



UNIVERSITY OF TARTU
Institute of Genomics

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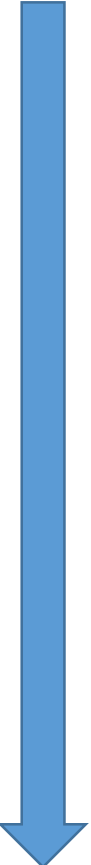


[Examples] Sex-biased and unbiased demographic processes in human history ... [genetic insights]



[Man and woman from Cernavoda (Romania), Hamangia culture, 5,000 BC]

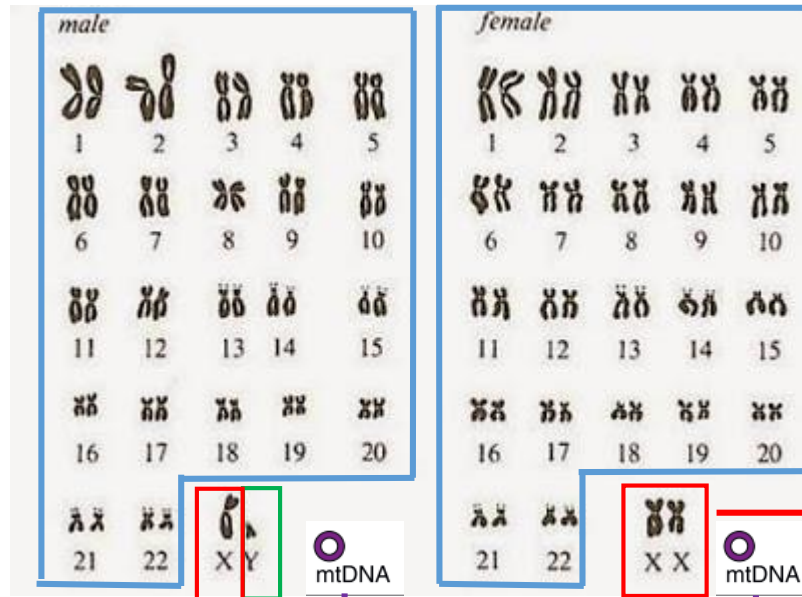
Outline

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- 1) [120-65 kya] Neanderthal and Human interbreeding
 - 2) [120-65 kya] Broad demographic patterns based on DNA after the out-of-Africa
 - 3) [8-4 ky BC] Farming expansion and cultural changes during the onset of the Bronze age
 - 4) [5-3 ky BC] Bronze age and the formation of Europe
 - 5) [500 ya - present] The 'New World' and the formation of North- and Latin-America

A note on chromosome inheritance and the study of sex biases in the human genome

The different histories of men and women leave traces in different parts of the genome; therefore we can study these different patterns and reconstruct both histories

'Standard' karyotype



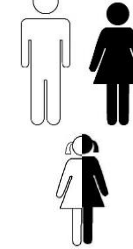
Autosomes

Many shared histories across many locations



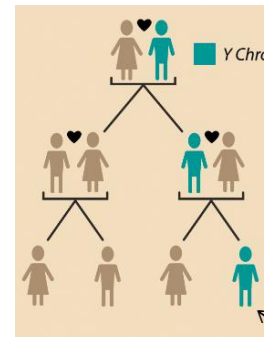
X chromosome

Fewer shared histories across fewer locations



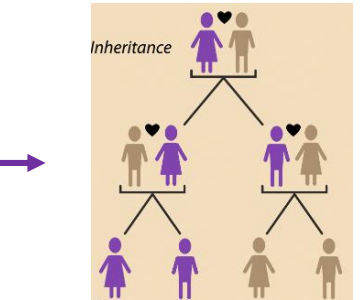
Mitochondria

One maternal history

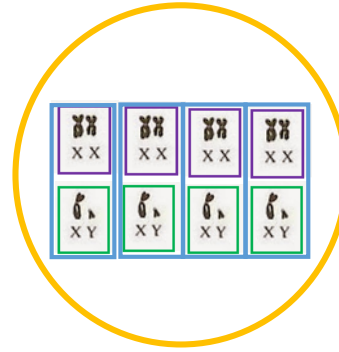
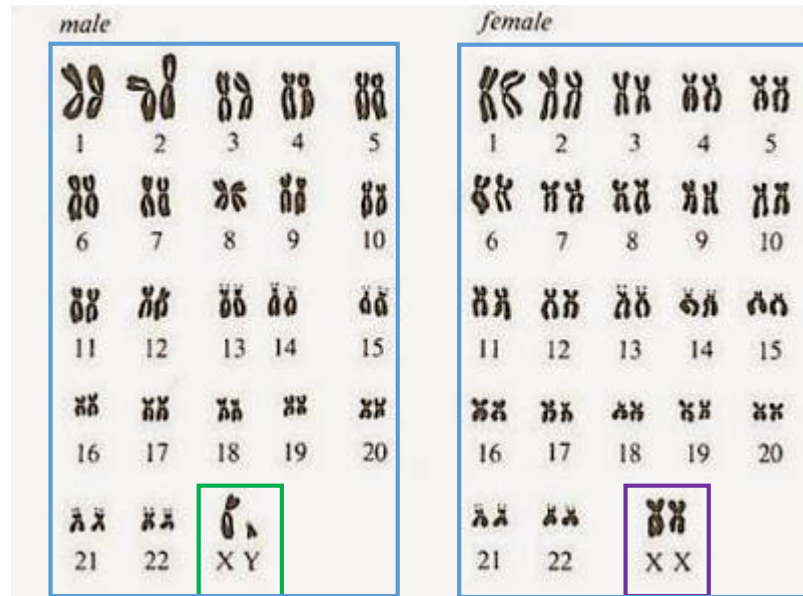


Y chromosome

One paternal history



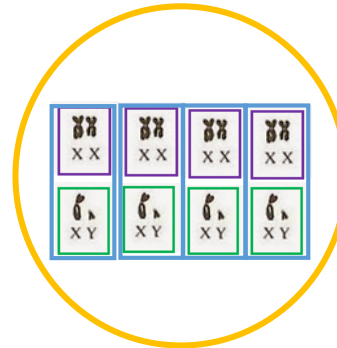
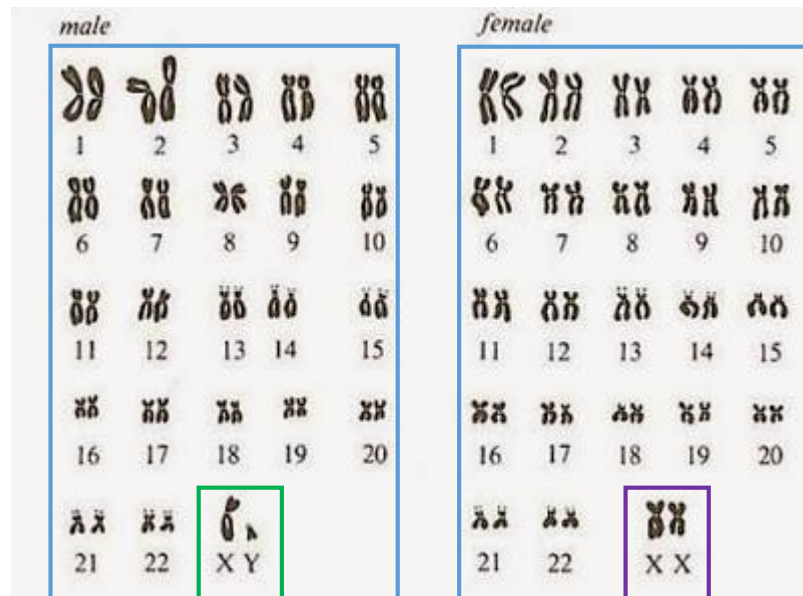
One example ...



**Neutral
Expectations**

$$\frac{\pi_X}{\pi_A} = \frac{3}{4} = 0.75$$

One example ...



Neutral Expectations

$$\frac{\pi_X}{\pi_A} = \frac{3}{4} = 0.75$$

Deviations from the expectations

Natural selection

Demographic/Cultural processes

Positive/Negative selection

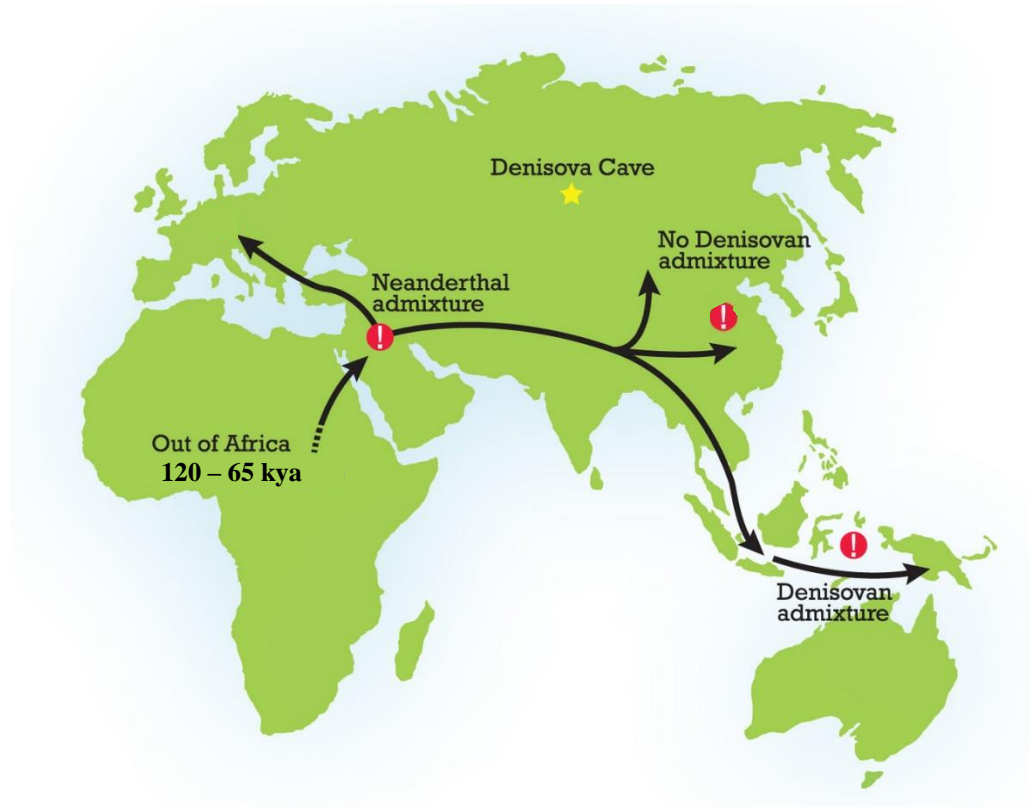
Sexual selection

Migration / Invasion

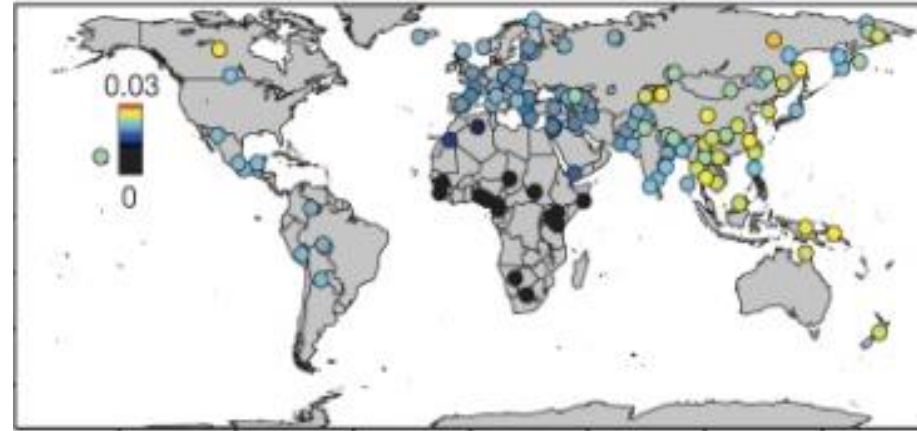
Expansion

Changes in culture and modes of living

[120-65 kya] [Neanderthal-Human interbreeding]



[Modified from Harvard Magazine.
July-Aug 2014]



[Sankararaman et al
Current Biology.2016]



[Museum of Mettmann
Germany. 2009]

[120-65 kya][Demographic processes after the out-of-Africa]

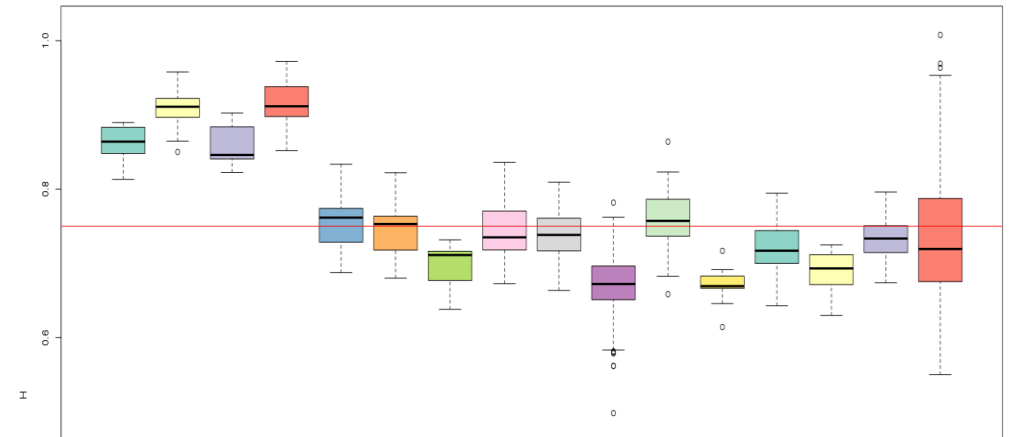


[B. deMenocal and Stringer. Nature 2016]

a) Out-of-Africa followed by male-biased migration

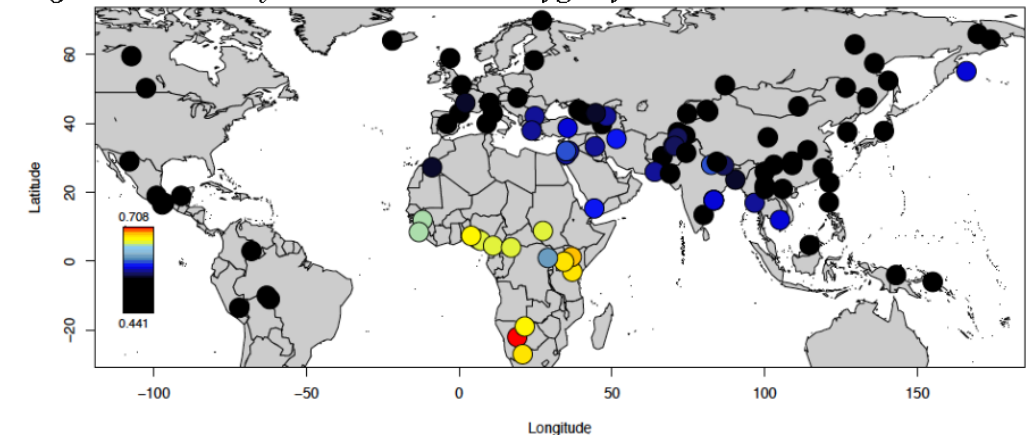
(anthropological studies provide evidence for female migration dominating at short distances, and male on long distances)

- a) Strong selection pressures on the X chromosome
- b) A small proportion of females having all the offspring
- c) Male homo sapiens having more offspring with female Neanderthals
- d) **Extensive male-biased migration and admixture in non-Africans after the Out-of-Africa event, and not in Africans**



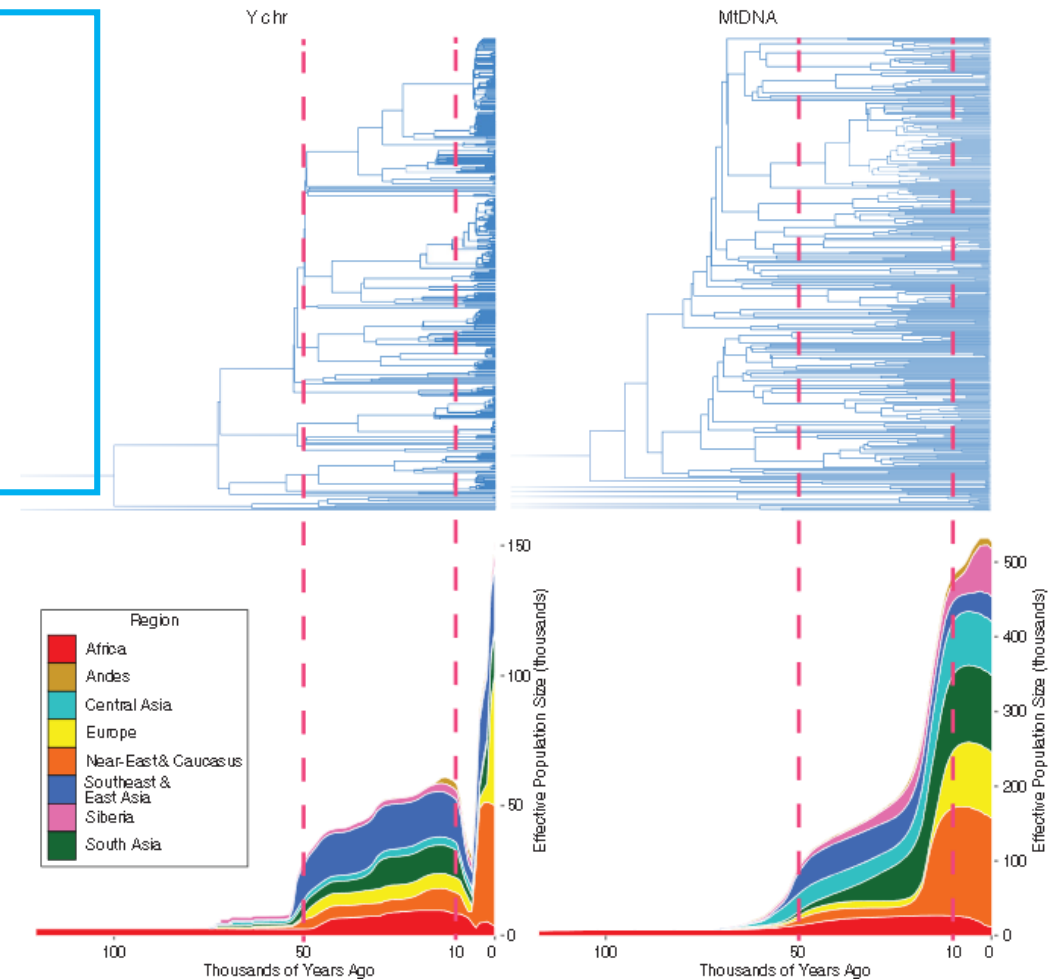
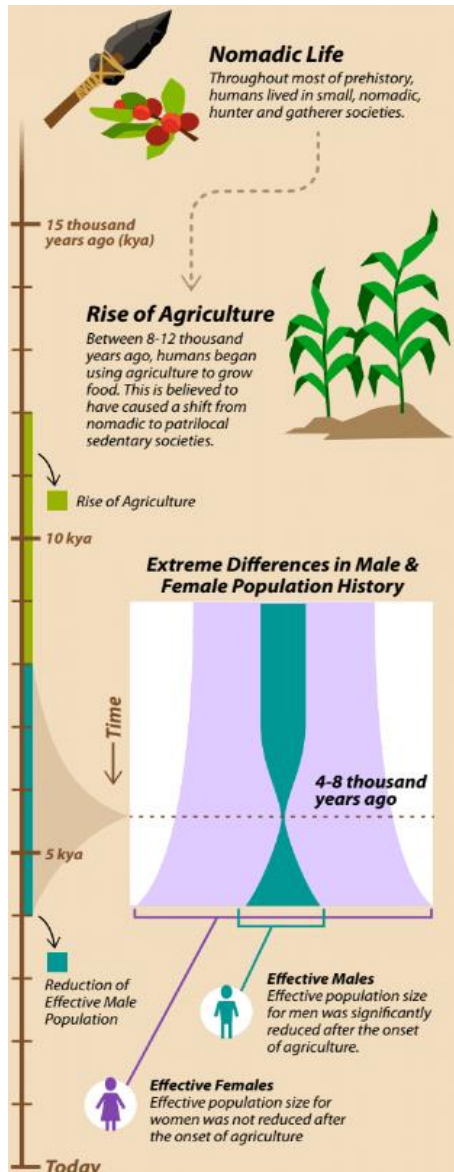
[unpublished data]

Figure S7.2. Ratio of X-to-autosome heterozygosity



[Mallick et al
Nature.2016]

[8 - 4 ky BC] [Farming societies during the onset of the Bronze age]

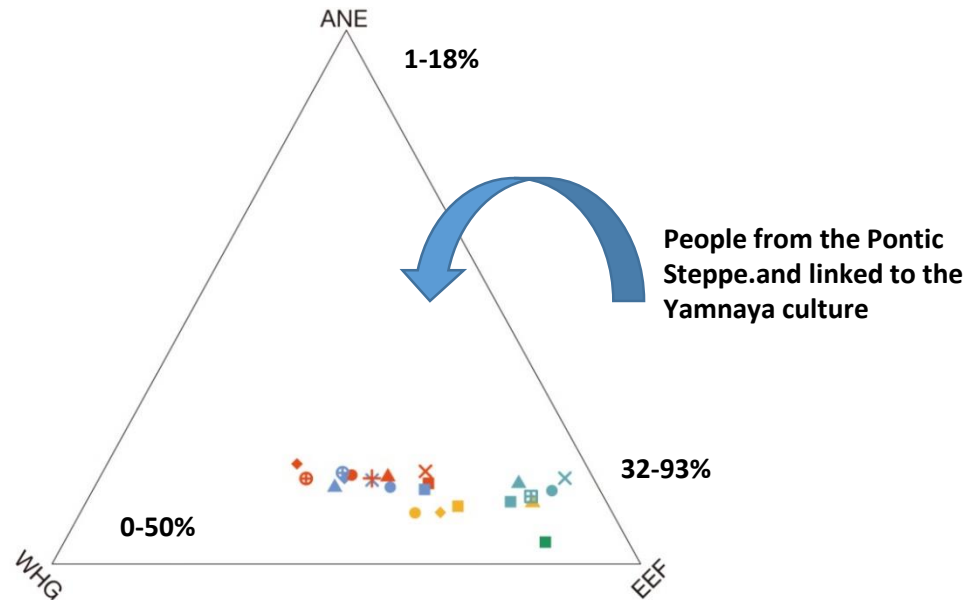
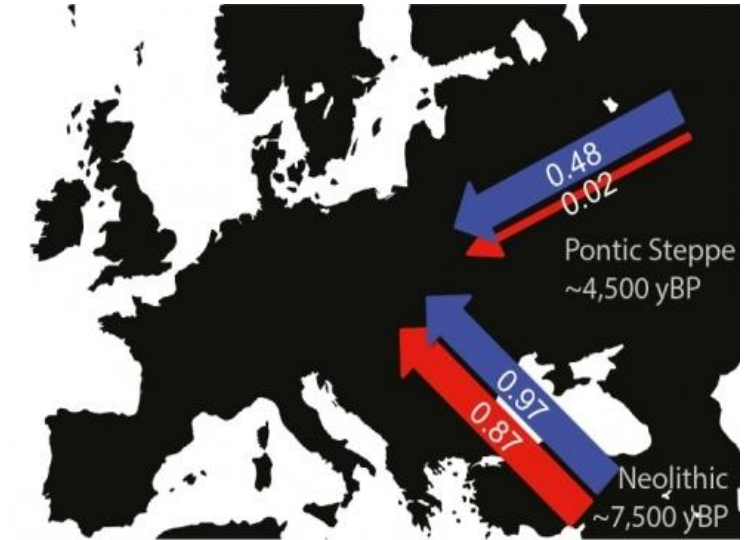


[Karmin et al. Genome Research. 2014]

[Infographic Material. Provided by Arizona State University]

[5-3 ky BC] [Bronze age and the formation of Europe]

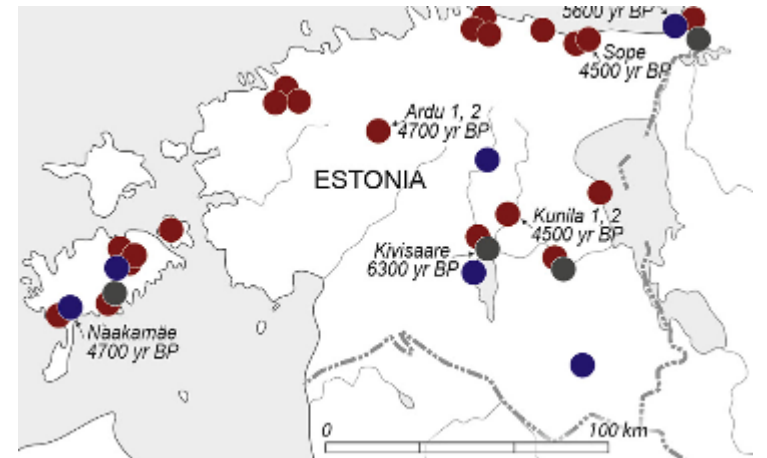
[Goldberg et al. PNAS 2017]



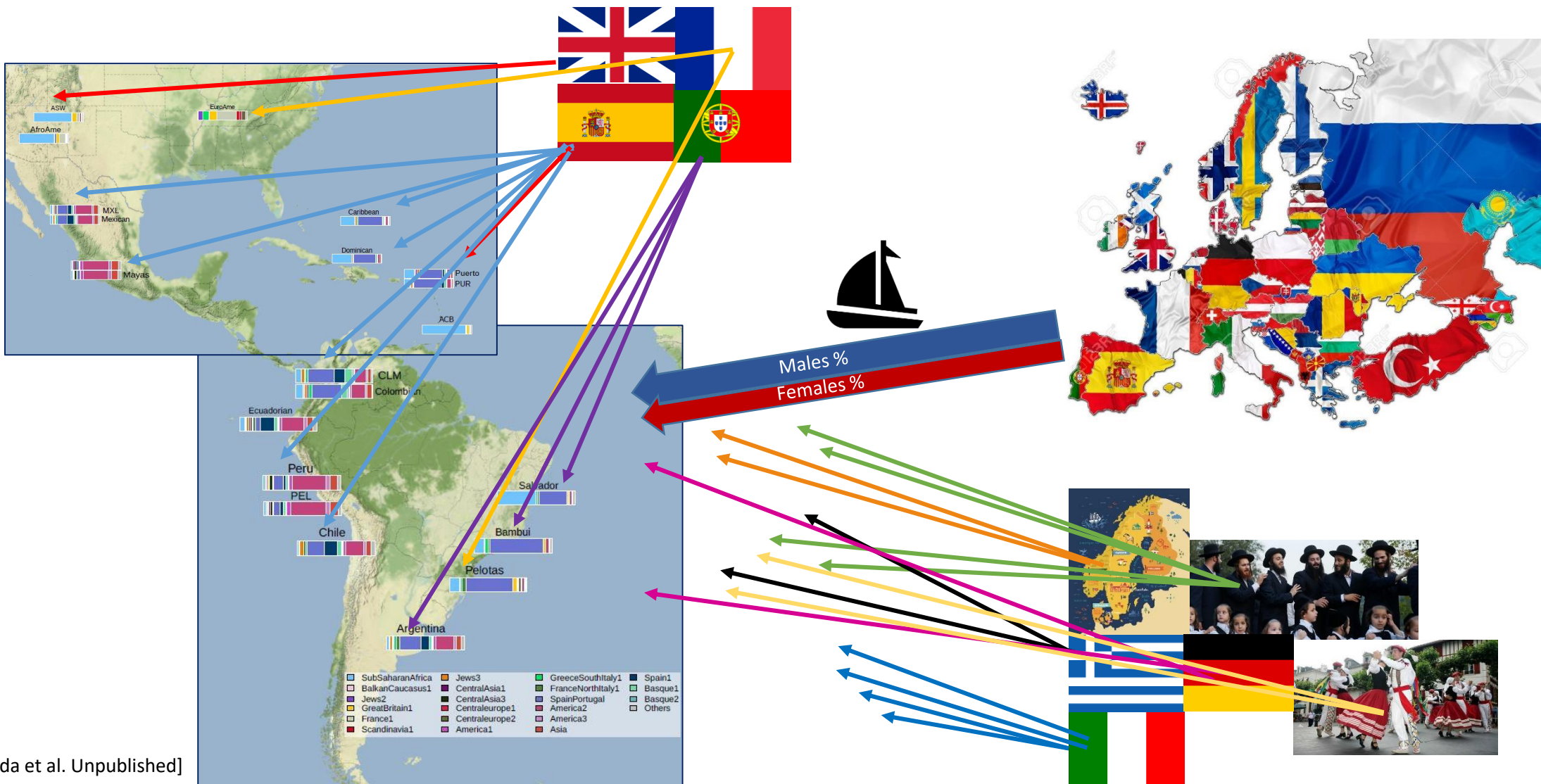
- | | | | |
|-------------|-------------|-----------------|--------------|
| ● Albanian | ■ French | ■ French_South | ◆ Estonian |
| ■ Bergamo | ▲ Icelandic | ▲ Spanish | × Hungarian |
| ▲ Bulgarian | ◆ Norwegian | ◆ Spanish_North | ⊕ Lithuanian |
| × Greek | × Orcadian | ● Belarusian | + Ukrainian |
| ■ Tuscan | ⊕ Scottish | ■ Croatian | ■ Sardinian |
| ● English | ● Basque | ▲ Czech | |

[Lazaridis et al. Nature 2014]

[Saag et al. Current Biology. 2017]



[500 ya - present] ['New World' and the formation of North- and Latin-America]



[Linda et al. Unpublished]



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Thanks !

