

1 Ancient Structure Report

1.1 Introduction

We want to develop an analogous model to STRUCTURE for ancient DNA data that borrowed information from ancient DNA data to define the clusters in pooled modern + ancient SNP data. We first became interested in this from reading Haak et al 2015 in which they claimed that modern Europeans can be written as a mixture of 3 ancestral source populations and produced the following figure (Fig 1).

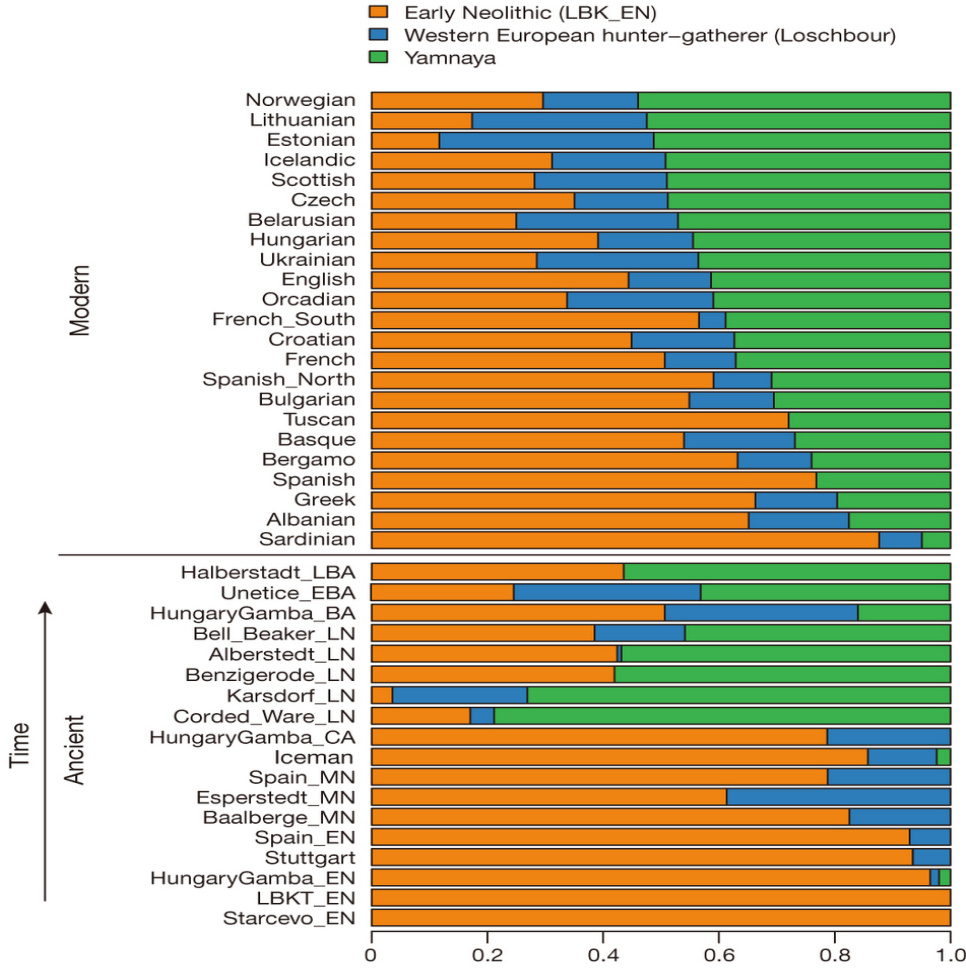


Figure 1. Haak et al (2015): modern and ancient European populations can be written as a mixture of Yamanaya, LBK-EN and Loschbour

To estimate the admixture proportions (α_i), Haak et al. used the "F4 statistics" concept (a statistic pioneered from their group) where,

$$f_4(Test; A; B, C) \approx \sum_{i=1}^N \alpha_i f_4(Ref_i; A; B, C)$$

with $\sum_{i=1}^N \alpha_i = 1$ and $\alpha_i \geq 0$ and *Test* represent the allele frequency of the test population (which are modern day populations in this case) and *A, B, C* are the allele frequencies of the "outgroups" populations. *Ref_i* is the allele frequency of the *i*th ancient population.

There are $n \binom{n-1}{2}$ combinations of *A, B, C*. Thus, for one test population, they have $n \binom{n-1}{2}$ linear equations and solve for α_i by least squares.

Why do we feel that there's room for an alternate analysis? We cite the following reasons

- We wanted to apply a more standard approach that is easier to interpret. We know that the STRUCTURE model is one such approach and has been proved to be effective for population genetic data-sets.
- We would like to cluster the data using the genotype data so as to get a better feel of within group heterogeneity, instead of using allele frequencies which is the case for the F4 approach.
- Haak et al fixed 3 source populations (Yamanya, LBK-EN, Loschbour) and expressed the modern day Europeans as a mixture of these 3 ancient source populations. From this analysis, Haak et al claim that Europeans therefore can be written as a mixture of just these 3 ancient populations. However, there might be a possibility that there are some unknown ancient populations which modern day populations derive significant ancestry from; something the authors did not investigate.
- There has been many other papers that apply ADMIXTURE to pooled ancient + modern day data that do not take account of the hierarchy of the pooled ancient + modern day data.