



UNIVERSITY OF TARTU  
Institute of Genomics

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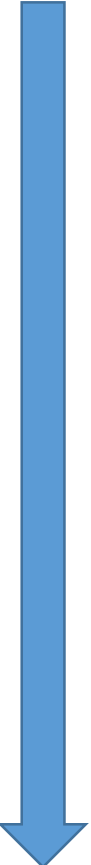


# [ Examples ] Sex-biased and unbiased demographic processes in human history ... [ genetic insights ]



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

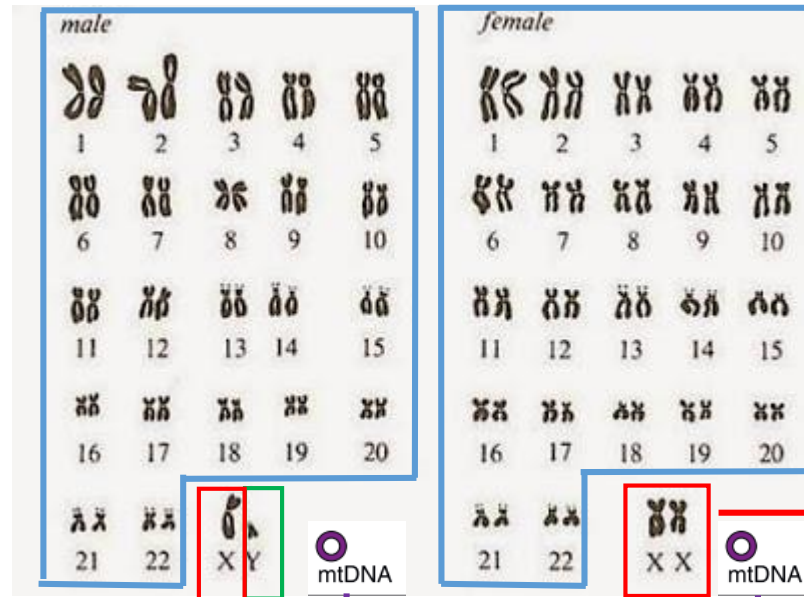
# Outline

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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



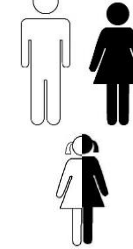
Autosomes

Many shared histories across many locations



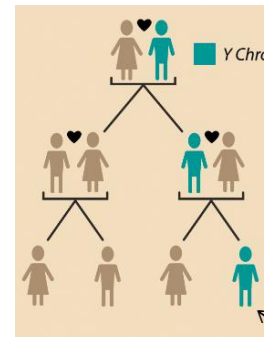
X chromosome

Fewer shared histories across fewer locations



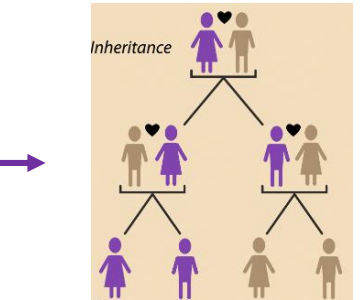
Mitochondria

One maternal history

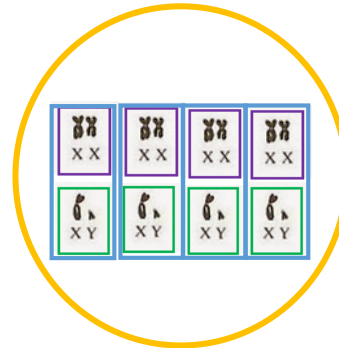
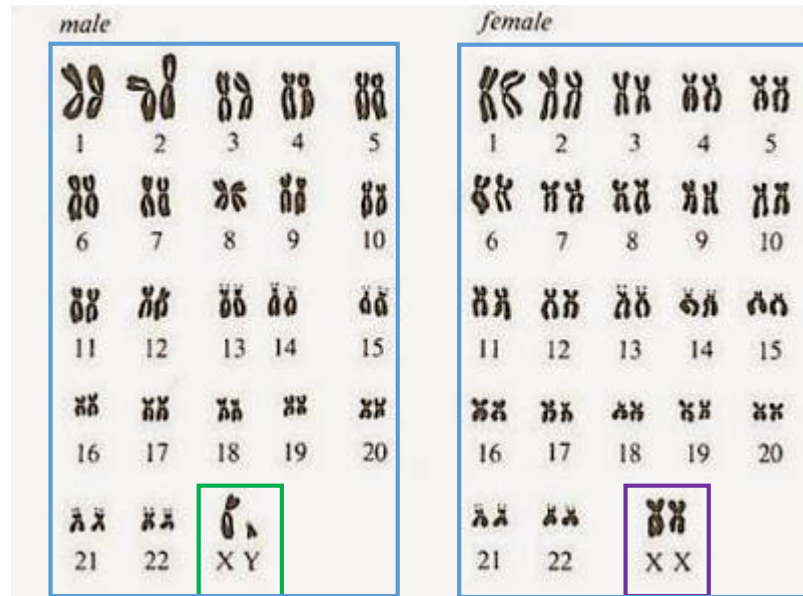


Y chromosome

One paternal history



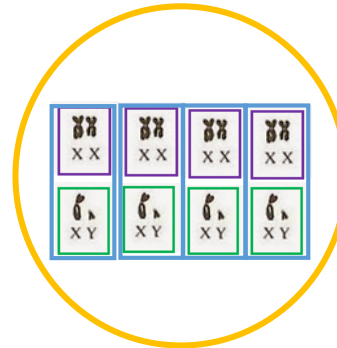
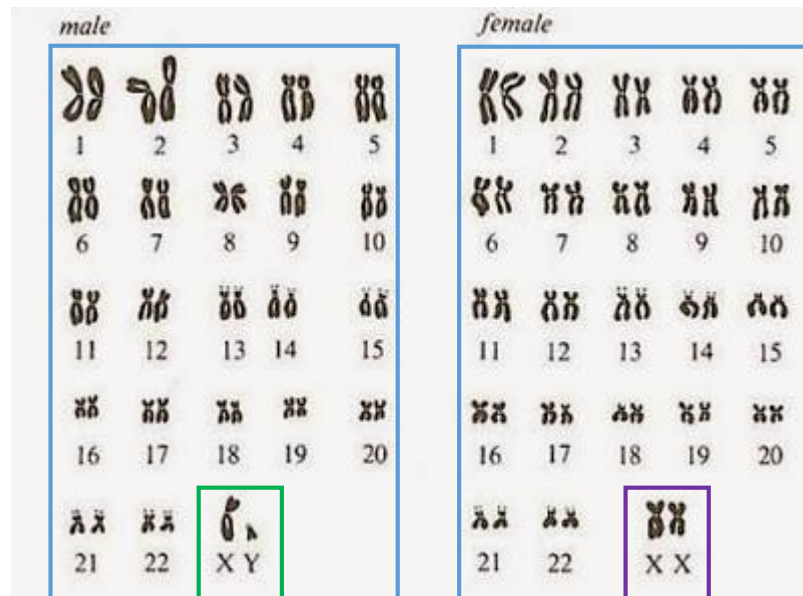
# One example ...



**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

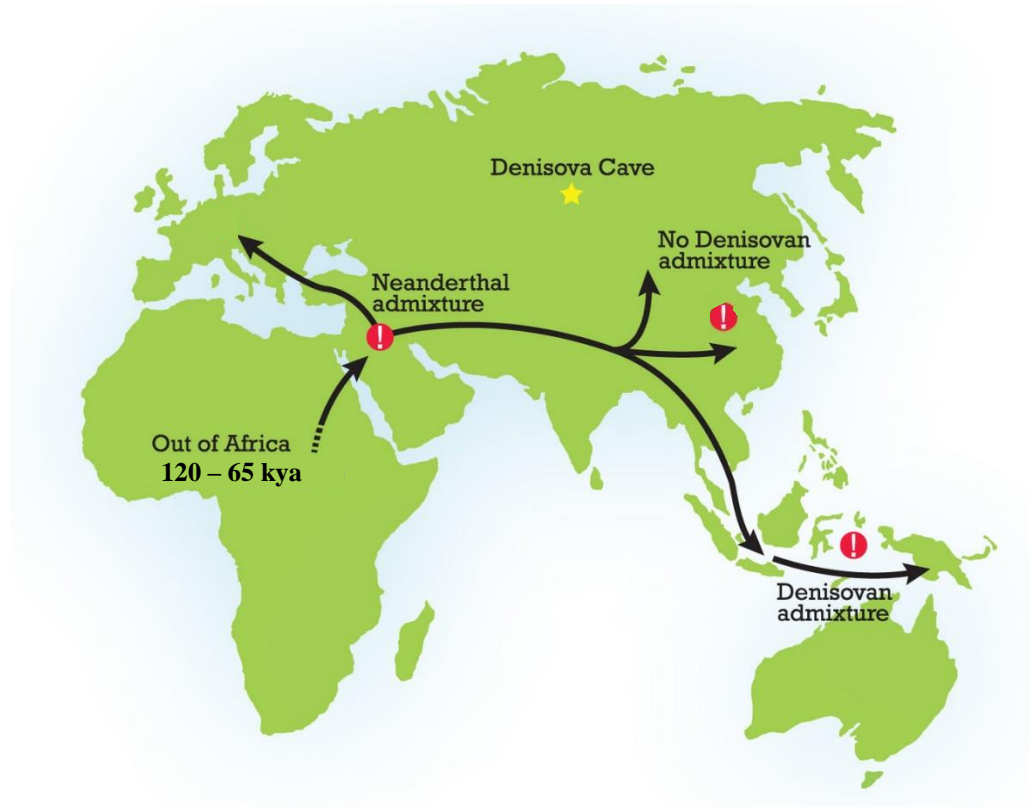
Sexual selection

Migration / Invasion

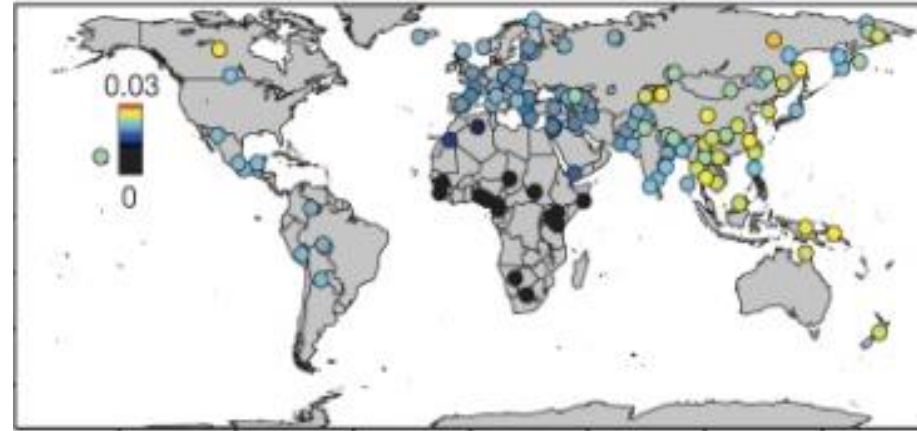
Expansion

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 ]

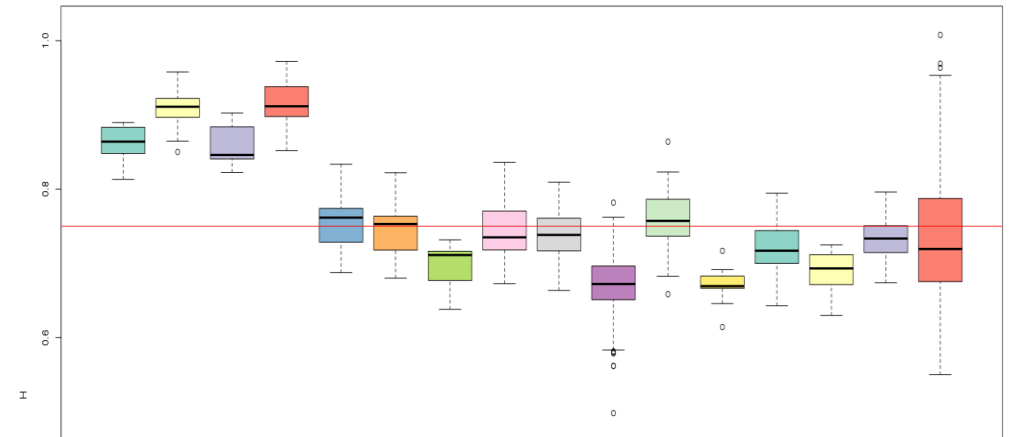


[B. deMenocal and Stringer. Nature 2016]

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

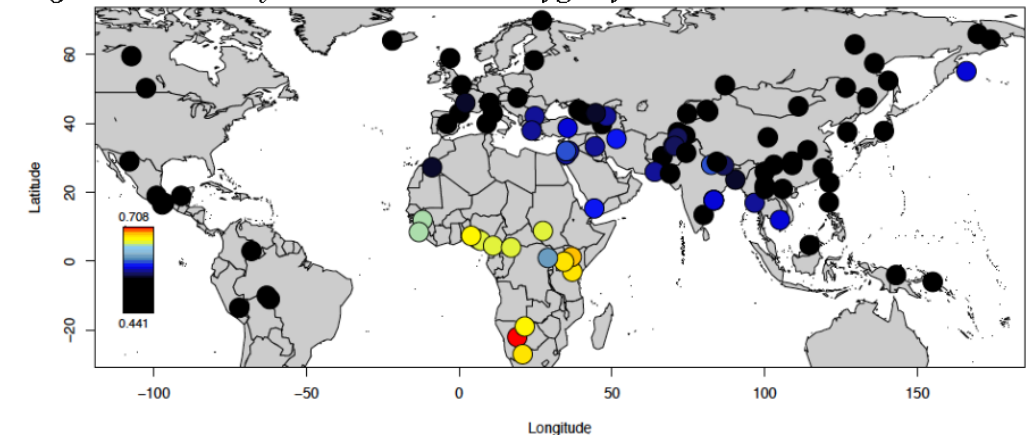
(anthropological studies provide evidence for female migration dominating at short distances, and male on long distances)

- 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]

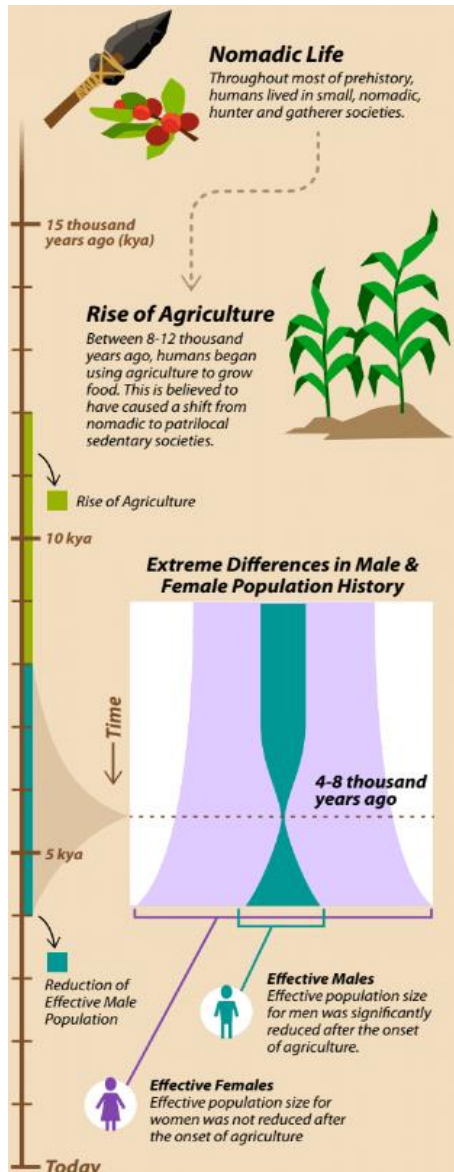
Figure S7.2. Ratio of X-to-autosome heterozygosity



[Mallick et al  
Nature.2016]

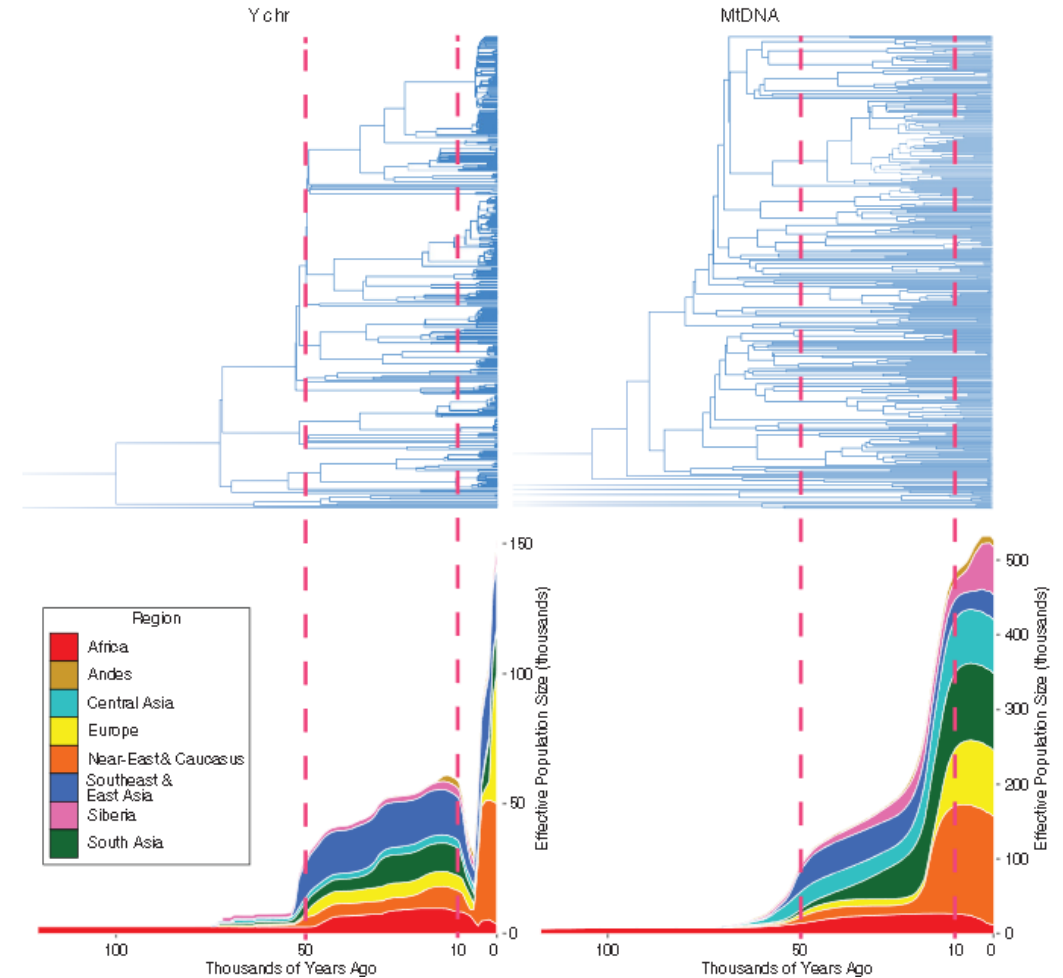


# [ 8 - 4 ky BC ] [ Farming societies during the onset of the Bronze age ]



## Survival of the... wealthiest?

Instead of "survival of the fittest," the accumulation of wealth and power may have increased the reproductive success of a small number of males and their sons.

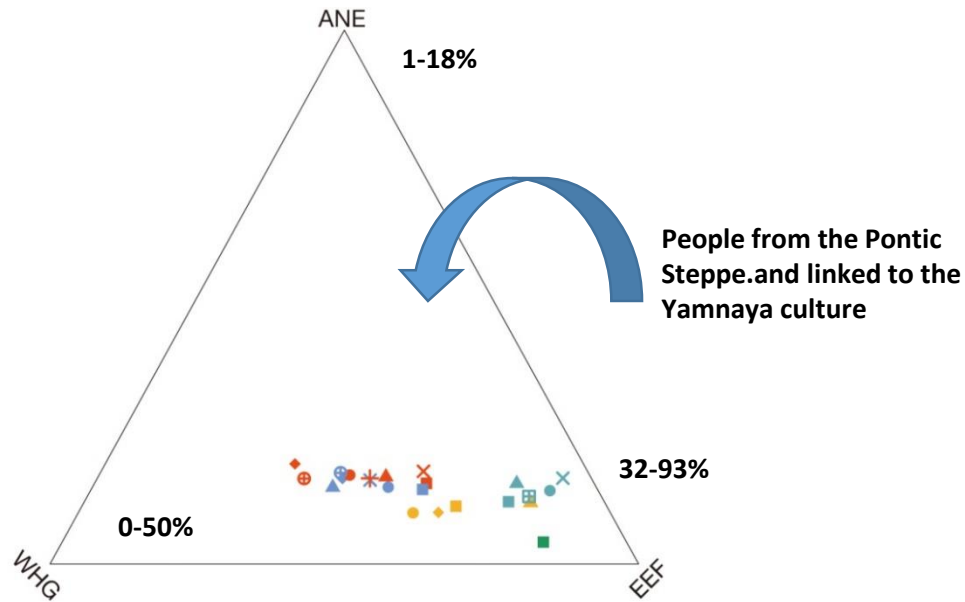
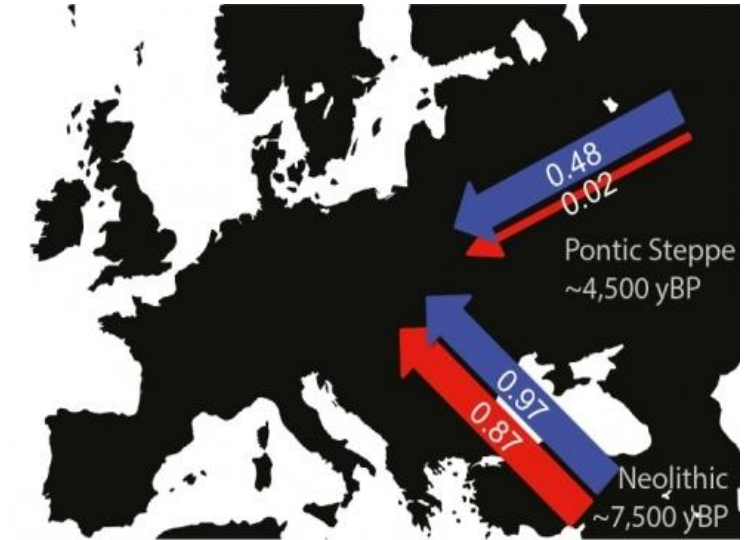


[Karmin et al. Genome Research. 2014]

[Infographic Material. Provided by Arizona State University]

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

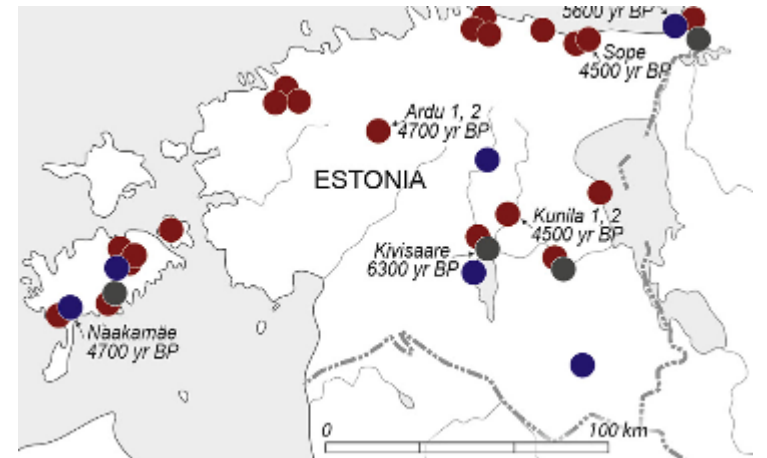
[Goldberg et al. PNAS 2017]



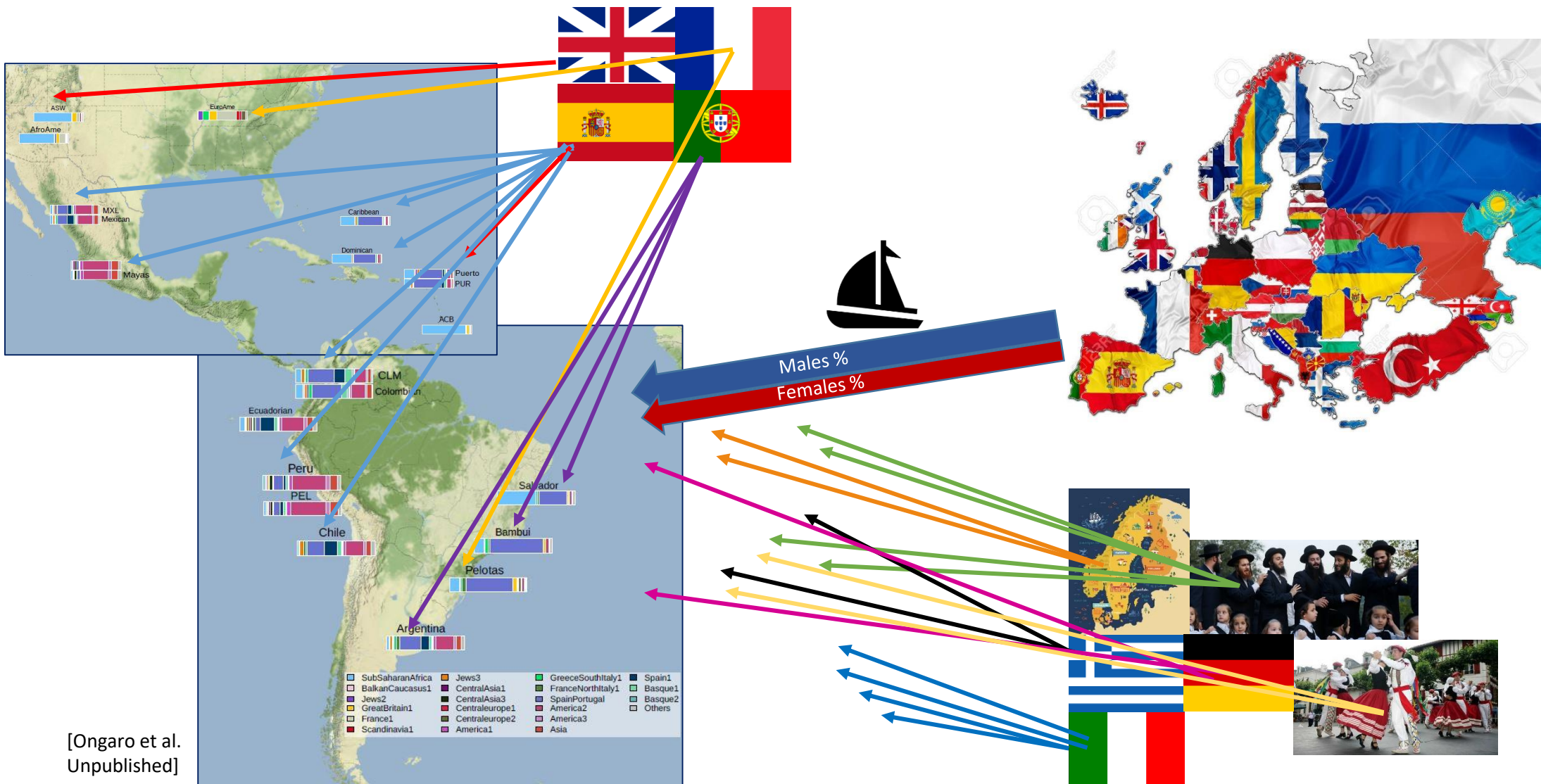
- |             |             |                 |              |
|-------------|-------------|-----------------|--------------|
| ● Albanian  | ■ French    | ■ French_South  | ◆ Estonian   |
| ■ Bergamo   | ▲ Icelandic | ▲ Spanish       | × Hungarian  |
| ▲ Bulgarian | ◆ Norwegian | ◆ Spanish_North | ⊕ 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 ]



[Ongaro et al.  
Unpublished]



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# Thanks !

