1700_Unetice_EBA CZ_2200_1700_Unetice_EBA CZ_2500_2000_BBC	0,683 0,602 0,341	0,194 0,352 0,55	0,123 0,046 0,109	0,077 0,09 0,072	0,057 0,068 0,052	0,046 0,053 0,043	0,935441404 0,599139604 0,060869425	319082 199781 359421
14886 14887 14888	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,554 0,393 0.457	0,37 0,465 0.421	0,076 0,142 0.122	0,076 0,071 0.07	0,054 0,053 0.051	0,044 0,043 0.041	0,145026537 0,641669352 0,73624549	373264 362513 461185
14889 14891	CZ_2500_2000_BBC CZ_2500_2000_BBC	0,652 0,469	0,295	0,053 0,138	0,07	0,05	0,042	0,894206919 0,146119294	459955 371293
14895 14896 15514	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,349 0,507	0,346 0,483 0,311	0,168 0,182	0,075 0,069 0,072	0,052 0,051	0,043 0,041 0,043	0,545037405 0,338692481	363522 378025
17205 17210 17211	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,532 0,492 0,552	0,3 0,358 0,333	0,167 0,15 0,115	0,074 0,072 0,067	0,054 0,053 0,049	0,044 0,044 0,039	0,049522031 0,431854047 0,184873899	342924 334858 478695
17212 17213 17214	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,443 0,436 0.469	0,414 0,323 0,411	0,142 0,241 0.12	0,072 0,082 0.073	0,051 0,055 0.053	0,043 0,048 0.043	0,08762187 0,001802048 0,781962873	474913 337528 342585
17249	CZ_2500_2000_BBC CZ_2500_2000_BBC	0,568 0,61	0,212 0,31	0,22 0,08	0,07	0,055	0,041 0,045	0,998165303 0,51442824	345878 336920
17275	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,388 0,422 0,601	0,454 0,486 0,319	0,092	0,072 0,073	0,059 0,055 0,053	0,045 0,047 0,044	0,245015924 0,054723974 0,370000732	318194 340607
17278 17281 17282	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,517 0,562 0,414	0,365 0,264 0,401	0,118 0,173 0,185	0,071 0,077 0,074	0,051 0,054 0,055	0,041 0,045 0,043	0,418187523 0,819255585 0,322373865	479507 338558 348317
17283 17286 17289	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,168 0,455 0,527	0,616 0,344 0.406	0,216 0,2 0.067	0,076 0,072 0.076	0,056 0,05 0.056	0,044 0,042 0.044	0,476066673 0,017501709 0.094945554	336470 480899 342133
17290 KO1003	CZ_2500_2000_BBC CZ_2500_2000_BBC	0,416 0,354	0,366 0,495	0,217 0,15	0,071 0,072	0,051 0,051	0,041 0,043 0.045	0,808908239 0,775274336	358818 381716
KO1004 KO1005	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,38 0,244	0,447	0,135	0,081 0,082	0,055	0,045	0,685376532 0,299601487	309212 221220
KOP002 KOP003 PRU001	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,488 0,245 0,237	0,436 0,487 0,651	0,076 0,267 0,112	0,081 0,08 0,075	0,06 0,059 0,056	0,048 0,048 0,045	0,168158651 0,332429946 0,596491621	267144 256178 247506
PRU002 PRU003 PRU004	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,55 0,523 0,577	0,3 0,279 0,275	0,151 0,197 0,148	0,08 0,085 0,079	0,057 0,057 0,057	0,047 0,05 0.046	0,195967818 0,88398352 0,255567553	301624 277150 280303
PRU005 VLI022 VLI024	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,533 0,312 0.505	0,331 0,535 0.445	0,136 0,154 0.049	0,099 0,113 0.079	0,07 0,083 0.052	0,057 0,062	0,697365107 0,129163371 0,298085457	181545 152604 304469
VLI024 VLI026 VLI029	CZ_2500_2000_BBC CZ_2500_2000_BBC CZ_2500_2000_BBC	0,505 0,572 0,581	0,285	0,143 0,178	0,075	0,058	0,045	0,82512565 0,260287673	279525 318885
VLI030 17279 17280	CZ_2500_2000_BBC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,538 0,684 0,727	0,344 0,164 0,176	0,118 0,152 0,097	0,125 0,077 0,072	0,092 0,058 0,053	0,071 0,045 0,043	0,272247118 0,421588701 0,673561395	116799 289540 346279
KO1002 KON001 KO1004	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,734 0,763 0.87	0,158 0,162 0.12	0,109 0,075 0.01	0,072 0,096 0,082	0,051 0,068 0,059	0,043 0,058 0.048	0,587445287 0,906491318 0,309284627	427875 208974 348476
OBR001 OBR003	CZ_2900_2200_CWC CZ_2900_2200_CWC	0,805	0,097	0,098	0,145	0,094 0,069	0,083	0,136427773 0,166758064	117318 210771
OHR001 OHR002	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,671	0,248 0,115 0,211	0,044 0,026 0,118	0,089 0,117 0,076	0,088	0,051 0,065 0,045	0,156042924 0,448584607	169855 346500
PNL001 PNL002 RDV001	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,73 0,642 0,78	0,103 0,219 0,156	0,168 0,139 0,064	0,083 0,077 0,079	0,059 0,056 0,055	0,049 0,043 0,045	0,064242451 0,004044555 0,373214257	290334 367952 348922
STD001 STD002 TRM003	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,604 0,814 0.907	0,239 0,099 0.085	0,158 0,087 0.007	0,081 0,078 0.079	0,058 0,058 0.057	0,049 0,048 0.045	0,999322311 0,940023502 0,490013559	279930 299390 351809
VLI007 VLI010	CZ_2900_2200_CWC CZ_2900_2200_CWC	0,923 0,624	0,065	0,013	0,076 0,078	0,055	0,047	0,282940193 0,6096421	366156
VLI016 VLI017 VLI019	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,65 0,733 0,873	0,195 0,13 0	0,155 0,137 0,127	0,076 0,078 0,097	0,055	0,045 0,097	0,596061447 0,797575276 0,231644463	314603 314419 218719
VLI020 VLI067 VLI071	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,754 0,625 0,658	0,185 0,265 0,197	0,061 0,11 0,145	0,083 0,078 0,08	0,06 0,056 0,057	0,05 0,047 0,046	0,461998448 0,461983296 0,215767508	297672 326899 345684
VLI076 VLI081 VLI085	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,926 0,925 0,57	0,022 0,075 0.266	0,052	0,077 0,169 0.104	0,056 0,169	0,048	0,334164853 0,933299486 0,223257791	333813 103431 181631
VLI088 VLI090	CZ_2900_2200_CWC CZ_2900_2200_CWC CZ_2900_2200_CWC	0,76 0,913	0,081	0,159	0,12	0,077	0,035	0,026518683 0,37921499	140186
VLI092 ZEL001	CZ_2900_2200_CWC CZ_2900_2200_CWC	0,435	0,388	0,178	0,076	0,054	0,046	0,845923847	337573 184382

AITI_119 AITI_2	DE_2000_1500_EBA DE_2000_1500_EBA	0,465	0,466	0,069 0,108	0,079 0,071	0,059	0,049	0,676291653 0,444659189	265181 347690
AITI_33 AITI_43 AITI_50	DE_2000_1500_EBA DE_2000_1500_EBA DE_2000_1500_EBA	0,508	0,524 0,587 0,331	0,155 0,141	0,074 0,07 0,11	0,050	0,043 0,041 0,058	0,053630845 0,101834549	388959 175306
AITI_70 AITI_72 AITI_98	DE_2000_1500_EBA DE_2000_1500_EBA DE_2000_1500_EBA	0,273 0,292 0,304	0,578 0,579 0,562	0,149 0,129 0,134	0,097 0,073 0,092	0,07 0,054 0,069	0,054 0,044 0,053	0,604342874 0,001702293 0,252556758	199528 327318 182778
OBKR_80 POST_28 POST_6	DE_2000_1500_EBA DE_2000_1500_EBA DE_2000_1500_EBA	0,536 0,464 0.433	0,403 0,452 0.421	0,061 0,084 0.146	0,076 0,088 0.068	0,054 0,061 0.051	0,046 0,052 0.04	0,442448616 0,696791013 0.073670917	340298 233517 418239
POST_99 WEHR_1415adult WEHR_1586	DE_2000_1500_EBA DE_2000_1500_EBA	0,477 0,461 0.489	0,398 0,385 0.375	0,125 0,154 0.137	0,098 0,087 0.084	0,074 0,059 0.062	0,051 0,052 0.053	0,27730396 0,034096992 0,314470236	201994 248934 200989
MX252 MX254	DE_2000_1500_EBA DE_2000_1500_EBA DE_2000_1500_EBA	0,412 0,3	0,5	0,087 0,158	0,086 0,082	0,063 0,059	0,05	0,177708439 0,057077745	209752 287194
MX257 MX286 MX270	DE_2000_1500_EBA DE_2000_1500_EBA DE_2000_1500_EBA	0,533 0,452 0,494	0,392 0,399 0,42	0,075 0,149 0,085	0,098 0,084 0,1	0,071 0,062 0,073	0,056 0,049 0,058	0,256433595 0,054190953 0,448819128	204653 246861 165219
MX279 MX280 MX275	DE_2000_1500_EBA DE_2000_1500_EBA DE_2000_1500_EBA	0,335 0,418 0,42	0,397 0,385 0,448	0,268 0,198 0,132	0,092 0,082 0,09	0,071 0,062 0,067	0,055 0,045 0,049	0,413939299 0,324541435 0,012168476	179404 275843 209051
MX283 MX277 HUGO 168	DE_2000_1500_EBA DE_2000_1500_EBA DE_2500_2000_BBC	0,203 0,331 0,754	0,607 0,574 0.173	0,19 0,095 0.073	0,076 0,085 0,106	0,054 0,065 0.077	0,046 0,049 0.06	0,223466124 0,636381866 0,197008935	297554 202058 180554
UNTA58_685k2 UNTA85_1343	DE_2500_2000_BBC DE_2500_2000_BBC	0,241 0,529	0,638 0,353 0,346	0,121 0,118 0.142	0,081 0,073 0,078	0,059 0,053 0,056	0,045	0,66712027 0,303148544	265258 365222 410220
10108 10112	DE_2500_2000_BBC DE_2500_2000_BBC DE_2500_2000_BBC	0,512 0,46 0,541	0,340 0,367 0,317	0,142 0,174 0,142	0,078 0,08 0,076	0,056 0,054	0,043	0,098898597 0,388621288	419239 333776 421708
13588 13589	DE_2500_2000_BBC DE_2500_2000_BBC DE_2500_2000_BBC	0,326 0,441 0,378	0,438 0,468 0,398	0,236 0,091 0,224	0,091 0,092	0,061 0,064 0,062	0,049 0,053 0,052	0,042568221 0,021165599	2/514/ 208867 253625
13590 13594 13601	DE_2500_2000_BBC DE_2500_2000_BBC DE_2500_2000_BBC	0,4 0,27 0,54	0,455 0,576 0,336	0,144 0,154 0,124	0,091 0,075 0,076	0,063 0,058 0,055	0,053 0,043 0,045	0,280349715 0,343765553 0,878339486	209361 287207 302634
15519 15521 15833	DE_2500_2000_BBC DE_2500_2000_BBC DE_2500_2000_BBC	0,437 0,581 0.487	0,353 0,31 0.371	0,21 0,11 0.143	0,071 0,081 0.075	0,052 0,056 0.054	0,043 0,046 0.048	0,344921141 0,106831202 0,136499522	324295 309458 307415
15834 16590	DE_2500_2000_BBC DE_2500_2000_BBC	0,425 0,409	0,48 0,391	0,094	0,079 0,073 0,069	0,059	0,045	0,131924876 0,375792487 0,595459912	283473 368600 474270
15835 112208	DE_2500_2000_BBC DE_2500_2000_BBC ES_2000_1200_BA	0,334 0,341 0,078	0,53 0,707	0,134 0,129 0,215	0,068 0,068	0,03 0,048 0,051	0,041 0,041 0,04	0,891624759 0,715220845	488261 383775
ALM001 ALM002 ALM003	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,089 0,255 0,177	0,604 0,669	0,199 0,141 0,154	0,089 0,081 0,079	0,063 0,057	0,046 0,047	0,283866338 0,828592823 0,110592072	230927 249136 271866
ALM006 ALM007 ALM008	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,195 0,048 0,167	0,64 0,752 0,636	0,166 0,2 0,198	0,074 0,083 0,072	0,054 0,06 0,053	0,045 0,047 0,042	0,424809684 0,781681341 0,332690822	348434 236425 325432
ALM015 ALM016 ALM017	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,211 0,185 0,198	0,63 0,616 0,603	0,158 0,2 0,199	0,076 0,075 0,07	0,058 0,055 0,05	0,043 0,043 0,042	0,217793809 0,262361085 0,076924701	305793 368645 428524
ALM019 ALM020 ALM021	ES_2000_1200_BA ES_2000_1200_BA FS_2000_1200_BA	0,155 0,015 0	0,689 0,774 0.686	0,156 0,211 0.314	0,069 0,081	0,052 0,058 0.043	0,04 0,045 0.043	0,936565861 0,799693324 0.001661511	372231 293441 321798
ALM025 ALM026	ES_2000_1200_BA ES_2000_1200_BA	0,112 0,088	0,723 0,631	0,165 0,281	0,099 0,085	0,045	0,056	0,804743407 0,260566286	201311 241563
ALM028 ALM029 ALM032	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,077 0,055	0,624 0,733 0,753	0,199 0,19 0,191	0,074 0,102 0,095	0,053 0,072 0,069	0,044 0,056 0,052	0,040599666 0,376924825 0,043160087	288151 196314 222415
ALM035 ALM036 ALM038	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,039 0,151 0,008	0,712 0,667 0,829	0,249 0,182 0,163	0,08 0,078 0,082	0,057 0,058 0,065	0,048 0,046 0,05	0,242032112 0,13691964 0,296927003	307838 289648 193680
ALM039 ALM040 ALM041	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,112 0,026 0.014	0,673 0,786 0.723	0,215 0,189 0,263	0,077 0,106 0.067	0,057 0,076 0.051	0,045 0,06 0.039	0,373598275 0,156185528 0,456843395	296021 164863 456110
ALM042 ALM044 ALM047	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,221 0,072 0.183	0,583 0,7 0.725	0,195 0,229 0.092	0,074 0,114 0.087	0,052 0,078 0.067	0,044 0,062 0.05	0,580484867 0,749048038 0,638809543	313426 167502 204168
ALM050 ALM051	ES_2000_1200_BA ES_2000_1200_BA	0,112 0,076	0,63	0,258 0,219 0,130	0,069	0,052	0,04	0,729767948 0,085605408 0,410674290	401473 275800 247040
ALM055 ALM057	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,173 0,183 0	0,669 0,728	0,139 0,148 0,272	0,094	0,059 0,068 0,054	0,048 0,058 0,054	0,715633447 0,934589506	174136 182206
ALM063 ALM064 ALM067	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,111 0 0,162	0,7 0,745 0,695	0,189 0,255 0,143	0,081 0 0,084	0,058 0,043 0,061	0,048 0,043 0,046	0,263737037 0,040793662 0,125222913	283186 325929 286536
ALM068 ALM069 ALM071	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,01 0,091 0,102	0,76 0,691 0,797	0,23 0,218 0,102	0,073 0,083 0,089	0,054 0,061 0,063	0,044 0,05 0,056	0,867864274 0,655168569 0,80976868	319603 248106 179233
ALM075 ALM076 ALM078	ES_2000_1200_BA ES_2000_1200_BA FS_2000_1200_BA	0,139 0,146 0.163	0,668 0,654 0.649	0,193 0,2 0.189	0,102 0,072 0.1	0,074 0,054 0.07	0,059 0,043 0.057	0,017470467 0,643781527 0.336625942	185076 318275 184135
ALM081 ALM084	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,178	0,604 0,739	0,218 0,261 0,205	0,074	0,052 0,044 0,058	0,045	0,082097504 0,773671565 0,227601601	362726 318288 395935
ALM080 ALM087 ALM088	ES_2000_1200_BA ES_2000_1200_BA	0,039 0,089	0,663 0,753	0,298 0,158	0,095 0,084	0,069	0,058 0,05	0,509125582 0,46791586	154412 249650
BAS002 BAS022 BAS023	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,144 0,086 0,183	0,641 0,758 0,675	0,215 0,156 0,141	0,077 0,075 0,079	0,055 0,056	0,045 0,043 0,048	0,970452347 0,6762968	290339 326556 285653
BAS024 BAS025 BAS027	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,122 0,275 0,069	0,648 0,581 0,712	0,23 0,144 0,219	0,076 0,083 0,083	0,054 0,058 0,06	0,044 0,048 0,051	0,678788079 0,952803228 0,063123418	324387 277096 235009
CBR004 CMO001 EFA011	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,169 0,076 0,231	0,655 0,695 0,66	0,176 0,229 0,109	0,066 0,097 0,102	0,047 0,068 0,072	0,041 0,057 0,057	0,696157746 0,433505953 0,850865089	487732 184370 182593
LHO001 LHO003 PL7001	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,062 0,131 0,252	0,722 0,66	0,216 0,209	0,075 0,078 0.058	0,055 0,056 0.051	0,044 0,045 0.042	0,06045906 0,53796099 0,977479521	332022 317977 342592
PUC001 PUC002 PUC002	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,199 0,086 0,136	0,59 0,724	0,212 0,19	0,07 0,069 0.08	0,05	0,043	0,699219207 0,70391687	337955 342142 232602
PUC004 ALM031	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,199 0,063	0,623 0,748	0,178 0,189	0,00	0,057	0,040	0,279041838 0,599253973	327047 152024
ALM034 ALM058 ALM060	ES_2000_1200_BA ES_2000_1200_BA ES_2000_1200_BA	0,015 0,122 0,06	0,691 0,674 0,698	0,294 0,204 0,243	0,073 0,079 0,072	0,054 0,061 0,051	0,044 0,045 0,044	0,494263288 0,589081583 0,144132767	272360 355116
ALM080 esp005 EHU001	ES_2000_1200_BA ES_2000_1200_BA ES_2500_2000_CA	0,144 0,327 0,441	0,664 0,519 0,417	0,192 0,154 0,142	0,075 0,07 0,087	0,055 0,052 0,063	0,043 0,041 0,051	0,386940691 0,964374542 0,327391019	347571 400962 257988
EHU002 10459 10460	ES_2500_2000_CA ES_2500_2000_CA ES_2500_2000_CA	0,269	0,542 0,743 0.726	0,19 0,257 0,274	0,075	0,056 0,038 0.042	0,043 0,038 0.042	0,893522884 0,406364733 0,328987317	309193 251527 182642
10461 13238 14247	ES_2500_2000_CA ES_2500_2000_CA ES_2500_2000_CA	0,319 0,21 0	0,533 0,698 0.862	0,148 0,091 0.138	0,082 0,127 0	0,056 0,086 0.054	0,049 0,079 0.054	0,283935036 0,179830338 0,194080459	328328 129274 122109
15665 16539	ES_2500_2000_CA ES_2500_2000_CA	0,326	0,587 0,675	0,087 0,166	0,095	0,067	0,054	0,010524661 0,299565521 0,246520641	231925 202670
BIS130 BIS385	FR_2200_1200_BA FR_2200_1200_BA	0,252 0,533 0,687	0,336	0,131 0,008	0,136	0,102 0,105	0,048	0,752352297 0,163897113	109254 130853
NIED OBE3626-1 OBE3722	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	0,343 0,638 0,452	0,569 0,348 0,345	0,088 0,014 0,203	0,143 0,103 0,125	0,109 0,072 0,091	0,075 0,06 0,07	0,913142693 0,500204956 0,349055116	105814 200310 127025
PSS4170 GBVPO I10342	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	0,376 0,362 0,535	0,333 0,597 0,342	0,29 0,041 0,123	0,114 0,072 0,073	0,085 0,051 0,052	0,061 0,045 0,041	0,621058242 0,982817312 0,97184464	151448 381019 409079
110343 110344 110345	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	0,514 0,32 0	0,351 0,492 0.811	0,135 0,188 0.189	0,07 0,075	0,055 0,054 0.042	0,04 0,044 0.042	0,218589929 0,271782915 0,573920492	370182 370617 359772
110345 110347 110348	FR_2200_1200_BA	0,348	0,517	0,135	0,073	0,055	0,043	0,657099725	359440 361392
PIR3116B TORTF	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	0,304 0,372 0,342	0,451 0,422 0,477	0,045 0,206 0,181	0,150 0,152 0,078	0,141 0,115 0,057	0,086	0,94544068 0,973126157	98300 334185
PIR6 QUIN234 QUIN58	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	0,611 0,248 0,262	0,26 0,548 0,541	0,129 0,204 0,197	0,175 0,161 0,133	0,13 0,112 0,099	0,109 0,087 0,081	0,273818802 0,48093178 0,534540184	85165 110689 102650
RIX15 RIX2 I15033	FR_2200_1200_BA FR_2200_1200_BA FR_2200_1200_BA	0,33 0,366 0.382	0,499 0,488 0.437	0,171 0,146 0.181	0,126 0,134 0.072	0,089 0,088 0.052	0,074 0,082 0.043	0,85237285 0,346798095 0,303719653	121433 130769 372148
115028 11388	FR_2200_1200_BA FR_2500_2000_BBC FR_2500_2000_BBC	0,279	0,511 0,802 0.222	0,21 0,198	0,073	0,051 0,038 0,134	0,043	0,157455608 0,723074386 0,284126077	363864 189132 87056
11381	FR_2500_2000_BBC	0,68	0,235	0,085	0,077	0,055	0,046	0,919758686	309009

11390 11391	FR_2500_2000_BBC FR_2500_2000_BBC	0,573 0,431	0,253 0,319	0,174 0,25	0,09 0,187	0,067 0,127	0,051 0,111	0,103842708 0,521074782	216670 83920
CBV95 GBVPK	FR_2500_2000_BBC FR_2500_2000_BBC	0,679 0,392	0,217 0,469	0,104 0,138	0,136 0,073	0,103 0,056	0,079 0,045	0,215743362 0,303760751	120687 310698
PE12 13874	FR_2500_2000_BBC FR_2500_2000_BBC	0,381	0,764 0,469	0,236	0 0,075	0,047 0,053	0,047	0,241637233 0,484684123	144052 302766
13875 116247 5¥32	FR_2500_2000_BBC FR_E_2800_2200_LN FR_E_2800_2200_LN	0,517	0,343	0,14 0,245 0.134	0,075	0,035	0,044 0,035 0.058	0,265386326	351547 222245 192556
11392 113710	FR_E_2800_2500_BBC/FR_E_2800_2200_LN GB_2200_1200_BA	0,333	0,772 0,396	0,228 0,13	0	0,032 0,079	0,032	0,424153787 0,601528104	293029 136699
113714 113716	GB_2200_1200_BA GB_2200_1200_BA	0,486 0,286	0,388 0,554	0,125 0,16	0,076 0,071	0,053 0,053	0,046 0,042	0,359539003 0,116961507	364130 385778
116403 119857	GB_2200_1200_BA GB_2200_1200_BA	0,509 0,385	0,297 0,514	0,193	0,091 0,073	0,068 0,053	0,05	0,144436942 0,821642198	213628 315550
119859	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	0,455	0,371 0,417 0.339	0,137	0,079	0,054	0,043	0,066734515	303672 318163 258884
119913 119915	GB_2200_1200_BA GB_2200_1200_BA	0,501 0,565	0,38	0,118 0,175	0,079	0,055	0,047 0,043	0,119301985 0,881866461	312419 354566
12448 112776	GB_2200_1200_BA GB_2200_1200_BA	0,538 0,486	0,26 0,377	0,203 0,136	0,086 0,075	0,062 0,055	0,051 0,042	0,851522678 0,731000723	240612 360328
112786 114543	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	0,439 0,508 0,675	0,37 0,303	0,19 0,189 0.1	0,075	0,055	0,046	0,899278492 0,061393561	305115 343384 244684
114355 116394 116395	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	0,675 0,12 0.427	0,542	0,338	0,079	0,057	0,045	0,656839986	62926 97654
116396 116400	GB_2200_1200_BA GB_2200_1200_BA	0,536 0,347	0,162 0,443	0,301 0,21	0,132 0,095	0,097	0,075 0,052	0,178995839 0,09036037	118685 225850
116424 118606	GB_2200_1200_BA GB_2200_1200_BA	0,462 0,449	0,359 0,338	0,179 0,213	0,07	0,052 0,056	0,041 0,043	0,644407186 0,418480638	359481 314310
120997	GB_2200_1200_BA GB_2200_1200_BA GB_2200_1200_BA	0,472 0,488 0,402	0,352	0,188	0,131 0,083 0.09	0,057	0,075	0,12291553	295222
12413	GB_2200_1200_BA GB_2200_1200_BA	0,471 0,592	0,502 0,386	0,028	0,202 0,136	0,131 0,102	0,124 0,078	0,008491115 0,280479494	87382 114698
114200 11767	GB_2500_2000_BBC GB_2500_2000_BBC	0,433 0,475	0,432 0,398	0,135 0,127	0,121 0,076	0,086	0,069 0,047	0,562662966 0,630759632	114034 327629
12417 12418	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	0,708	0,117 0,302 0,432	0,175 0,187 0.175	0,07	0,05	0,043	0,600727356 0,33823929	364550 305656 236200
12440 12447 12450	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	0,752	0,164 0,153	0,084 0,09	0,075	0,054 0,054	0,043	0,756604635 0,530044603	396128 401173
12452 12453	GB_2500_2000_BBC GB_2500_2000_BBC	0,5 0,505	0,329 0,328	0,172 0,166	0,069 0,084	0,05 0,06	0,041 0,049	0,913725761 0,425531608	397681 281620
12454 13256	GB_2500_2000_BBC GB_2500_2000_BBC	0,542 0,603	0,324 0,262	0,134	0,073 0,072	0,055	0,042	0,066732939 0,83819007	368471 369941
15379 15512	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	0,512 0,429 0,651	0,345 0,447 0,224	0,124 0,125	0,08 0,077 0,075	0,055	0,047	0,031881949 0,091628532	3441// 315545 385504
15513 16775	GB_2500_2000_BBC GB_2500_2000_BBC	0,606 0,518	0,223 0,34	0,171 0,142	0,078 0,077	0,054 0,056	0,045 0,044	0,037406965 0,763559661	359202 303559
16776 16777	GB_2500_2000_BBC GB_2500_2000_BBC	0,813 0,531	0,094	0,093	0,121 0,079	0,087	0,072	0,10588155	134796 346505
12443.SG	GB_2500_2000_BBC GB_2500_2000_BBC GB_2500_2000_BBC	0,455 0,646 0.55	0,384 0,255 0,312	0,099	0,081	0,057 0,049 0.047	0,045	0,6204904	470297
13255.SG 124342	GB_2500_2000_BBC HR_1800_1600_MBA	0,758 0,48	0,184 0,465	0,057	0,071 0,067	0,051 0,05	0,041 0,042	0,582299364 0,955129164	487608 375686
126726 126773	HR_1800_1600_MBA HR_1800_1600_MBA	0,378 0,426	0,59 0,569	0,032 0,005	0,071 0,076	0,049 0,055	0,042	0,448286963 0,584086773	399646 334408
126774 126893 1AG06	HR_1800_1600_MBA HR_1800_1600_MBA HR_1800_1600_MBA	0,25 0,46 0.449	0,653 0,482 0.36	0,058	0,072	0,052	0,041 0,041 0.048	0,846436619	3//18/ 385631 309140
JAG58 JAG78	HR_1800_1600_MBA HR_1800_1600_MBA	0,453 0,421	0,293 0,375	0,254 0,204	0,078	0,055	0,049 0,045	0,790430045 0,024164581	275007 339355
JAG82 JAG85	HR_1800_1600_MBA HR_1800_1600_MBA	0,283 0,433	0,438 0,438	0,278 0,129	0,077 0,079	0,055	0,047 0,048	0,627621119 0,852097439	318872 266391
12364	HU_2500_2000_BBC HU_2500_2000_BBC	0,292	0,508	0,05	0,082	0,057	0,044	0,348620871 0,744866571	341142 398027
12741 12786	HU_2500_2000_BBC HU_2500_2000_BBC	0,036 0,643	0,791 0,281	0,173 0,075	0,067 0,076	0,05	0,041 0,045	0,729416045 0,413212072	381735 352162
12787 13529	HU_2500_2000_BBC HU_2500_2000_BBC	0,794 0,463	0,146 0,402	0,06	0,082	0,059 0,062	0,048	0,445646695 0,378162775	303752 265682
17044	HU_2500_2000_BBC HU_2500_2000_BBC HU_2500_2000_BBC	0,344	0,547	0,18 0,109 0.169	0,082	0,054	0,045	0,318698056	270865 347709 343498
BRC003 BRC007	IT_2200_1500_BA IT_2200_1500_BA	0,201 0,337	0,662 0,573	0,136	0,074 0,17	0,053 0,119	0,043 0,089	0,277573423 0,349099888	321328 108338
BRC010 111442	IT_2200_1500_BA IT_2200_1500_BA	0,144	0,668 0,89	0,188 0,11	0,112	0,077 0,043	0,066 0,043	0,848311244 0,128139709	153517 334984
13122 13123 13124	IT_2200_1500_BA IT_2200_1500_BA IT_2200_1500_BA	0,134 0,096 0.208	0,865	0,002 0,128 0.031	0,073	0,052	0,044 0,041	0,238225977	391697 390382
13125 13878	IT_2200_1500_BA IT_2200_1500_BA	0,122 0,081	0,878	0 0,03	0,052 0,069	0,052	0 0,04	0,292636276 0,394926896	394122 372187
18561 13123	IT_2200_1500_BA IT_2200_1500_BA	0,239 0,132	0,606	0,156 0,124	0,072 0,064	0,052	0,041 0,038	0,122671947 0,52191734	394289 488360
12477	IT_2500_2000_BBC IT_2500_2000_BBC IT_2500_2000_BBC	0,321	0,833	0,167	0,102	0,069	0,059	0,809653516	352656
111629 111971	NL_1600_1100_BA NL_1600_1100_BA	0,636	0,295 0,317	0,068	0,122 0,076	0,084	0,069 0,044	0,030743746 0,309535359	154737 331727
111972 111973	NL_1600_1100_BA NL_1600_1100_BA	0,467 0,477	0,315 0,373	0,218 0,149	0,075	0,051 0,05	0,044 0,042	0,135585226	377784 377285
112081	NL_1600_1100_BA NL_1600_1100_BA NL 1600_1100_BA	0,61 0.502	0,359 0,29 0.385	0,151 0,1 0,1	0,075	0,053	0,042 0,042 0,043	0,187240326	346375 349520
117019 120062	NL_1600_1100_BA NL_1600_1100_BA	0,417 0,594	0,317 0,257	0,266 0,149	0,085 0,073	0,062 0,053	0,051 0,043	0,140875449 0,181097674	230729 364787
126828 126829	NL_1600_1100_BA	0,581 0,416	0,28 0,461 0,237	0,139 0,122 0,169	0,073 0,071 0.074	0,053 0,051 0.056	0,044	0,025099323 0,642426822 0.15024223	388687 372181 380771
126831 126832	NL_1600_1100_BA NL_1600_1100_BA	0,566 0,658	0,327	0,214 0,146	0,112 0,071	0,087 0,051	0,043	0,641988768 0,5871718	124091 383961
113025 113027	NL_2500_2000_BBC NL_2500_2000_BBC	0,684	0,181 0,283	0,135	0,073 0,081	0,052	0,045	0,598801317 0,335308454	367216 292355
113028 14068	NL_2500_2000_BBC NL_2500_2000_BBC NL_2500_2000_BBC	0,601	0,292 0,275 0.275	0,108 0,166 0,222	0,075 0,089 0.075	0,053 0,066	0,046	0,035311787 0,017686034	378887 227503 323275
14073	NL_2500_2000_BBC NL_2500_2000_BBC	0,596	0,277 0,221	0,127 0,173	0,077 0,074	0,056 0,053	0,045	0,075352821 0,872732031	338983 347330
14075 14076	NL_2500_2000_BBC NL_2500_2000_BBC	0,536 0,342	0,319 0,433	0,145 0,225	0,07 0,081	0,052 0,061	0,041 0,05	0,90294727 0,586536626	348693 216741
15748 16531	NL_2500_2000_BBC PO_2400_2000_BBC PO_2400_2000_BBC	0,689	0,195 0,209 0.272	0,116	0,073	0,05	0,045	0,647836079 0,596018906 0,540200272	487883 350397 252452
16579	PO_2400_2000_BBC PO_2400_2000_BBC PO_2400_2000_BBC	0,478 0,662	0,242 0,216	0,28	0,074 0,079	0,053 0,057	0,043 0,047	0,045805548 0,55601803	354237 299557
16581 16582	PO_2400_2000_BBC PO_2400_2000_BBC	0,446 0,407	0,496	0,058	0,081 0,074	0,057	0,048 0,044	0,702646145 0,434437829	285412 356010
16583 pcw260	PO_2400_2000_BBC PO_2400_2000_BBC PO_2400_2000_BBC	0,534 0,433	0,313 0,422 0,214	0,153 0,145 0.164	0,074 0,068 0,000	0,055	0,044	0,877208449 0,995614613 0,445395927	370878 381046 184819
N45 N47	PO_2800_2300_CWC PO_2800_2300_CWC	0,766 0,471	0,314 0,189 0,24	0,044 0,289	0,079 0,073	0,053 0,052	0,045	0,06185138 0,492877354	415461 420610
pcw040 pcw041	PO_2800_2300_CWC PO_2800_2300_CWC	0,772	0,177 0,201	0,051 0,143	0,075 0,113	0,053	0,043 0,069	0,449816623 0,4744452	450821 162535
pcw061 pcw070	PO_2800_2300_CWC PO_2800_2300_CWC R0_2800_2300_CWC	0,788	0,126	0,086	0,086	0,062	0,051	0,722949053 0,575938245	271795 277503
pcw350 pcw361 pcw362	P0_2800_2300_CWC P0_2800_2300_CWC P0_2800_2300_CWC	0,618	0,195 0,252 0.199	0 0,129 0.048	0,126 0,07 0.072	0,049 0.051	0,043	0,050338676 0,236657587	135341 465927 483966
TV32032 TV3831	PT_1800_1400_MBA PT_1800_1400_MBA	0,203 0,192	0,622	0,175 0,168	0,093 0,08	0,066	0,053	0,053837469 0,035040595	238465 268449
VO10207	PT_1800_1400_MBA PT_2500_2000_CA	0,088	0,777	0,136	0,138	0,092	0,082	0,025729704	123137 127069
14229	PT_2500_2000_CA	0	0,726	0,274	0	0,03	0,03	0,48717168	382908

Target Group	Generation (± 95% CI)	ed fit of a sin	Date calBCE	Admixture date BCE
FR_N_2500_2000_BBC_SMGB54	12,42 ± 5,51	0,48	2339 - 2139	2586,82 ± 154,30
FR_N_2500_2000_Bre445FK	18,18 ± 3,06	0,48	2509 - 2371	2948,95 ± 85,68
FR_S_2500_2000_BBC	19,03 ± 7,33	0,60	2435 - 2351	2925,94 ± 205,22
NL_2500_2000_BBC	22,03 ± 9,73	0,62	2523 - 2345	3050,87 ± 272,35
NL_2500_2000_BBC	35,24 ± 5,41	0,50	2119 - 1967	3029,84 ± 151,38
NL_1800_1600_BA	35,12 ± 12,22	0,64	1837 - 1699	2751,25 ± 342,19
GB_2500_2000_BBC	19,63 ± 7,62	0,45	2091 - 1967	2578,53 ± 213,28
FR_S_1700_1200_MBA	38,18 ± 16,84	0,26	1687 - 1611	2718,16 ± 471,54
FR_N_2200_1700_EBA	14,91 ± 6,29	0,48	2133 - 2029	2498,43 ± 176,15
FR_E_2200_1700_EBA	31,06 ± 4,50	0,57	1878 - 1772	2694,72 ± 126,04
FR_S_2200_1700_EBA	28,06 ± 6,17	0,42	1944 - 1880	2697,60 ± 172,78
IE_Rathlin_2000_1500_EBA	24,35 ± 4,93	0,57	1996 - 1900	2629,92 ± 138,08
CZ_2500_2000_BBC	21,85 ± 11,39	0,54	2433 - 2335	2995,80 ± 318,89
CZ_2500_2000_BBC (n=5)	27,69 ± 2,45	0,83	2326 - 2218	3047,40 ± 68,51
PT_1800_1400_MBA*	34,58 ± 4,30	0,46	1800 - 1400	2568,22 ± 120,31
ES_2000_1200_BA	24,61 ± 4,22	0,56	1914 - 1816	2554,07 ± 118,06
FR_N_2500_2000_Bre445YY	16,73 ± 3,50	0,73	2609 - 2445	2995,55 ± 97,96

Table S7. fastGLOBETROTTER inference of Yamnaya and Late Neolithic surrogate groups for ancient individuals

\*Archaeological context dates were used as radiocarbon dates

Table S10. Comparison of the estimation of the number of generations since the admixture between Neolithic- and steppe-ancestry individuals using either fastGlobeTrotter or DATES and varying source populations

fastGLOBETROTTER	WesternLN x Yamnaya	EasternLN x Yamnaya	EuropeLN x Yamnaya
SMGB54	11,92 ± 7,32	15,50 ± 4,98	12,42 ± 5,51
BRE445FK	15,45± 5,23	18,34 ± 4,84	18,18 ± 3,06
GBVPK	17,95 ± 3,76	18,56 ± 4,55	19,03 ± 7,33

DATES v4010	WesternLN x Yamnaya	EasternLN x Yamnaya	EuropeLN x Yamnaya
SMGB54	7,15 ± 18.99	56,80 ± 77,33	-21,40 ± 98,32
BRE445FK	12,16 ± 7,63	7,10 ± 4,57	8,40 ± 6,01
GBVPK	10,14 ± 3,14	16,81 ± 8,17	11,52 ± 4,24

To allow comparison of the two methods, the shotgun whole genomes of the same individuals v

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## **General Conclusion**

The recovery of DNA and the generation of genomic data from ancient specimens significantly transformed our understanding of the genetic history of human populations. As a result of methodological developments of both molecular biology and bioinformatics, the contribution of paleogenomics to the fundamental questions of evolutionary biology and human history is drastically increasing. Although the first large-scale studies covering vast geographical regions and time periods provided the first glimpse of world-wide peopling processes, especially in western Eurasia, regional small-scale studies at higher resolution are required to reconstruct the human past. These studies are hampered by the low coverage of a large part of the genomic data. This is of particular concern for most genomes from older periods, such as the Upper Paleolithic, due to the scarcity and low accessibility of well-preserved materials, although exceptions exist (e.g., the genomes obtained from the remains preserved in the Denisova cave in southern Siberia). In the Holocene, however, coinciding with the start of the Neolithic period, the abundance of human remains increases due to the increase in population size, the gathering in settlements as a consequence of the sedentary lifestyle. The petrosal part of the temporal bone has been shown to be the skeletal part from which the highest endogenous DNA yields are obtained. This discovery boosted the paleogenomic field as it led to higher data quality and decreased costs. For the projects of the present thesis project, we chose different study designs with the use of state-of-the-art methods tailored to the abundance of the remains analyzed, the degree of DNA preservation, the quantity and quality of published data for the comparative analyses and the scientific questions addressed.

Methodological developments of the DNA extraction, purification and library construction protocols enabled us to generate low coverage genome sequences from the cranial fragments of two Early Upper Paleolithic Buran Kaya III individuals from Crimea, in which DNA is very poorly preserved (Chapter 2, Fig S10-12). To maximize the amount of comparable

data between these individuals and other Paleolithic genomes, we exploited the SNP panel coming from Human Genome Diversity Project (HGDP). We applied population genetics tools that can deal with missing data. The combined analysis of these genomes with other recent ancient genomic findings from Europe allowed us to create a broad and updated model of population movements, interactions and turnovers during the first peopling waves of Europe by Homo sapiens in the Early Upper Paleolithic. Both individuals from Crimea were found to be more similar to subsequent European populations than to earlier inhabitants of Europe associated with the Initial Upper Paleolithic (IUP). However, since the Buran Kaya III individuals carried European IUP-associated ancestry, we can conclude that some of this ancestry persisted following the climatic crisis during the severe Heinrich 4 stadial and the CI super-eruption that devastated southern and eastern Europe at the beginning of the Heinrich 4 event. Thus, various levels of admixture events must have occurred between local and early migrating populations where migrating populations may be more numerous than the local ones, a phenomenon paralleled by the later Holocene expansions.

The two studies of the Holocene population dynamics in the Paris Basin presented in this thesis covers a period from the Late Mesolithic to the beginning of the Bronze Age, between 8,200 and 4,200 years ago, The ancient genomes produced have sufficient coverage to allowed us to impute and phase them together with other contemporary genomes using the reference panel of the 1000 Genomes Project with recently developed methods. Our sampling strategy made the preparation of a dataset possible suited for a deep characterization of Neolithic farmer populations in western Europe. By generating genomic data from the earliest farmer population that arrived in the Paris Basin, the last stage of the early Neolithic expansion, we were able to discriminate the genomes of the people moving along the continental and Mediterranean migration routes although they diverged from a common ancestor in southeastern Europe just around one thousand years ago. The early Neolithization of Europe is paralleled by a continuous fine-scale differentiation process of the genome of the early farmers. This differentiation became more apparent in later populations when the early expansion of farming came to an end and the population size of the different groups increased. The newly established local ancestries were preserved even during the Bronze Age as we were able to distinguish distinct Neolithic ancestries after the arrival of Yamnaya-related steppe-ancestry in western Europe. The detection of such prehistoric fine-scale structures in Europe allowed us to locate the possible origins of individuals or groups whose ancestors were moving and to reveal

interactions that could not be detected by the archaeological data alone. For instance, we detected the ICC-related ancestry in an individual buried in a particular burial in an LBK site in the Paris Basin, possibly after being sacrificed, which might indicate the notion of different identities during the Early Neolithic. We have shown complex gene flow processes by analyzing spatiotemporal patterns of admixture events between encountering populations from transition periods of the Mesolithic to the Neolithic and from the Late Neolithic to the Bronze Age. These analyses revealed correlations between cultural and genomic transformations as we detected different admixture dates pointing to known prehistorical events such as the expansion of farming via the ICC and LBK cultures, the end of Early Neolithic, the emergence of the Corded Ware and Bell Beaker cultural complexes. On the other hand, by analyzing the genomes of individuals with highly elevated hunter-gatherer ancestry we detected that the ancestors of these individuals were hunter-gatherers, who received recent gene flow from Neolithic groups yet preserved their hunter-gatherer ancestry. This means that they did not receive further gene flow from the Neolithic individuals but rather mated inside of their group. The individuals and groups with high hunter-gatherer ancestry were not identifiable archaeologically but seem to have been integrated into the Neolithic villages. The admixture dating results indicate that the admixture between hunter-gatherers and Neolithic farmers took place in the first half of the 4th millennium BCE lending particular importance to this period for future studies. Strikingly, we also observed similar cases of preferential mating between individuals of related ancestry when studying the spread of the steppe-ancestry in Europe at the onset of the Bronze age. The pattern of preservation of a high level of steppe-ancestry during the westward migration into Europe and the observation that most of the admixture with local Neolithic farmers could be dated to an initial major pulse of admixture when arriving in eastern Europe is also indicative of preferential intra-community mating of people with related ancestry. Indeed, we detected in real-time the emergence of a second admixture pulse when analyzing a Neolithic woman who had a son with an individual with steppe ancestry. We dated this second pulse to a period that saw the emergence of a new culture, the advanced Bell Beaker Complex, a situation that mirrors the previous emergence of the Corded Ware Culture in Central Europe. The analyzed individuals dated after 2500 BCE were descendants of this second major admixture pulse. They have kept for about one thousand years a relatively high level of steppe-ancestry indicating that they must have preferred intra-community mating over exogamy. Thus, even though mating between people of different ancestries occurred in pulses, often associated with the emergence of new cultural practices, as seen for the LBK, the CWC and the BBC, the pattern of preferential intra-community mating appears to be widespread even when two communities

share the same territory. This mating preference is probably mainly connected to culture, and most of all to language, and a major trait of human behavior in most cultures up to the present. Another case of segregation associated with ancestry could also be detected in the two Chouilly hypogea, as the dead appear to have been segregated in time (although the timing overlaps) but also based on their origin, with one hypogeum entombing individuals with Northern France ancestry, and one hypogeum entombing people of Southern France ancestry. Indeed, the belonging to a community, either via biological or cultural affiliation, or both, is of such importance to humans that they preserve the community links beyond death.

The imputation of ancient genomes allowed us to exploit different haplotype-based methods to answer various questions by providing further resolution to our analyses compared to more commonly used independent SNP-based methods. Therefore, to better characterize the populations and understand their genetic variation it was our strategic choice to analyze more but less well-covered genomes rather than a few high coverage genomes. It must be noted, however, that this was possible only since we analyzed the ancestors of present-day populations who are well-represented in the reference panels. Indeed, it would be highly challenging to characterize past populations when their various ancestries are not represented in the presentday populations, as in the case of early AMHs, or when the reference panels are poorly represented, such as for the Sub-Saharan African populations. Although the imputation and phasing of ancient genomes using present-day reference panels can provide sufficient power for a high-resolution analysis of past populations, it is still challenging to infer the exact haplotypes in ancient genomes. Since in the present-day populations the ancestral haplotypes are broken by recombination through many generations, the best solution would be to use ancient panels specific to certain periods and regions to access the accurate ancestral haplotypes. However, this would require the generation of many high coverage genomes from ancient individuals and family trios, which is technologically highly challenging and costly despite the fact that the number of high coverage genomes has been increasing recently.