## European admixture in Chinchorro DNA

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#### Abstract

It is widely held that, except for migrations from Beringia or Siberia, there was no contact between the Old World and the New World prior to the colonization of North America by the Norse in the late $10^{\text {th }}$ century AD. Analyses of 23 ancient American DNA samples reveal, however, the presence of European admixture in a sample taken from a Chinchorro mummy of northern Chile dated to 3972-3806 BC. This discovery implies a more complex history of the peopling of the Americas than previously accepted.


## Introduction

Mainstream accounts of the peopling of the Americas stipulate that there was a large migration of people from Beringia during the late Pleistocene, and that modern Amerindians derive most of their ancestry from these migrants. It is commonly believed that these migrants were the originators of the Clovis material culture, and it was long asserted that the appearance of these migrants south of Beringia did not predate the earliest datings of Clovis artifacts, around 13,200 years ago. The accumulation of evidence for earlier American settlements has forced mainstream scholars to abandon the latter position, however. Mainstream accounts also acknowledge two later migrations from Siberia, responsible for bringing speakers of Na-Dene and Eskimo-Aleut languages to the Americas.

A small minority of researchers have advanced theories of other migrations to the Americas. Dennis Stanford and Bruce Bradley, observing the many similarities between Clovis technology and that of the Upper Paleolithic Solutrean culture of Western Europe, have theorized that the ancestors of the Clovis people came not from Siberia, but from Europe, by traversing the Atlantic Ocean during the Last Glacial Maximum [1, 2]. In his 1947 crossing of the Pacific on the balsa raft Kon-Tiki [3], and his 1970 crossing of the Atlantic on the reed boat Ra II [4], Thor Heyerdahl demonstrated the feasibility of early transoceanic contacts, and in his written works he produced an abundance of historical, archeological, and anthropological evidence that such contacts had indeed taken place [5, 6, 7].

Mainstream scholars have continually rejected these other proposed migrations to the Americas, in spite of the evidence from a multitude of scientific disciplines in support of them. Ancient DNA evidence, however, can prove incontrovertibly that these other migrations took place, and such evidence is presented here for the first time.

## Methods

## Data

The 23 ancient American genomes analyzed are those published in [8]. Genotype calls generated from aligned reads were intersected with a set of 110,817 transversion SNPs (set 1) for principal component analysis, and a set of 228,841 transversion SNPs (set 2) for qpAdm and ADMIXTURE analyses. The resultant numbers of SNPs for each of the ancient American samples are shown in Table 1.

## qpAdm analysis

The program qpAdm [9] was used to estimate mixture coefficients for the ancient American samples, using the following populations:

- Target population: One of the 23 ancient American samples.
- Source population 1: A collection of populations shown to be purely Amerindian in admixture analyses: Mixe, Piapoco, Wichi, Chané, Karitiana, and Surui.
- Source population 2: One of 11 ancient or modern European, Middle Eastern, or South Asian populations.
- Outgroup populations: Mbuti Pygmies, Han Chinese, Nganasans, Eskimos, and Papuans.


## Principal component analysis

Principal component analysis of the ancient American samples was performed using the smartpca program of EIGENSOFT [10], using default parameters and the lsqproject: YES and numoutlieriter: 0 options.

## ADMIXTURE analysis

Model-based clustering analysis of the ancient American samples was performed with the ADMIXTURE program [11], with the number of assumed ancestral populations ranging from $K$ $=4$ to $K=13$.

## Results

## qpAdm analysis

The results of the of the 253 qpAdm analyses are shown in Table 2, which gives the mean source population 2 mixture coefficient, and the coefficients plus or minus one standard error, for each analysis. The analyses are listed in decreasing order of the mixture coefficient lower bounds.

## Principal component analysis

A plot of the results of a principal component analysis of ancient and modern American, European, and Middle Eastern samples is shown in Figure 1. Figure 2 is a plot of the results of a second principal component analysis, in which the Middle Eastern samples were excluded, leaving only the American and European samples.

## ADMIXTURE analysis

Plots of the results of $K=4,5,6,7,9$, and 13 ADMIXTURE analyses of the ancient American samples, along with other ancient and modern samples, are shown in Figures 3 through 8.

## Discussion

## qpAdm analysis

In Table 2, the 11 analyses in which the Chinchorro mummy sample was the target population have the 11 largest European, Middle Eastern, or South Asian mixture coefficient lower bounds. The mean coefficients for the Chinchorro sample tend to be around 0.45 , with the lower bounds mostly around 0.30 .

## Principal component analysis

In Figure 1, some of the Mayan, Bolivian, and Quechua samples, which ADMIXTURE analyses show to contain up to $17 \%$ European admixture, are shifted to the right of the more pure Amerindian samples, toward the European and Middle Eastern samples. To the right of them is a Mixtec sample which is $23.5 \%$ European, and to the right of that Mixtec sample is the 30-40\% European Chinchorro mummy sample, and also the Pericú sample BC23, which ADMIXTURE analyses also show to have a significant amount of European admixture. Note that in Figure 1 the Chinchorro mummy sample has a positive value of the second principal component, making it shifted in the direction of Europeans rather than Middle Easterners. In Figure 2 the positions of the Amerindian samples are similar, but BC23 is horizontally between the Mixtec sample and the Chinchorro mummy sample.

## ADMIXTURE analysis

In Figures 3 through 8, for all of the different values of $K$, the Chinchorro mummy sample consistently shows between $30 \%$ and $40 \%$ non-Amerindian admixture, and the only other samples that show a pattern of non-Amerindian components similar to that seen in the Chinchorro sample are the European samples from before the Last Glacial Maximum (LGM):

- $K=4$ : The Chinchorro sample is $31.66 \%$ non-Amerindian. It has a large amount of the blue component, and a small amount of the yellow component. The pre-LGM European
samples also have large amounts of the blue component, and smaller amounts of the yellow component.
- $\quad K=5$ : The Chinchorro sample is $32.13 \%$ non-Amerindian. It has a large amount of the blue component, a very small amount of the yellow component, and some of the purple component. The pre-LGM European samples also have large amounts of the blue component, and smaller amounts of the yellow and purple components.
- $K=6$ : The Chinchorro sample is $32.67 \%$ non-Amerindian. It has large amounts of the blue and green components, and small amounts of the yellow and purple components. The pre-LGM European samples also have large amounts of the blue component, and smaller amounts of the yellow and purple components, and some of them, particularly Kostenki 14 and the Gravettian sample Goyet Q53-1 from Belgium, have some of the green component.
- $K=7$ : The Chinchorro sample is $34.30 \%$ non-Amerindian. It has significant amounts of the plain blue, light blue, and green components, and a small amount of the purple component. The pre-LGM European samples also have significant amounts of the plain blue, light blue, green, and purple components.
- $K=9$ : The Chinchorro sample is $37.00 \%$ non-Amerindian. It has significant amounts of the plain blue, light blue, and plain green components. The pre-LGM European samples also have significant amounts of the plain blue, light blue, and plain green components. The pine green component is completely absent in the Chinchorro sample, and, with the exception of Kostenki 14, it is also completely absent in the pre-LGM European samples. The plain green component is absent in post-Magdalenian Europeans, and the pine green component is present in significant amounts in Europeans from the Copper Age on, which eliminates modern contamination as a possible source of the European admixture in the Chinchorro sample.
- $K=13$ : The Chinchorro sample is $36.49 \%$ non-Amerindian. The Chinchorro sample has significant amounts of the dark blue, light blue, and plain green components, and a small amount of the plain yellow component. The pre-LGM European samples also have significant amounts of the dark blue, light blue, and plain green components, and small amounts of the plain yellow component. The medium blue component is completely absent in the Chinchorro sample, and since the Eastern European and Western Siberian hunter-gatherers are made up mostly of that component, they are excluded as sources of the European admixture in the Chinchorro sample.


## Conclusions

The above qpAdm, principal component, and ADMIXTURE analyses of 23 ancient American
samples reveal that one of them, taken from a Chinchorro mummy of northern Chile dated to 3972-3806 BC, contains 30-40\% European admixture. That the non-Amerindian admixture present in the Chinchorro sample is more closely related to Europeans than to Middle Easterners is demonstrated by both the principal component and ADMIXTURE analyses. The ADMIXTURE analyses further shed light on exactly which European population the nonAmerindian admixture in the Chinchorro sample might be from: only the pre-LGM Europeans show a pattern of non-Amerindian components similar to that seen in the Chinchorro sample, which strongly suggests that the pre-LGM Aurignacians or Gravettians, or possibly the LGM Solutreans, were the source of the admixture. The Solutreans seem like a particularly likely source population, in light of the ample archeological evidence for their presence in the Americas. A complicating factor in identifying the exact source of the European admixture in the Chinchorro sample is the amount of divergent genetic drift that would have occurred between the arrival of the European source population in the Americas and the time of the Chinchorro individual analyzed. If the Solutreans were the source, and if they arrived in the Americas around 26,000 years ago, then around 20,000 years of divergent genetic drift would have accumulated in their American descendants by the time of the Chinchorro individual. This drift might account for the differences in the exact proportions of the non-Amerindian components in the Chinchorro and pre-LGM European samples, but it could also conceivably result in a somewhat later European population, such as the Magdalenians, not being correctly identified as the true source population. Regardless of the exact source of the European admixture in the Chinchorro sample, the fact that such admixture exists is the first ancient DNA proof of pre-Norse transatlantic contact.

## References

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Table 1. Description and numbers of SNPs used for 23 ancient American samples.

| Sample | Tribe | Region | Age BP | SNP set 1 | SNP set 2 |
| :--- | :--- | :--- | :--- | ---: | ---: |
| 939 | Unknown | British Columbia | $6260-5890$ | 38,692 | 81,341 |
| MARC1492 | Micmac | New Brunswick | $516-258$ | 15,374 | 27,461 |
| F9 | Unknown | Northwestern Mexico | $>500$ | 684 | 1,320 |
| MOM6 | Unknown | Northwestern Mexico | $>500$ | 1,233 | 2,378 |
| BC23 | Pericú | Baja California Sur | $800-300$ | 1,068 | 2,100 |
| BC25 | Pericú | Baja California Sur | $800-300$ | 21,180 | 38,118 |
| BC27 | Pericú | Baja California Sur | $800-300$ | 1,216 | 2,195 |
| BC28 | Pericú | Baja California Sur | $800-300$ | 1,083 | 2,041 |
| BC29 | Pericú | Baja California Sur | $800-300$ | 5,634 | 10,770 |
| BC30 | Pericú | Baja California Sur | $800-300$ | 12,469 | 24,827 |
| Enoque65 | Unknown | Northeastern Brazil | $3635-3483$ | 7,433 | 15,098 |
| Chinchorro | Unknown | Northern Chile | $5922-5756$ | 1,067 | 2,055 |
| AM66 | Alacaluf | Chilean Patagonia | 132 | 3,167 | 5,899 |
| AM71 | Alacaluf | Chilean Patagonia | 132 | 13,322 | 24,060 |
| AM72 | Alacaluf | Chilean Patagonia | 132 | 502 | 918 |
| AM73 | Alacaluf | Chilean Patagonia | 132 | 2,398 | 4,290 |
| AM74 | Alacaluf | Chilean Patagonia | 132 | 46,680 | 87,680 |
| MA572 | Selknam | Tierra del Fuego | $\sim 200$ | 1,242 | 2,268 |
| MA575 | Selknam | Tierra del Fuego | $\sim 200$ | 369 | 732 |
| MA577 | Selknam | Tierra del Fuego | $\sim 200$ | 93,774 | 181,308 |
| 890 | Yaghan | Tierra del Fuego | $\sim 200$ | 28,202 | 50,746 |
| 894 | Yaghan | Tierra del Fuego | $\sim 200$ | 66,852 | 121,408 |
| 895 | Yaghan | Tierra del Fuego | $\sim 200$ | 71,415 | 129,719 |

Table 2. Estimated source population 2 mixture coefficients produced by 253 qpAdm analyses.

| Target population | Source population 2 | $\mathbf{- 1 ~ S E}$ | Mean | $\mathbf{+ 1}$ SE |
| :--- | :--- | ---: | ---: | ---: |
| Chinchorro mummy | Pit Grave CA | 0.3526 | 0.5426 | 0.7326 |
| Chinchorro mummy | Spanish | 0.3141 | 0.4741 | 0.6341 |
| Chinchorro mummy | Iran EN | 0.3070 | 0.4770 | 0.6470 |
| Chinchorro mummy | Mala | 0.2927 | 0.4697 | 0.6467 |
| Chinchorro mummy | NW Asia Minor EN | 0.2868 | 0.4368 | 0.5868 |
| Chinchorro mummy | Pre-LGM Euro | 0.2849 | 0.4749 | 0.6649 |
| Chinchorro mummy | West Euro HG | 0.2841 | 0.4481 | 0.6121 |
| Chinchorro mummy | Georgia HG | 0.2634 | 0.4014 | 0.5394 |
| Chinchorro mummy | Tamil | 0.2595 | 0.4205 | 0.5815 |
| Chinchorro mummy | East Euro HG | 0.2280 | 0.5600 | 0.8920 |
| Chinchorro mummy | Natufian | 0.1447 | 0.3457 | 0.5467 |
| Mex mummy F9 | East Euro HG | 0.1303 | 0.4593 | 0.7883 |
| Mex mummy F9 | Spanish | 0.1033 | 0.2683 | 0.4333 |
| Mex mummy F9 | Pit Grave CA | 0.0964 | 0.2944 | 0.4924 |
| Mex mummy F9 | Tamil | 0.0954 | 0.2844 | 0.4734 |
| Mex mummy F9 | West Euro HG | 0.0924 | 0.3034 | 0.5144 |
| Mex mummy F9 | NW Asia Minor EN | 0.0896 | 0.2476 | 0.4056 |
| Mex mummy F9 | Georgia HG | 0.0880 | 0.2470 | 0.4060 |
| Mex mummy F9 | Iran EN | 0.0720 | 0.2570 | 0.4420 |
| Patagonian AM73 | Natufian | 0.0668 | 0.1698 | 0.2728 |
| Mex mummy F9 | Pre-LGM Euro | 0.0611 | 0.2161 | 0.3711 |
| Micmac MARC1492 | Georgia HG | 0.0359 | 0.0749 | 0.1139 |
| Micmac MARC1492 | Pit Grave CA | 0.0355 | 0.0785 | 0.1215 |
| Micmac MARC1492 | NW Asia Minor EN | 0.0336 | 0.0686 | 0.1036 |
| Brazilian Enoque65 | Natufian | 0.0335 | 0.1025 | 0.1715 |
| Brazilian Enoque65 | Mala | 0.0334 | 0.0874 | 0.1414 |
| Micmac MARC1492 | Spanish | 0.0326 | 0.0706 | 0.1086 |
| Micmac MARC1492 | Iran EN | 0.0323 | 0.0673 | 0.1023 |
| Pericú BC25 | Spanish | 0.0233 | 0.0563 | 0.0893 |
| Brazilian Enoque65 | Tamil | 0.0792 | 0.1352 |  |
| Pericú BC25 | 0.0951 |  |  |  |
|  |  |  |  |  |


| Target population | Source population 2 | $\mathbf{- 1} \mathbf{~ S E}$ | Mean | $+\mathbf{1}$ SE |
| :--- | :--- | ---: | ---: | ---: |
| Pericú BC25 | Georgia HG | 0.0225 | 0.0565 | 0.0905 |
| Pericú BC25 | NW Asia Minor EN | 0.0222 | 0.0532 | 0.0842 |
| Pericú BC25 | Pre-LGM Euro | 0.0220 | 0.0550 | 0.0880 |
| Pericú BC25 | Tamil | 0.0217 | 0.0577 | 0.0937 |
| Micmac MARC1492 | East Euro HG | 0.0209 | 0.0779 | 0.1349 |
| Pericú BC25 | Pit Grave CA | 0.0204 | 0.0604 | 0.1004 |
| Micmac MARC1492 | West Euro HG | 0.0204 | 0.0624 | 0.1044 |
| Pericú BC25 | Mala | 0.0186 | 0.0546 | 0.0906 |
| Pericú BC25 | Iran EN | 0.0184 | 0.0504 | 0.0824 |
| Mex mummy F9 | Mala | 0.0184 | 0.2364 | 0.4544 |
| Micmac MARC1492 | Natufian | 0.0151 | 0.0581 | 0.1011 |
| Micmac MARC1492 | Pre-LGM Euro | 0.0146 | 0.0516 | 0.0886 |
| Brazilian Enoque65 | Georgia HG | 0.0133 | 0.0683 | 0.1233 |
| Pericú BC25 | Natufian | 0.0128 | 0.0498 | 0.0868 |
| Brazilian Enoque65 | Iran EN | 0.0079 | 0.0569 | 0.1059 |
| Brazilian Enoque65 | Pit Grave CA | 0.0061 | 0.0661 | 0.1261 |
| Brazilian Enoque65 | NW Asia Minor EN | 0.0041 | 0.0541 | 0.1041 |
| Mex mummy MOM6 | Natufian | 0.0040 | 0.1150 | 0.2260 |
| Brazilian Enoque65 | Pre-LGM Euro | 0.0036 | 0.0586 | 0.1136 |
| Fuegian 894 | Natufian | 0.0023 | 0.0213 | 0.0403 |
| Brazilian Enoque65 | Spanish | 0.0023 | 0.0553 | 0.1083 |
| Fuegian 890 | Natufian | 0.0022 | 0.0302 | 0.0582 |
| Micmac MARC1492 | Tamil | 0.0014 | 0.0414 | 0.0814 |
| Brazilian Enoque65 | West Euro HG | -0.0004 | 0.0576 | 0.1156 |
| Fuegian MA577 | Georgia HG | -0.0026 | 0.0158 | 0.0358 |
| Fuegian MA577 | West Euro HG | 0.0161 | 0.0341 |  |
| Pericú BC25 | East Euro HG | 0.037 | 0.0374 |  |
| Fuegian MA577 | Iran EN | -0.0029 | 0.0141 | 0.0311 |
| Fuegian MA577 | NW Asia Minor EN | -0.0034 | 0.0136 | 0.0306 |
| Fuegian MA577 | Pit Grave CA | 0.0036 | 0.0184 | 0.0404 |
| Fuegian MA577 | Fuegian MA577 | 0.0338 |  |  |
|  |  | 0.0493 | 0.1013 |  |


| Target population | Source population 2 | - 1 SE | Mean | + 1 SE |
| :---: | :---: | :---: | :---: | :---: |
| Patagonian AM66 | Natufian | -0.0045 | 0.0995 | 0.2035 |
| Fuegian MA577 | Pre-LGM Euro | -0.0056 | 0.0124 | 0.0304 |
| Fuegian MA577 | Mala | -0.0074 | 0.0136 | 0.0346 |
| Micmac MARC1492 | Mala | -0.0093 | 0.0327 | 0.0747 |
| Fuegian MA577 | East Euro HG | -0.0097 | 0.0173 | 0.0443 |
| Fuegian MA577 | Natufian | -0.0103 | 0.0087 | 0.0277 |
| Fuegian 890 | East Euro HG | -0.0125 | 0.0305 | 0.0735 |
| Fuegian 894 | NW Asia Minor EN | -0.0127 | 0.0053 | 0.0233 |
| Fuegian 894 | West Euro HG | -0.0138 | 0.0072 | 0.0282 |
| Fuegian 894 | Spanish | -0.0140 | 0.0060 | 0.0260 |
| Fuegian 894 | Iran EN | -0.0141 | 0.0049 | 0.0239 |
| Fuegian 894 | Georgia HG | -0.0144 | 0.0056 | 0.0256 |
| Fuegian 894 | Pit Grave CA | -0.0145 | 0.0085 | 0.0315 |
| Fuegian 894 | Pre-LGM Euro | -0.0153 | 0.0047 | 0.0247 |
| Fuegian 890 | West Euro HG | -0.0173 | 0.0137 | 0.0447 |
| Fuegian 890 | Georgia HG | -0.0175 | 0.0105 | 0.0385 |
| Patagonian AM74 | Natufian | -0.0176 | 0.0064 | 0.0304 |
| Patagonian AM66 | Pre-LGM Euro | -0.0181 | 0.0539 | 0.1259 |
| Pericú BC28 | Pre-LGM Euro | -0.0185 | 0.0945 | 0.2075 |
| Fuegian 890 | Pre-LGM Euro | -0.0189 | 0.0091 | 0.0371 |
| Fuegian 890 | Iran EN | -0.0194 | 0.0076 | 0.0346 |
| Fuegian 894 | East Euro HG | -0.0198 | 0.0102 | 0.0402 |
| Fuegian 890 | Spanish | -0.0199 | 0.0081 | 0.0361 |
| Fuegian 890 | NW Asia Minor EN | -0.0199 | 0.0071 | 0.0341 |
| Fuegian 890 | Mala | -0.0201 | 0.0119 | 0.0439 |
| Fuegian 890 | Pit Grave CA | -0.0202 | 0.0138 | 0.0478 |
| Fuegian 890 | Tamil | -0.0208 | 0.0102 | 0.0412 |
| Patagonian AM66 | West Euro HG | -0.0210 | 0.0540 | 0.1290 |
| Patagonian AM66 | Iran EN | -0.0212 | 0.0448 | 0.1108 |
| Pericú BC23 | Natufian | -0.0218 | 0.2042 | 0.4302 |
| Fuegian 894 | Tamil | -0.0219 | 0.0001 | 0.0221 |
| Patagonian AM66 | NW Asia Minor EN | -0.0224 | 0.0456 | 0.1136 |


| Target population | Source population 2 | $\mathbf{- 1 ~ S E}$ | Mean | $\mathbf{+ 1}$ SE |
| :--- | :--- | ---: | ---: | ---: |
| Patagonian AM66 | Spanish | -0.0235 | 0.0525 | 0.1285 |
| Fuegian 894 | Mala | -0.0244 | -0.0014 | 0.0216 |
| Patagonian AM74 | NW Asia Minor EN | -0.0246 | -0.0046 | 0.0154 |
| Patagonian AM74 | Iran EN | -0.0247 | -0.0047 | 0.0153 |
| Patagonian AM74 | East Euro HG | -0.0248 | 0.0072 | 0.0392 |
| Patagonian AM74 | Spanish | -0.0253 | -0.0043 | 0.0167 |
| Patagonian AM66 | Georgia HG | -0.0256 | 0.0524 | 0.1304 |
| Patagonian AM74 | Georgia HG | -0.0256 | -0.0046 | 0.0164 |
| Patagonian AM66 | Pit Grave CA | -0.0276 | 0.0634 | 0.1544 |
| Patagonian AM74 | Pit Grave CA | -0.0276 | -0.0026 | 0.0224 |
| Patagonian AM74 | West Euro HG | -0.0280 | -0.0040 | 0.0200 |
| Patagonian AM74 | Pre-LGM Euro | -0.0288 | -0.0068 | 0.0152 |
| Mex mummy MOM6 | Iran EN | -0.0305 | 0.0945 | 0.2195 |
| Patagonian AM66 | Mala | -0.0312 | 0.0488 | 0.1288 |
| Patagonian AM74 | Tamil | -0.0332 | -0.0092 | 0.0148 |
| Pericú BC29 | Iran EN | -0.0340 | 0.0160 | 0.0660 |
| Mex mummy MOM6 | NW Asia Minor EN | -0.0352 | 0.0698 | 0.1748 |
| Patagonian AM74 | Mala | -0.0364 | -0.0124 | 0.0116 |
| Patagonian AM66 | Tamil | -0.0366 | 0.0444 | 0.1254 |
| Pericú BC29 | Natufian | -0.0479 | -0.0049 | 0.0381 |
| Pericú BC29 | NW Asia Minor EN | -0.0468 | 0.0172 | 0.0712 |
| Pericú BC29 | Spanish | -0.0396 | 0.0204 | 0.0804 |
| Fuegian 895 | Georgia HG | -0.0435 | -0.0235 | -0.0035 |
| Pericú BC29 | Natufian | -0.0438 | 0.0182 | 0.0802 |
| Pericú BC29 | West Euro HG | -0.0438 | 0.0172 | 0.0782 |
| Pericú BC28 | Tamil | -0.0441 | 0.0779 | 0.1999 |
| Mex mummy MOM6 | Georgia HG | -0.0447 | 0.0723 | 0.1893 |
| Fuegian 895 | Spanish | -0.0461 | -0.0271 | -0.0081 |
| Pericú BC29 | NW Asia Minor EN | -0.0468 | 0.0192 | 0.0852 |
| Fuegian 895 |  | -0.0469 | -0.0279 | -0.0089 |
| Fuegian 895 | Patagonian AM71 | -0.0094 |  |  |
|  | Grave CA | 0.0737 |  |  |


| Target population | Source population 2 | $\mathbf{- 1 ~ S E}$ | Mean | $\mathbf{+ 1}$ SE |
| :--- | :--- | ---: | ---: | ---: |
| Fuegian 895 | Spanish | -0.0481 | -0.0281 | -0.0081 |
| Fuegian 895 | Pre-LGM Euro | -0.0507 | -0.0307 | -0.0107 |
| Pericú BC28 | Spanish | -0.0507 | 0.0733 | 0.1973 |
| Fuegian 895 | West Euro HG | -0.0517 | -0.0307 | -0.0097 |
| Pericú BC29 | Mala | -0.0520 | 0.0090 | 0.0700 |
| Patagonian AM66 | East Euro HG | -0.0530 | 0.0480 | 0.1490 |
| Brazilian Enoque65 | East Euro HG | -0.0540 | 0.0210 | 0.0960 |
| Pericú BC28 | NW Asia Minor EN | -0.0545 | 0.0615 | 0.1775 |
| Fuegian 895 | Pit Grave CA | -0.0551 | -0.0321 | -0.0091 |
| Pericú BC29 | Pre-LGM Euro | -0.0553 | 0.0027 | 0.0607 |
| Pericú BC28 | West Euro HG | -0.0568 | 0.0822 | 0.2212 |
| Mex mummy F9 | Natufian | -0.0598 | 0.1282 | 0.3162 |
| Fuegian 895 | Tamil | -0.0601 | -0.0381 | -0.0161 |
| Pericú BC28 | Pit Grave CA | -0.0602 | 0.0798 | 0.2198 |
| Mex mummy MOM6 | Georgia HG | -0.0603 | 0.0877 | 0.2357 |
| Pericú BC28 | Mala | -0.0610 | 0.0850 | 0.2310 |
| Pericú BC28 | Iran EN | -0.0626 | 0.0634 | 0.1894 |
| Fuegian 895 | Mala | -0.0647 | -0.0417 | -0.0187 |
| Pericú BC27 | Natufian | -0.0650 | 0.0570 | 0.1790 |
| Fuegian 895 | East Euro HG | -0.0651 | -0.0361 | -0.0071 |
| Pericú BC28 | East Euro HG | -0.0678 | 0.1322 | 0.3322 |
| Pericú BC28 | Tamil | -0.0699 | 0.0641 | 0.1981 |
| Pericú BC30 |  | NW Asia Minor EN | -0.0710 | -0.0320 |
| Pericú BC30 | Iran EN | 0.0070 |  |  |
| Pericú BC30 | Georgia HG | -0.0720 | -0.0330 | 0.0060 |
| Mex mummy MOM6 | Pre-LGM Euro | -0.0722 | -0.0312 | 0.0098 |
| Mex mummy MOM6 | West Euro HG | -0.0730 | 0.0480 | 0.1690 |
| Pericú BC30 | Spanish | -0.0736 | 0.0794 | 0.2324 |
| Pericú BC29 | -0.0741 | -0.0331 | 0.0079 |  |
| Mex mummy MOM6 | -0.0744 | -0.0044 | 0.0656 |  |
| Pericú BC27 | Pericú BC30 | 0.0783 | 0.0647 | 0.2077 |
|  | 0.0066 |  |  |  |


| Target population | Source population 2 | $\mathbf{- 1}$ SE | Mean | $\mathbf{+ 1}$ SE |
| :--- | :--- | ---: | ---: | ---: |
| Pericú BC23 | Tamil | -0.0818 | 0.0732 | 0.2282 |
| Pericú BC30 | Pit Grave CA | -0.0831 | -0.0361 | 0.0109 |
| Pericú BC30 | Natufian | -0.0856 | -0.0376 | 0.0104 |
| Patagonian AM72 | Mala | -0.0864 | 0.1236 | 0.3336 |
| Pericú BC27 | NW Asia Minor EN | -0.0871 | 0.0229 | 0.1329 |
| Patagonian AM72 | NW Asia Minor EN | -0.0884 | 0.1086 | 0.3056 |
| Pericú BC30 | Tamil | -0.0900 | -0.0450 | 0.0000 |
| Pericú BC30 | Pre-LGM Euro | -0.0904 | -0.0464 | -0.0024 |
| Pericú BC23 | Georgia HG | -0.0906 | 0.0554 | 0.2014 |
| Pericú BC23 | Iran EN | -0.0919 | 0.0571 | 0.2061 |
| British Columbia 939 | NW Asia Minor EN | -0.0923 | -0.0673 | -0.0423 |
| Pericú BC29 | East Euro HG | -0.0932 | -0.0072 | 0.0788 |
| Pericú BC23 | Spanish | -0.0934 | 0.0546 | 0.2026 |
| Pericú BC23 | Pre-LGM Euro | -0.0934 | 0.0716 | 0.2366 |
| Pericú BC23 | NW Asia Minor EN | -0.0934 | 0.0536 | 0.2006 |
| Pericú BC30 | Mala | -0.0935 | -0.0495 | -0.0055 |
| British Columbia 939 | Iran EN | -0.0936 | -0.0676 | -0.0416 |
| Pericú BC27 | Spanish | -0.0949 | 0.0251 | 0.1451 |
| Patagonian AM71 | Iran EN | -0.0953 | -0.0593 | -0.0233 |
| British Columbia 939 | Georgia HG | -0.0962 | -0.0692 | -0.0422 |
| Mex mummy MOM6 | Tamil | -0.0966 | 0.0454 | 0.1874 |
| Patagonian AM73 | Iran EN | -0.0972 | -0.0262 | 0.0448 |
| British Columbia 939 | Spanish | -0.0978 | -0.0708 | -0.0438 |
| Patagonian AM73 | NW Asia Minor EN | -0.0979 | -0.0249 | 0.0481 |
| Patagonian AM72 | Georgia HG | -0.0984 | 0.1506 | 0.3996 |
| Patagonian AM72 | Iran EN | -0.0988 | 0.0842 | 0.2672 |
| Patagonian AM72 | Spanish | -0.1007 | 0.1043 | 0.3093 |
| Patagonian AM71 | NW Asia Minor EN | -0.1014 | -0.0644 | -0.0274 |
| Patagonian AM73 | Spanish | -0.0287 | 0.0463 |  |
| Pericú BC30 | East Euro HG | 0.1621 |  |  |
| Patagonian AM73 | Pericú BC27 | -0.1030 | -0.0400 | 0.0230 |
|  | -0.023 | -0.0253 | 0.0517 |  |
|  |  | -0.037 |  |  |


| Target population | Source population 2 | - 1 SE | Mean | + 1 SE |
| :---: | :---: | :---: | :---: | :---: |
| Patagonian AM72 | Tamil | -0.1059 | 0.1171 | 0.3401 |
| Pericú BC27 | Iran EN | -0.1060 | 0.0110 | 0.1280 |
| Patagonian AM71 | Georgia HG | -0.1064 | -0.0664 | -0.0264 |
| Patagonian AM71 | Spanish | -0.1072 | -0.0682 | -0.0292 |
| Pericú BC23 | West Euro HG | -0.1076 | 0.0534 | 0.2144 |
| British Columbia 939 | West Euro HG | -0.1083 | -0.0783 | -0.0483 |
| Pericú BC27 | West Euro HG | -0.1086 | 0.0214 | 0.1514 |
| Pericú BC27 | Pit Grave CA | -0.1096 | 0.0304 | 0.1704 |
| Patagonian AM73 | East Euro HG | -0.1097 | 0.0043 | 0.1183 |
| Patagonian AM73 | Pit Grave CA | -0.1099 | -0.0199 | 0.0701 |
| British Columbia 939 | Pre-LGM Euro | -0.1116 | -0.0846 | -0.0576 |
| Mex mummy MOM6 | Mala | -0.1120 | 0.0360 | 0.1840 |
| Patagonian AM71 | Pre-LGM Euro | -0.1129 | -0.0729 | -0.0329 |
| British Columbia 939 | Pit Grave CA | -0.1152 | -0.0832 | -0.0512 |
| Patagonian AM73 | Pre-LGM Euro | -0.1152 | -0.0372 | 0.0408 |
| British Columbia 939 | Tamil | -0.1164 | -0.0874 | -0.0584 |
| Patagonian AM71 | Tamil | -0.1170 | -0.0770 | -0.0370 |
| Pericú BC27 | Tamil | -0.1186 | 0.0064 | 0.1314 |
| Patagonian AM72 | Pre-LGM Euro | -0.1189 | 0.0861 | 0.2911 |
| Patagonian AM71 | Mala | -0.1191 | -0.0801 | -0.0411 |
| Patagonian AM73 | Mala | -0.1197 | -0.0417 | 0.0363 |
| British Columbia 939 | Mala | -0.1216 | -0.0916 | -0.0616 |
| Pericú BC27 | Mala | -0.1221 | -0.0031 | 0.1159 |
| Patagonian AM73 | Tamil | -0.1228 | -0.0428 | 0.0372 |
| Patagonian AM71 | West Euro HG | -0.1231 | -0.0801 | -0.0371 |
| Patagonian AM73 | West Euro HG | -0.1241 | -0.0371 | 0.0499 |
| Pericú BC23 | Mala | -0.1251 | 0.0379 | 0.2009 |
| British Columbia 939 | Natufian | -0.1271 | -0.0971 | -0.0671 |
| Pericú BC23 | Pit Grave CA | -0.1280 | 0.0460 | 0.2200 |
| Patagonian AM72 | Pit Grave CA | -0.1299 | 0.1241 | 0.3781 |
| Patagonian AM71 | Pit Grave CA | -0.1308 | -0.0828 | -0.0348 |
| Patagonian AM71 | East Euro HG | -0.1344 | -0.0774 | -0.0204 |


| Target population | Source population 2 | $\mathbf{- 1} \mathbf{~ S E}$ | Mean | $\mathbf{+ 1}$ SE |
| :--- | :--- | ---: | ---: | ---: |
| British Columbia 939 | East Euro HG | -0.1434 | -0.1044 | -0.0654 |
| Patagonian AM72 | West Euro HG | -0.1447 | 0.1213 | 0.3873 |
| Mex mummy MOM6 | East Euro HG | -0.1657 | 0.0323 | 0.2303 |
| Pericú BC27 | East Euro HG | -0.1731 | 0.0249 | 0.2229 |
| Fuegian MA572 | Georgia HG | -0.1806 | -0.0816 | 0.0174 |
| Fuegian MA572 | NW Asia Minor EN | -0.1941 | -0.0861 | 0.0219 |
| Pericú BC23 | East Euro HG | -0.1991 | 0.0389 | 0.2769 |
| Fuegian MA572 | Iran EN | -0.2024 | -0.0924 | 0.0176 |
| Fuegian MA572 | West Euro HG | -0.2039 | -0.0859 | 0.0321 |
| Patagonian AM72 | Natufian | -0.2101 | 0.2569 | 0.7239 |
| Fuegian MA572 | Pre-LGM Euro | -0.2137 | -0.0997 | 0.0143 |
| Fuegian MA572 | Spanish | -0.2184 | -0.1014 | 0.0156 |
| Fuegian MA572 | Mala | -0.2217 | -0.1097 | 0.0023 |
| Fuegian MA572 | Tamil | -0.2228 | -0.1018 | 0.0192 |
| Fuegian MA572 | East Euro HG | -0.2326 | -0.0956 | 0.0414 |
| Pericú BC28 | Natufian | -0.2424 | -0.1064 | 0.0296 |
| Fuegian MA572 | Pit Grave CA | -0.2532 | -0.1122 | 0.0288 |
| Fuegian MA572 | Natufian | -0.2882 | -0.1412 | 0.0058 |
| Fuegian MA575 | Pre-LGM Euro | -0.3196 | -0.1466 | 0.0264 |
| Fuegian MA575 | Iran EN | -0.3350 | -0.1380 | 0.0590 |
| Fuegian MA575 | Georgia HG | -0.3576 | -0.1676 | 0.0224 |
| Fuegian MA575 | Spanish | -0.3629 | -0.1779 | 0.0071 |
| Fuegian MA575 | NW Asia Minor EN | -0.3717 | -0.1837 | 0.0043 |
| Fuegian MA575 | Mala | -0.3774 | -0.1454 | 0.0866 |
| Patagonian AM72 | East Euro HG | -0.3854 | 0.0356 | 0.4566 |
| Fuegian MA575 | Natufian | -0.3864 | -0.1784 | 0.0296 |
| Fuegian MA575 | Tamil | -0.3923 | -0.1723 | 0.0477 |
| Fuegian MA575 | Pit Grave CA | -0.4451 | -0.2371 | -0.0291 |
| Fuegian MA575 | West Euro HG | -0.4688 | -0.2238 | 0.0212 |
| Fuegian MA575 | East Euro HG | -0.2947 | -0.0187 |  |

Figure 1: PCA of Amerindians, Europeans, and Middle Easterners


Figure 2: PCA of Amerindians and Europeans



