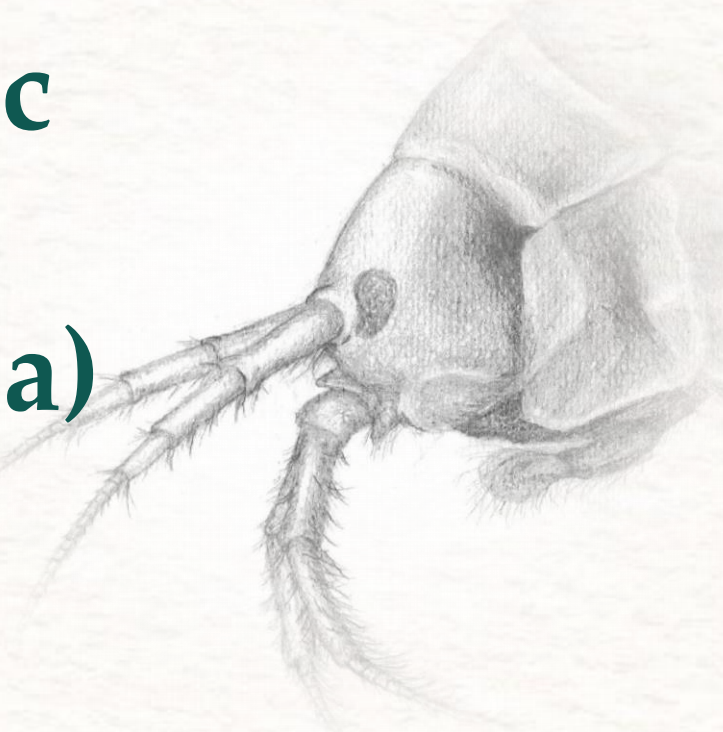
Postglacial colonizer or cryptic invader? Case of *Gammarus roeselii* (Crustacea Amphipoda) in Europe



Tomasz Rewicz, Paula Krzywozniak, Tomasz Mamos, Karolina Bacela – Spychalska, Remi Wattier, Michal Grabowski

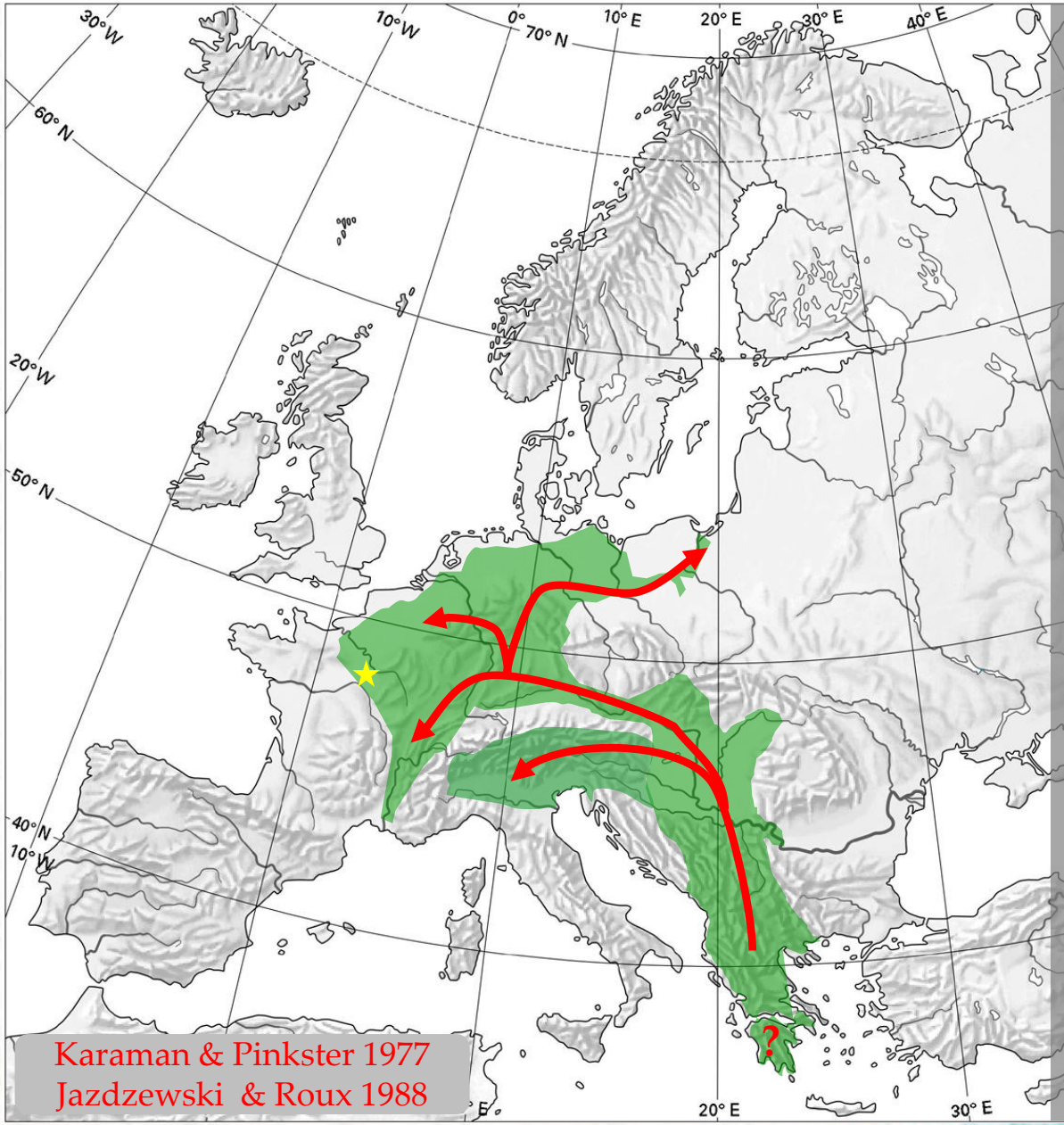
Department of Invertebrate Zoology & Hydrobiology
University of Lodz, Poland

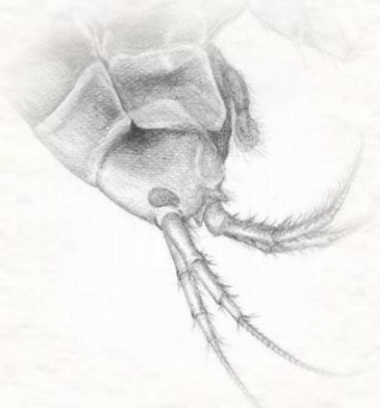
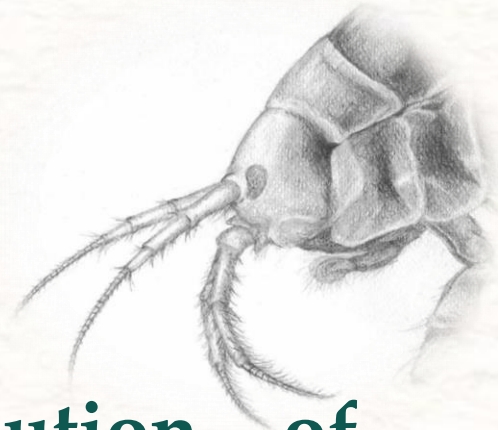
Laboratoire Biogéoscience, UMR CNRS 6282
Univeristé Bourgogne Franche-Comte, France

Gammarus roeselii Gervais, 1835

neotype locality: river Yonne, at Coulanges-sur-Yonne, France.

Wide & weird distribution range in Europe suggesting spread from the Balkan region.




Main goal

To reveal whether the current distribution of *Gammarus roeselii* in Europe is a result of population expansion from the diversity hotspot in the Balkans.

Grabowski M, Mamos T, Bącela-Spychalska K, Rewicz T, Wattier RA. 2017. **Neogene paleogeography provides context for understanding the origin and spatial distribution of cryptic diversity in a widespread Balkan freshwater amphipod.** PeerJ 5:e3016

Krzywozniak P. 2016. **Phylogeography of *Gammarus roeselii* in Western and Central Europe based on fragment of cytochrome oxidase I (COI) polymorphism.** MSc thesis. Supervised by Michal Grabowski, Tomasz Rewicz.

Hypothesis I

The species will be characterised by high levels of cryptic diversity in the Balkans.

Hypothesis II

Most of the diversification and speciation events in the Balkans precede the Pleistocene Ice Ages.

Hypothesis III

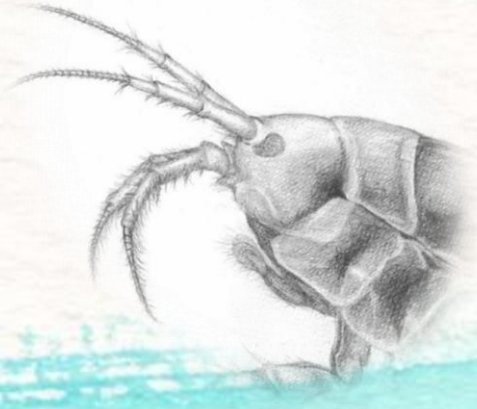
Evolutionary history may be linked to presence and deterioration of the Balkan Neogene paleolake system.

Hypothesis IV

One of the Balkan populations has been the source for colonisation of the Western and Central Europe.

Hypothesis V

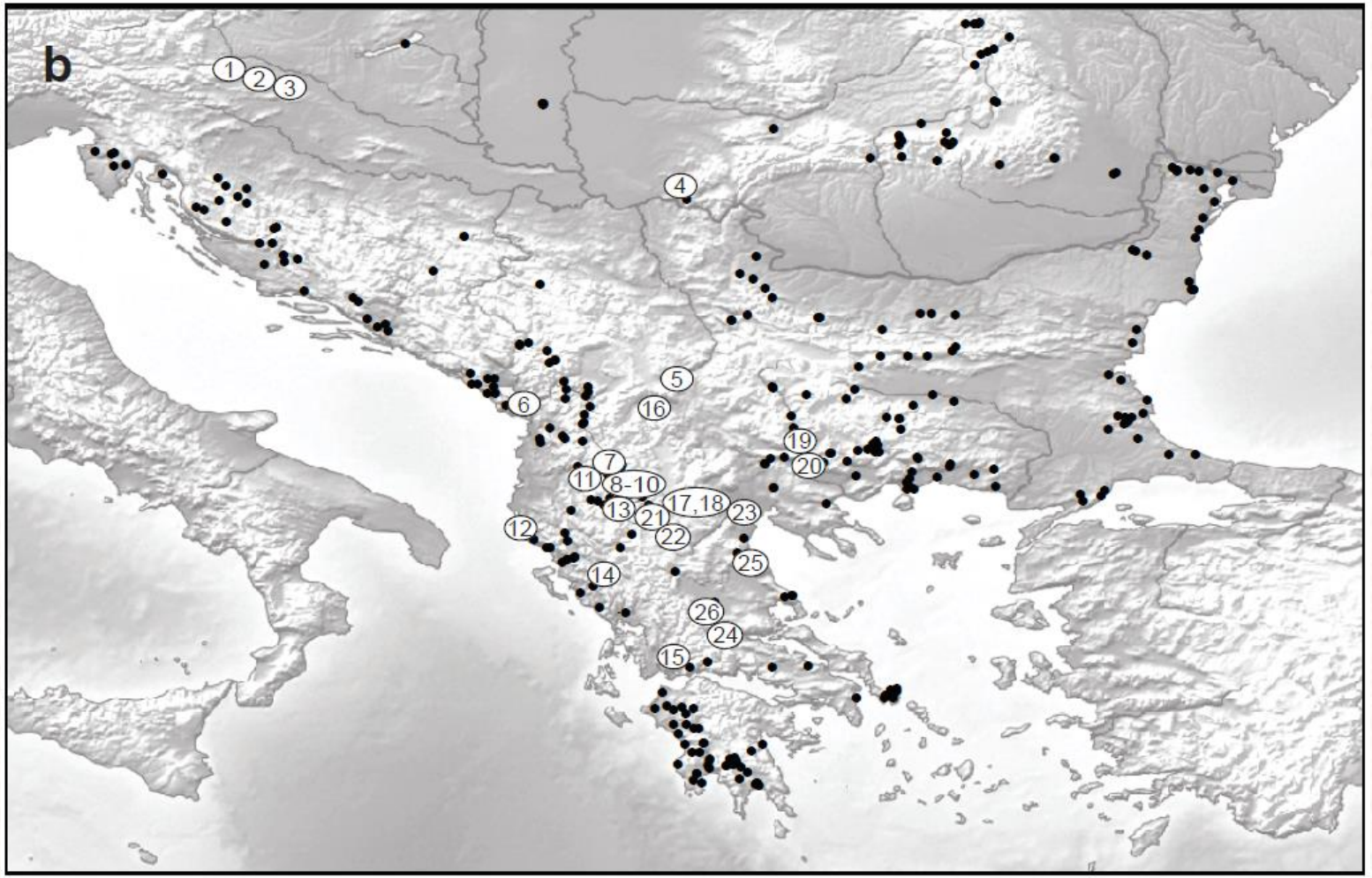
The colonisation of the Western & Central Europe has been due to some anthropogenic factors.



Materials & Methods

Balkan Region

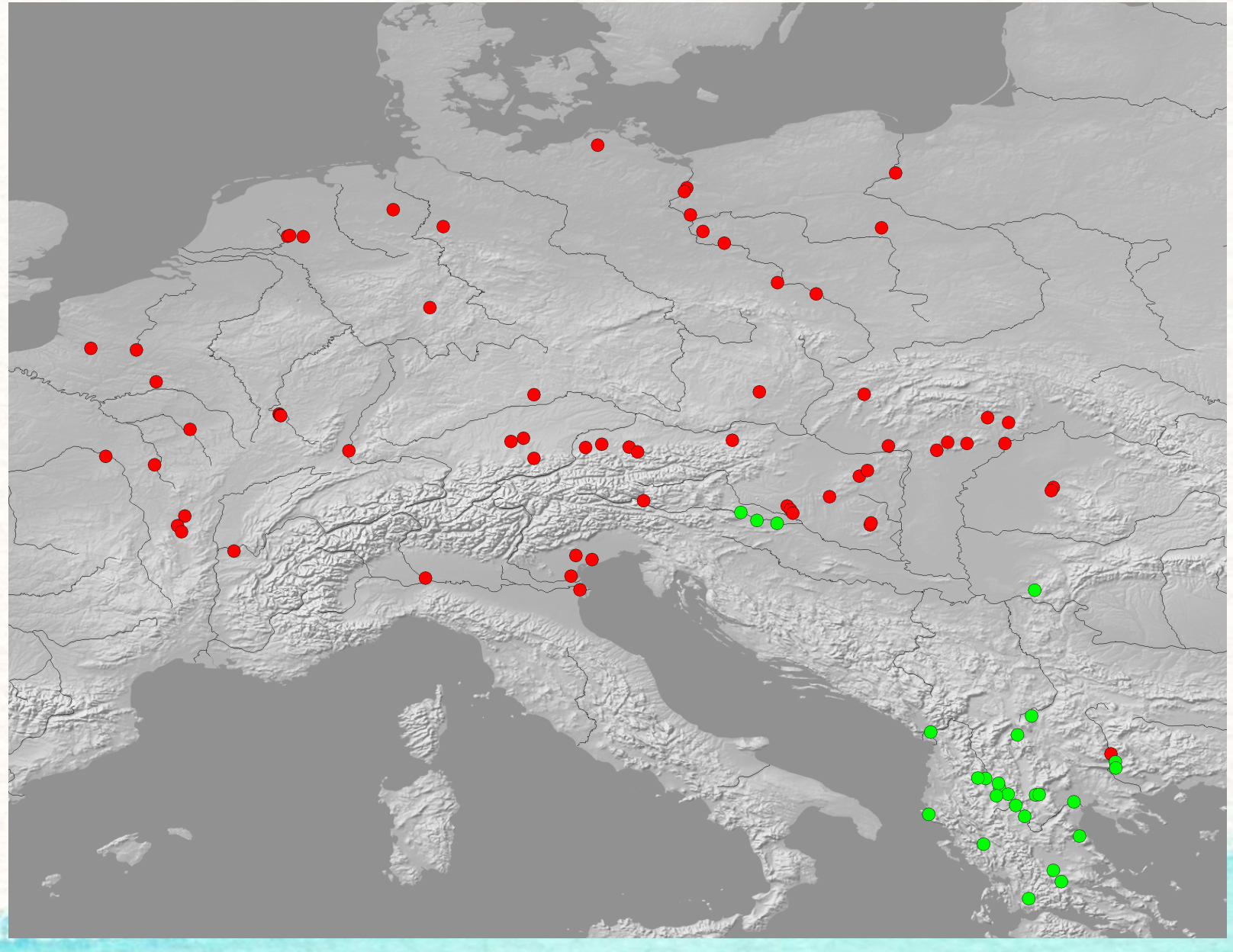
26 sites
177 individuals



Materials & Methods

Western & Central Europe

66 sites
651 individuals



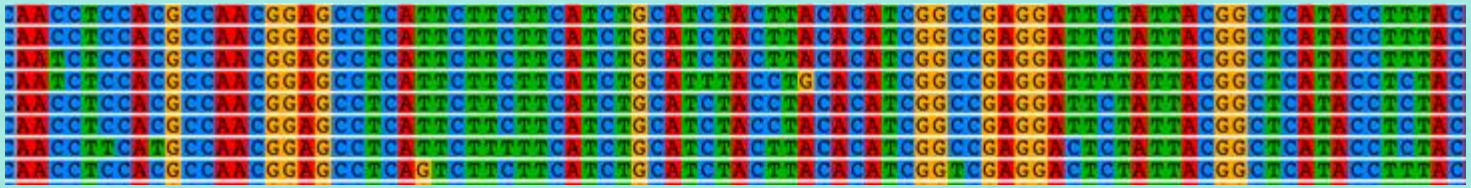
Materials & Methods

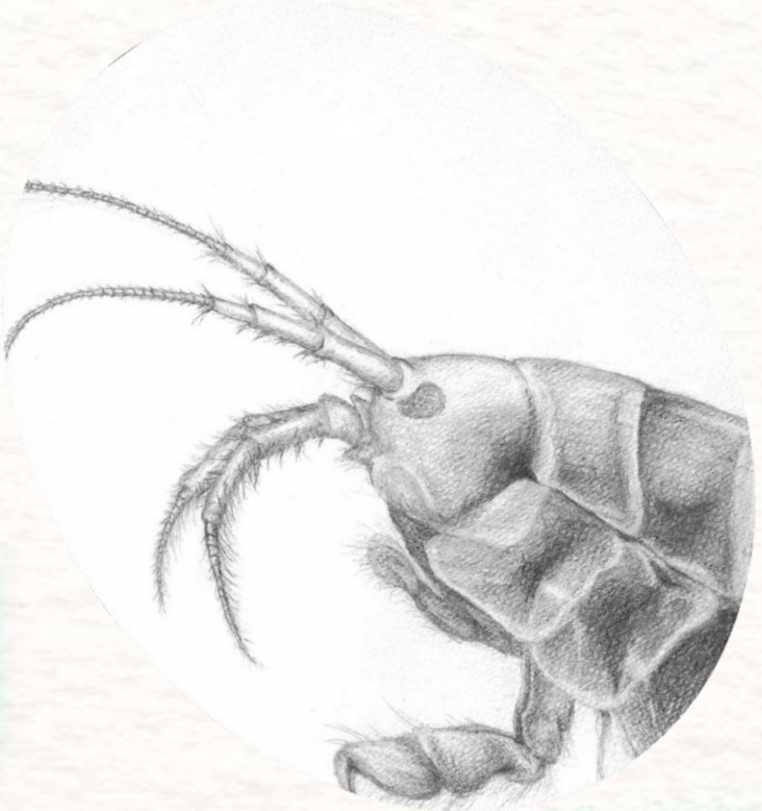
mitochondrial DNA: cytochrome oxidase I – 650/533 bp

828 individuals sequenced

nuclear DNA: 28S rDNA – 900 bp

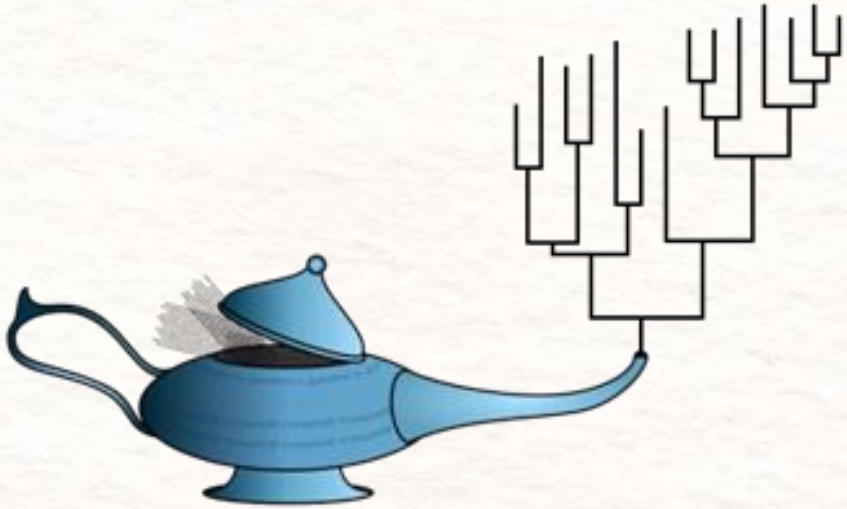
50 individuals sequenced

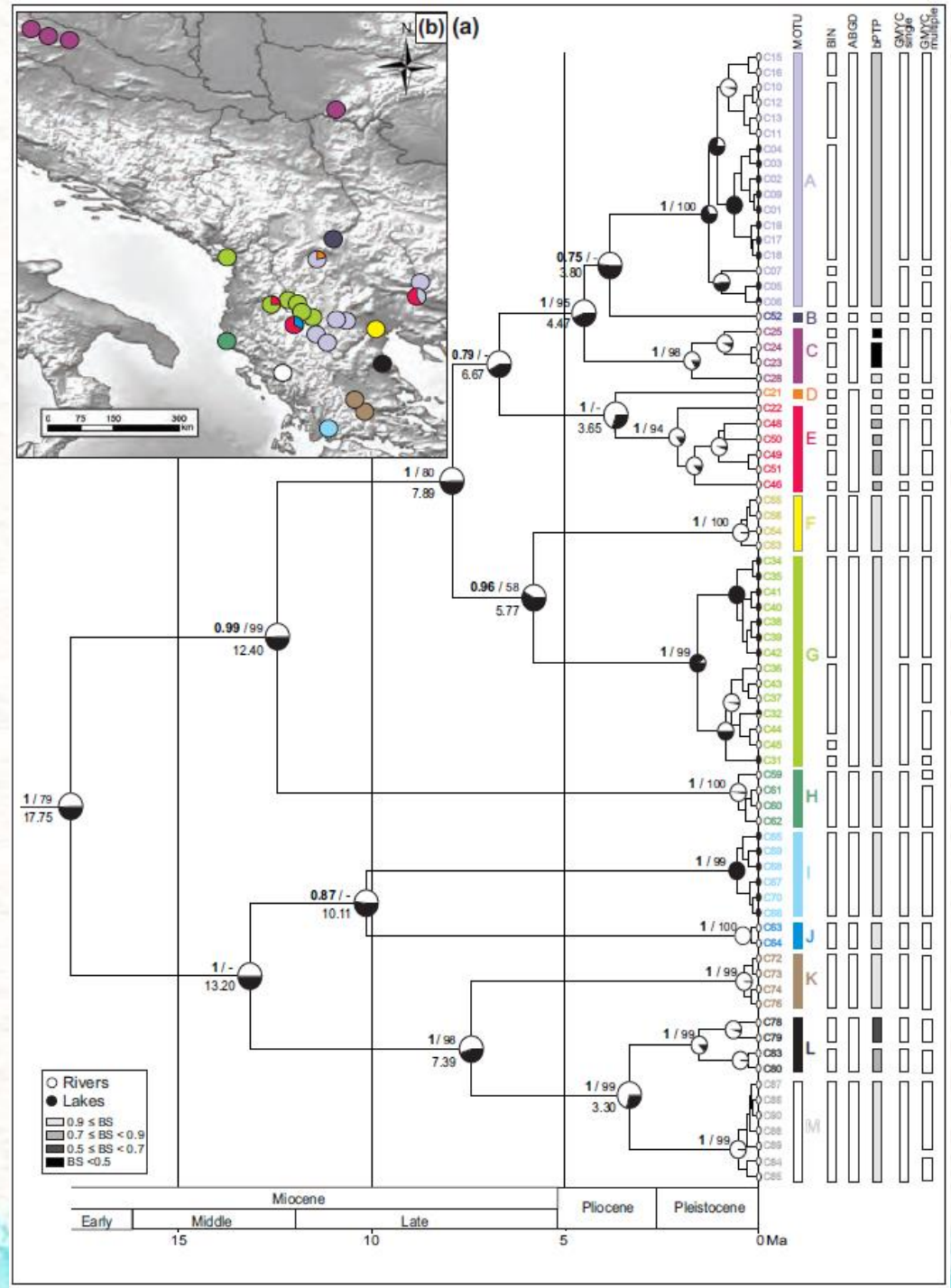




Materials & Methods

- DNA barcoding
- Bayesian chronogram
- Neighbor-Joining tree
- Haplotype Minimum Spanning Network
- Ancestral state reconstructions
    - habitat
    - divergence area
- MOTU delimitation
    - distance-based
    - phylogeny-based
- Demographic analyses
    - mismatch distribution
    - neutrality tests
    - Bayesian skyline plots





Results

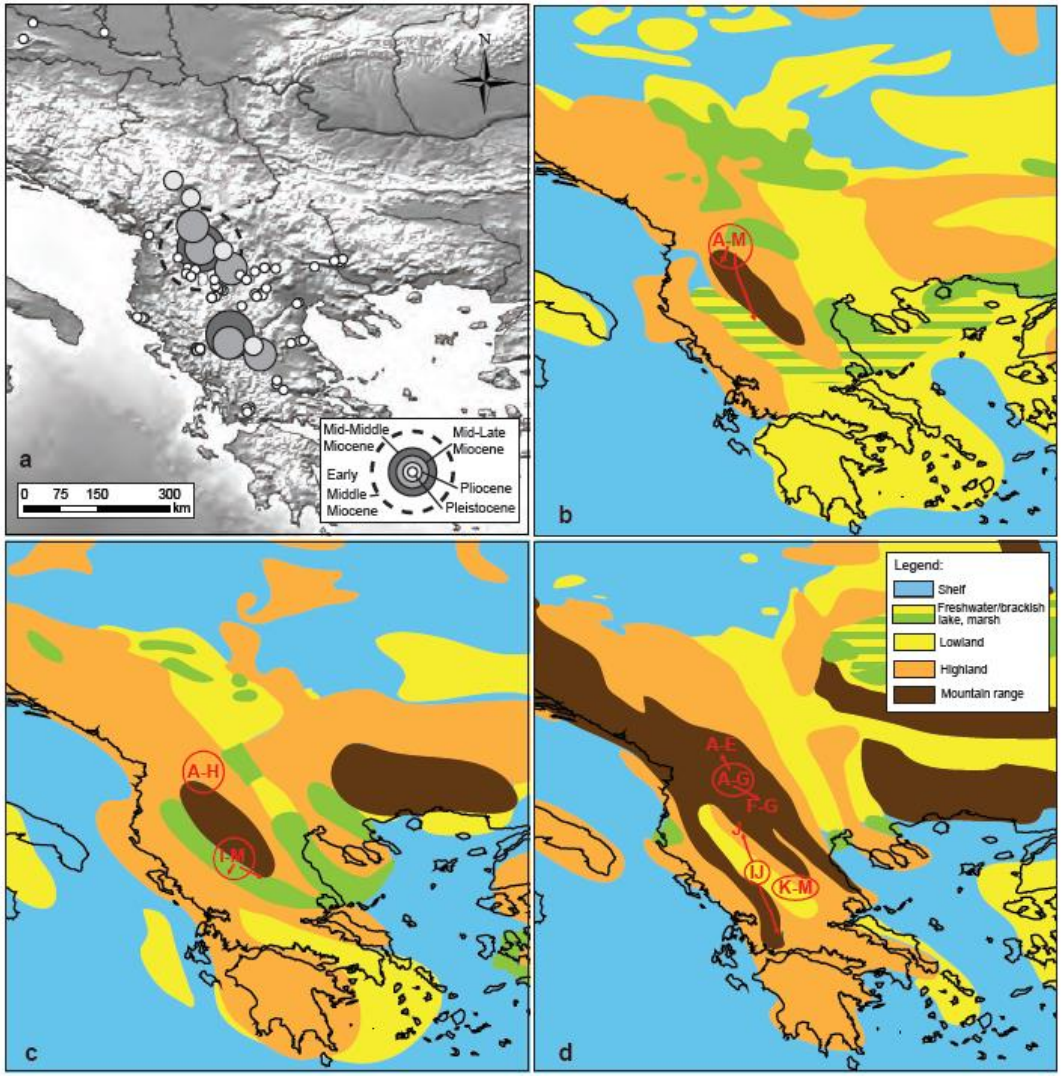
High cryptic diversity
at least 13 MOTUs in the Balkans

High level of endemism
localised distribution of most MOTUs

Old divergence
lineage diversification from early Miocene till Pleistocene

Evidence of habitat shifts
during Pleistocene, lakes could serve as microrefugia for riverine populations

Results



High cryptic diversity

at least 13 MOTUs in the Balkans

High level of endemism

localised distribution of most MOTUs

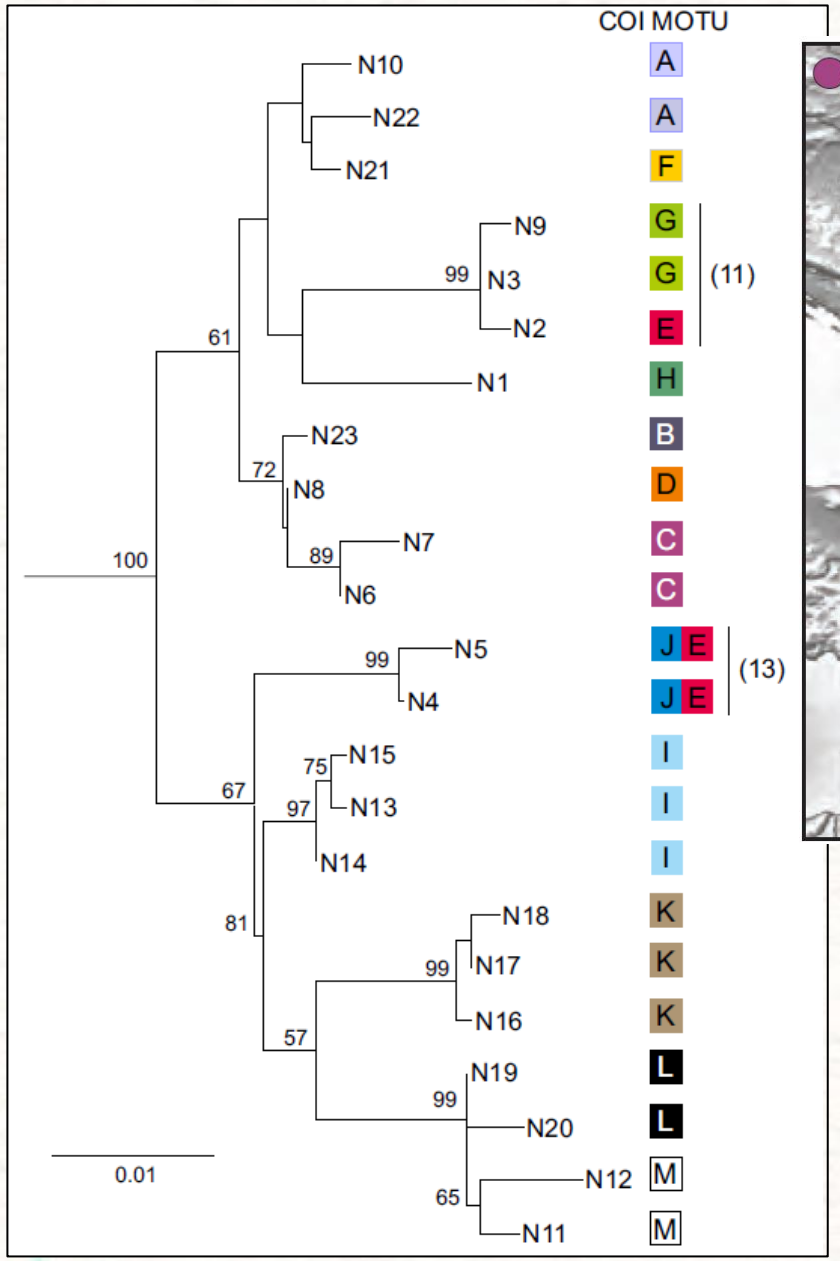
Old divergence

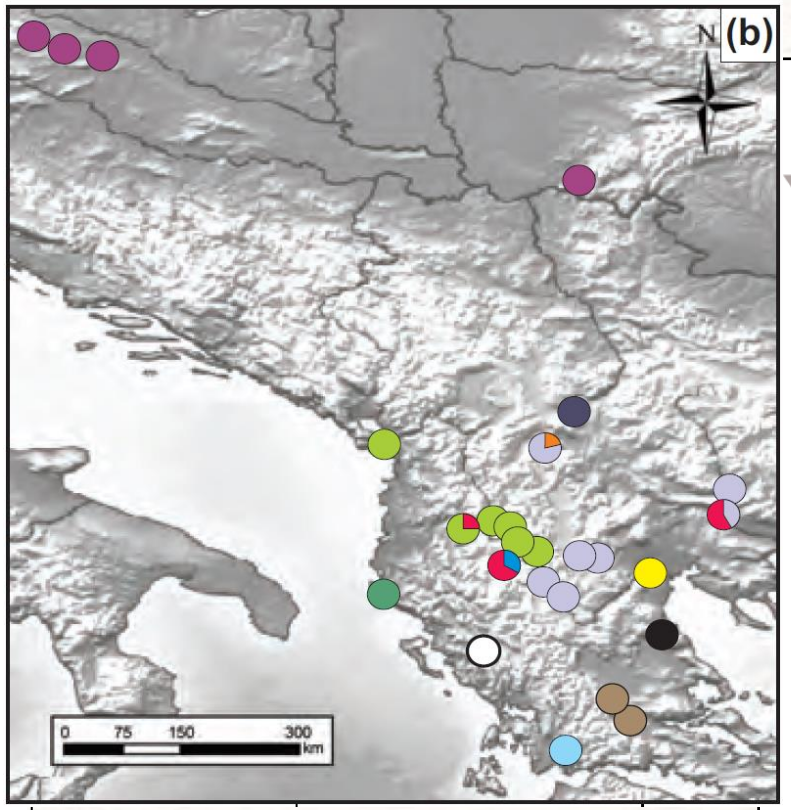
lineage diversification from early Miocene till Pleistocene

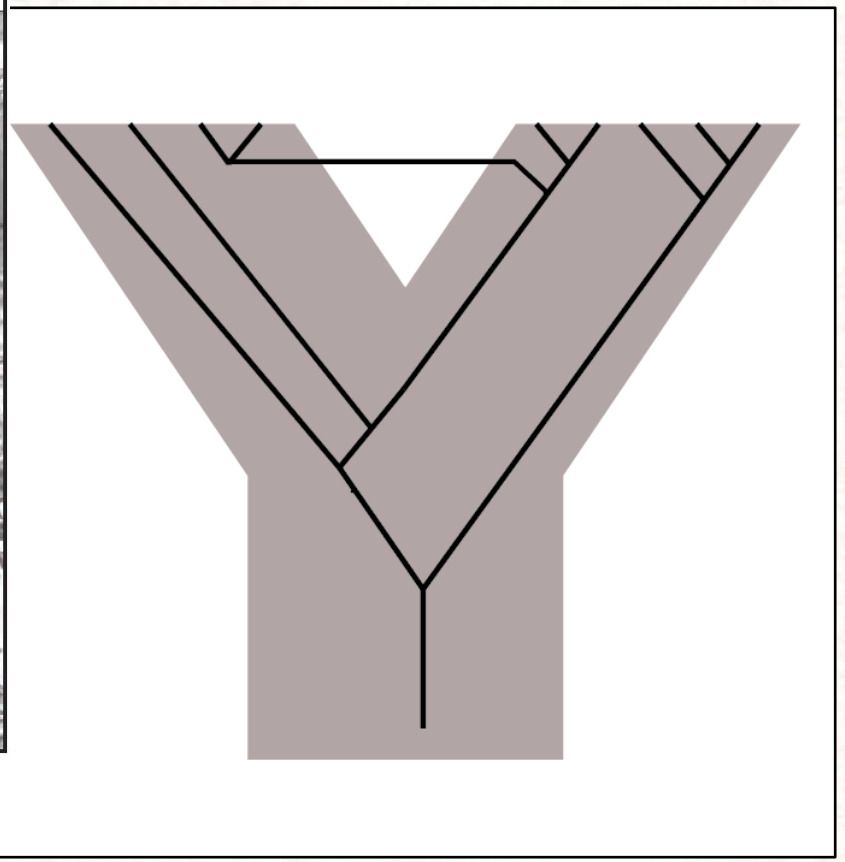
Evidence of habitat shifts

during Pleistocene, lakes could serve as microrefugia for riverine populations

lineage divergence could be associated with Neogene lacustrine systems

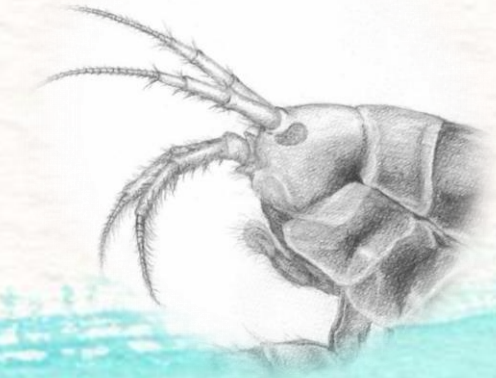


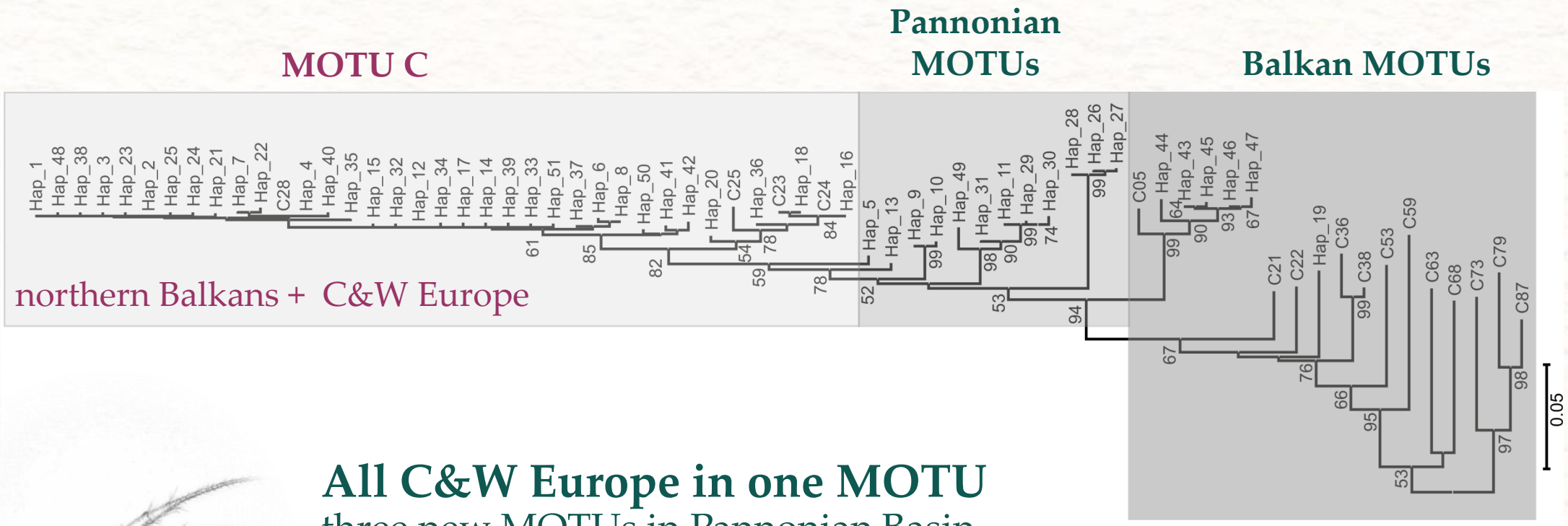




Evidence of introgression

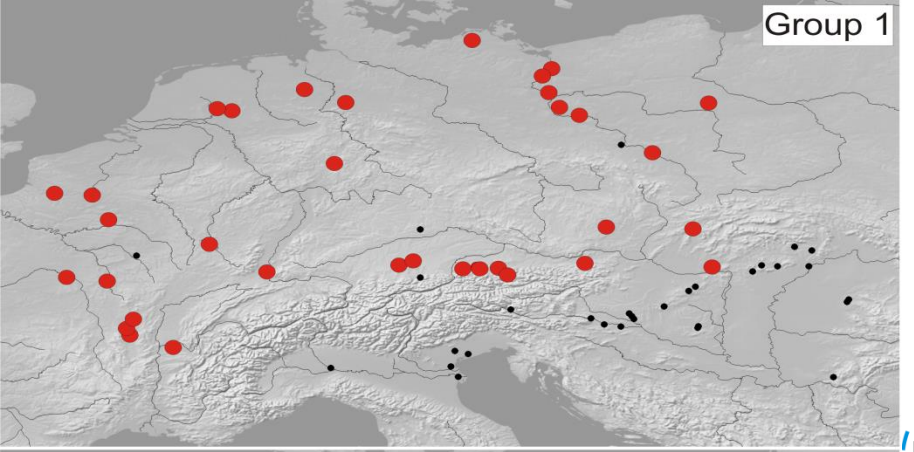
hybridisation between lines that diverged already in Miocene (7.5 and 17 Mya)

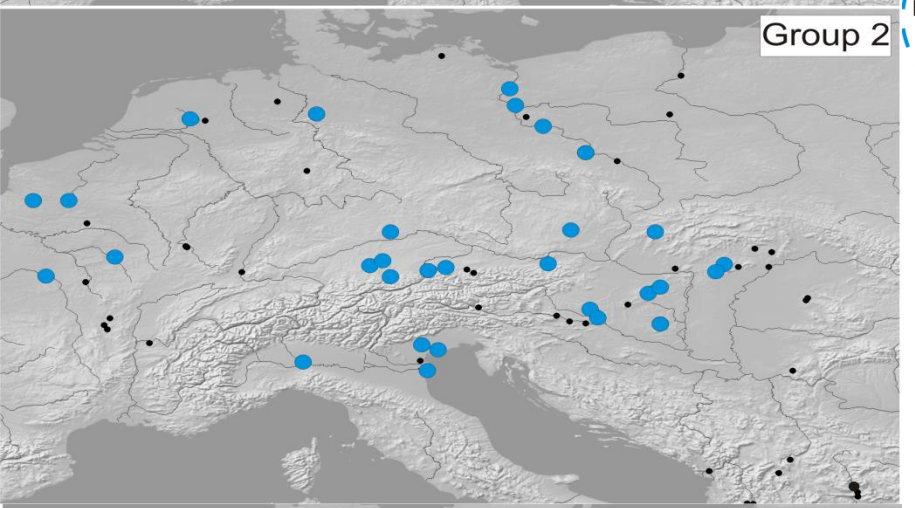


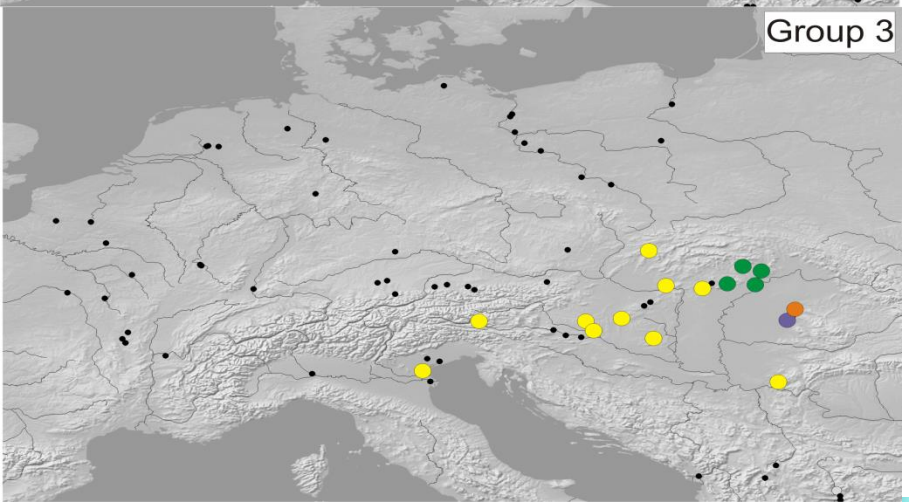


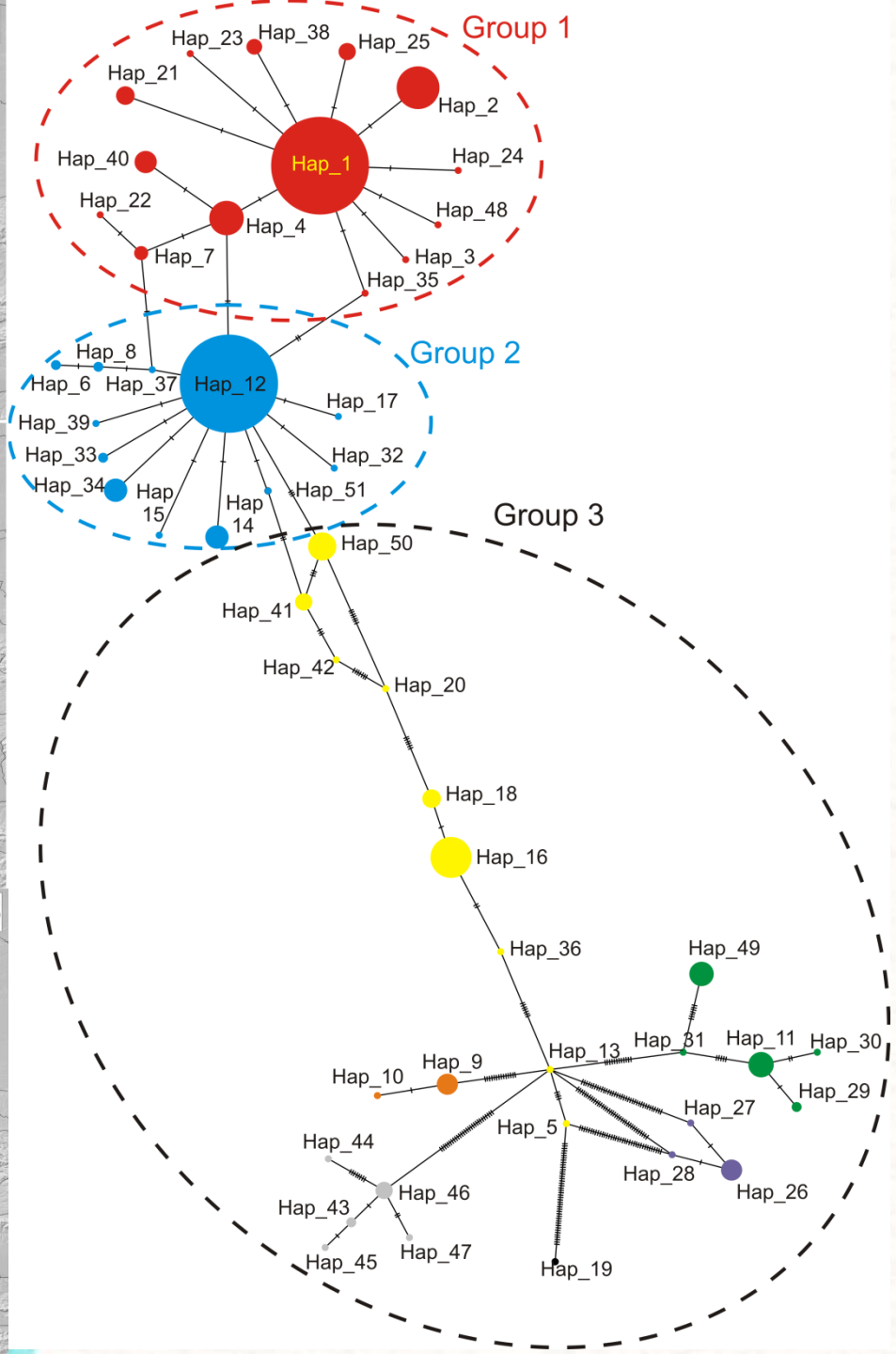
All C&W Europe in one MOTU

three new MOTUs in Pannonian Basin





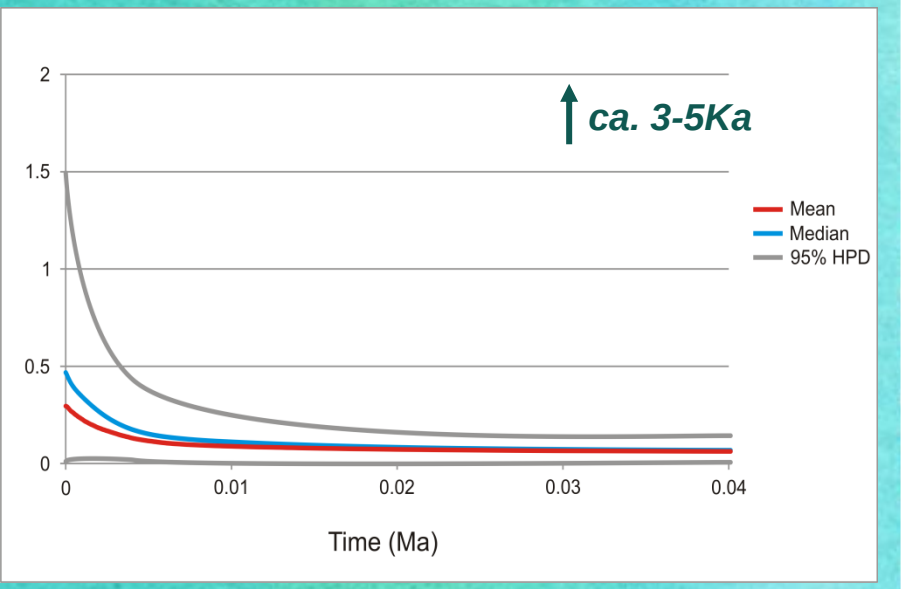




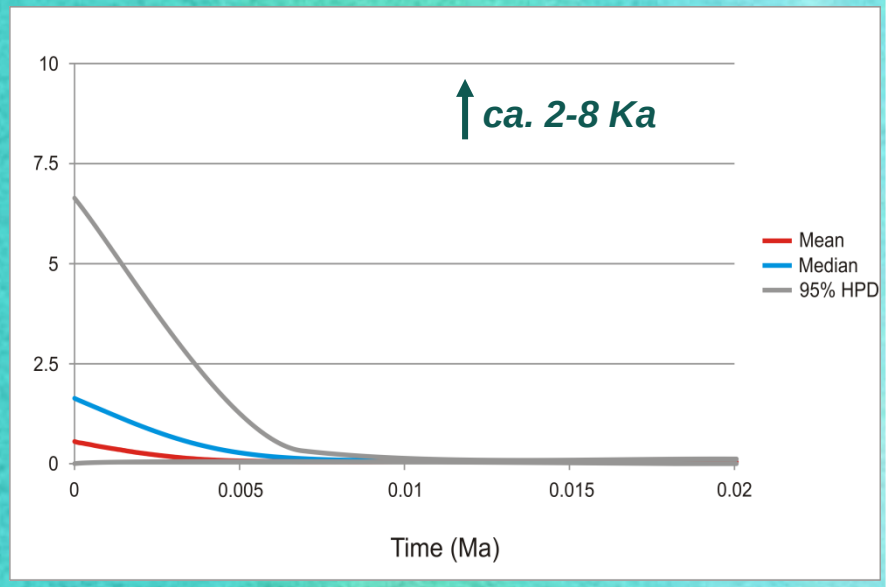
Several group of haplotypes

spatial structure
starlike/reticulate
topology

Group 1

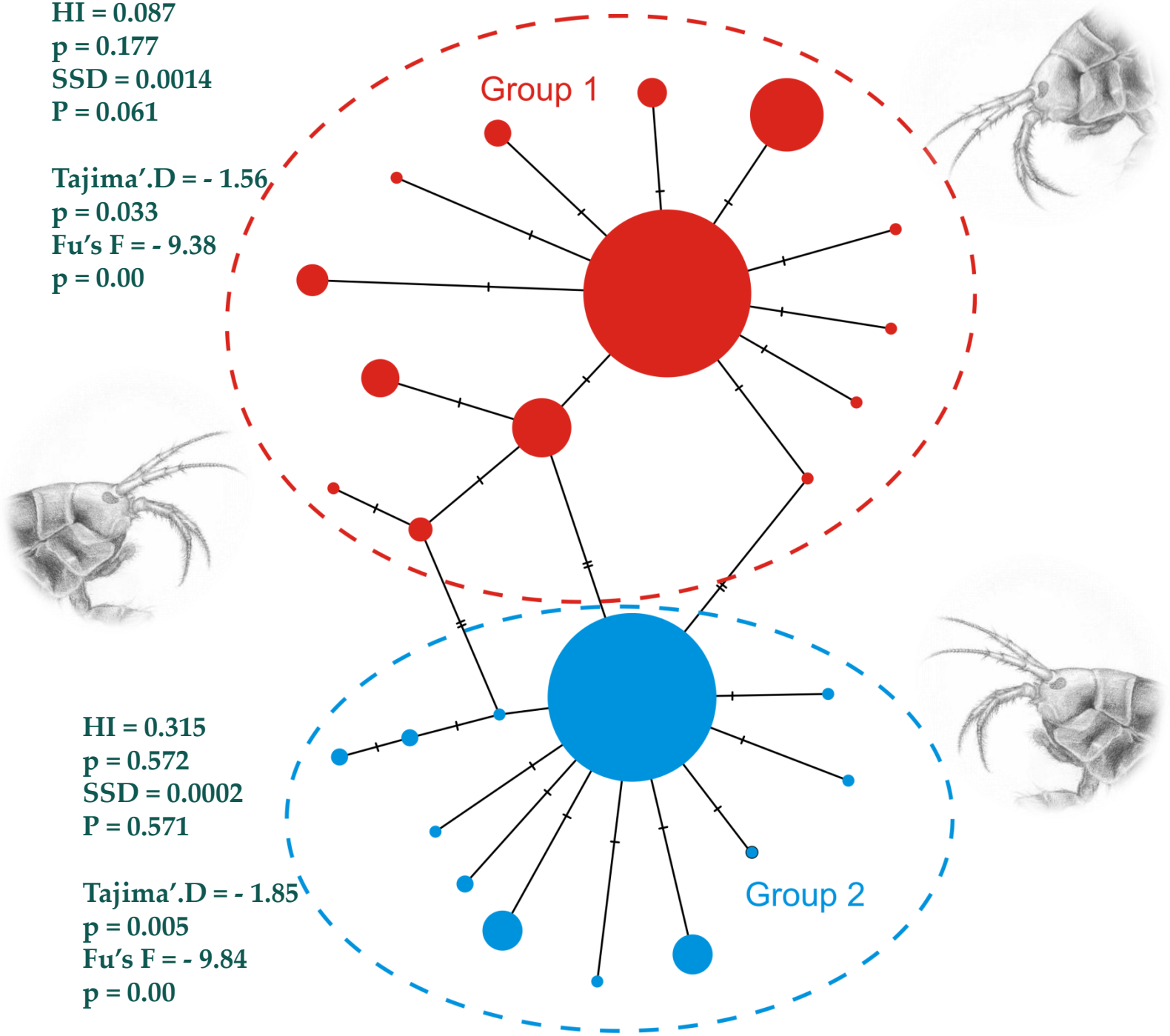


Group 2



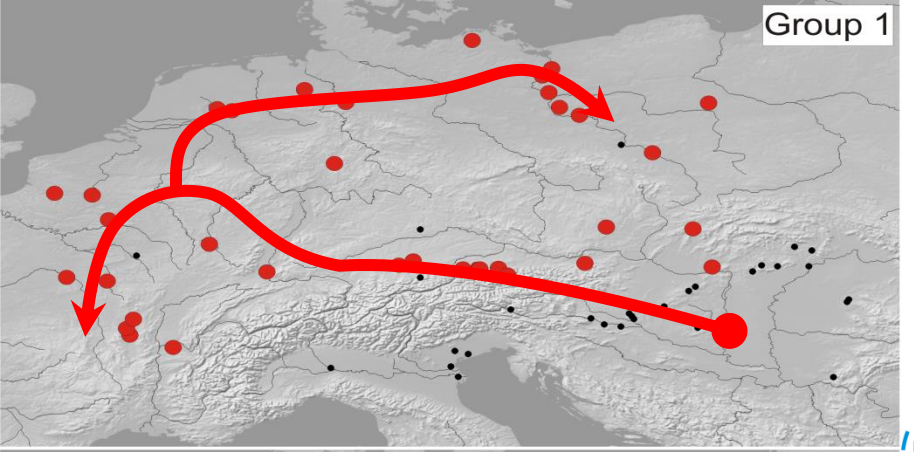
HI = 0.087
p = 0.177
SSD = 0.0014
P = 0.061

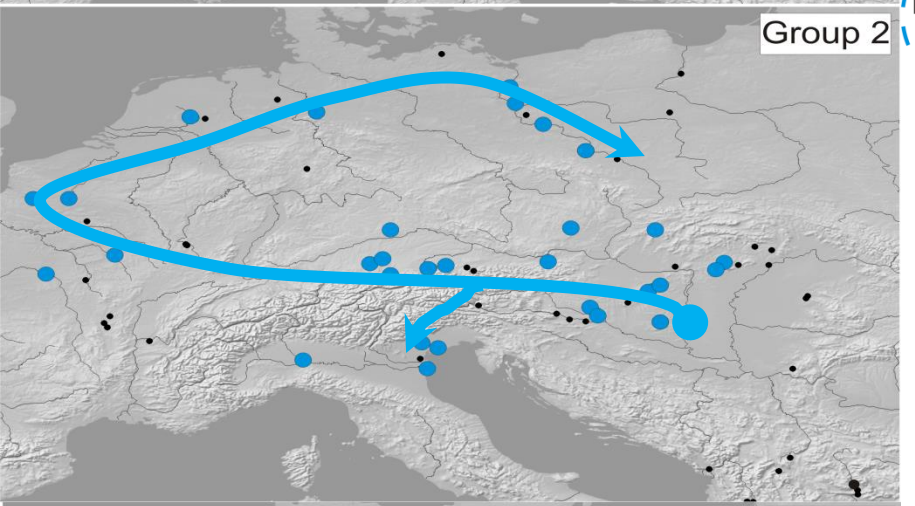
Tajima'.D = - 1.56
p = 0.033
Fu's F = - 9.38
p = 0.00

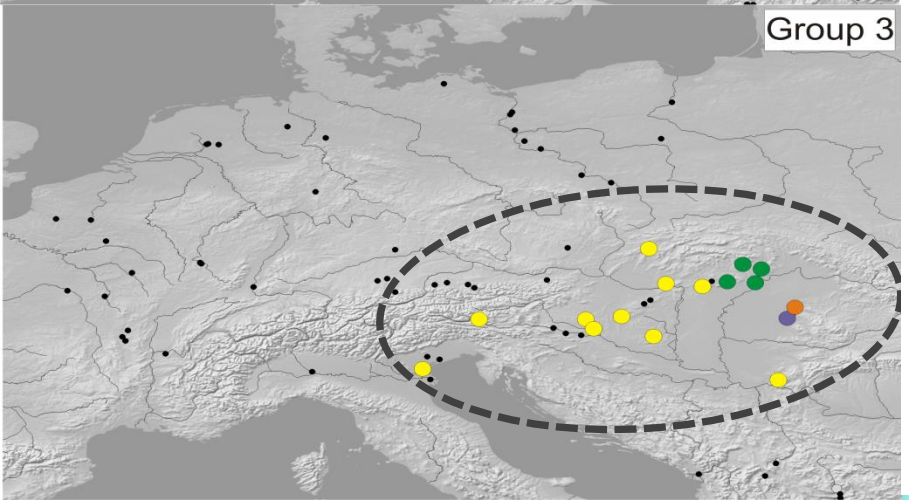


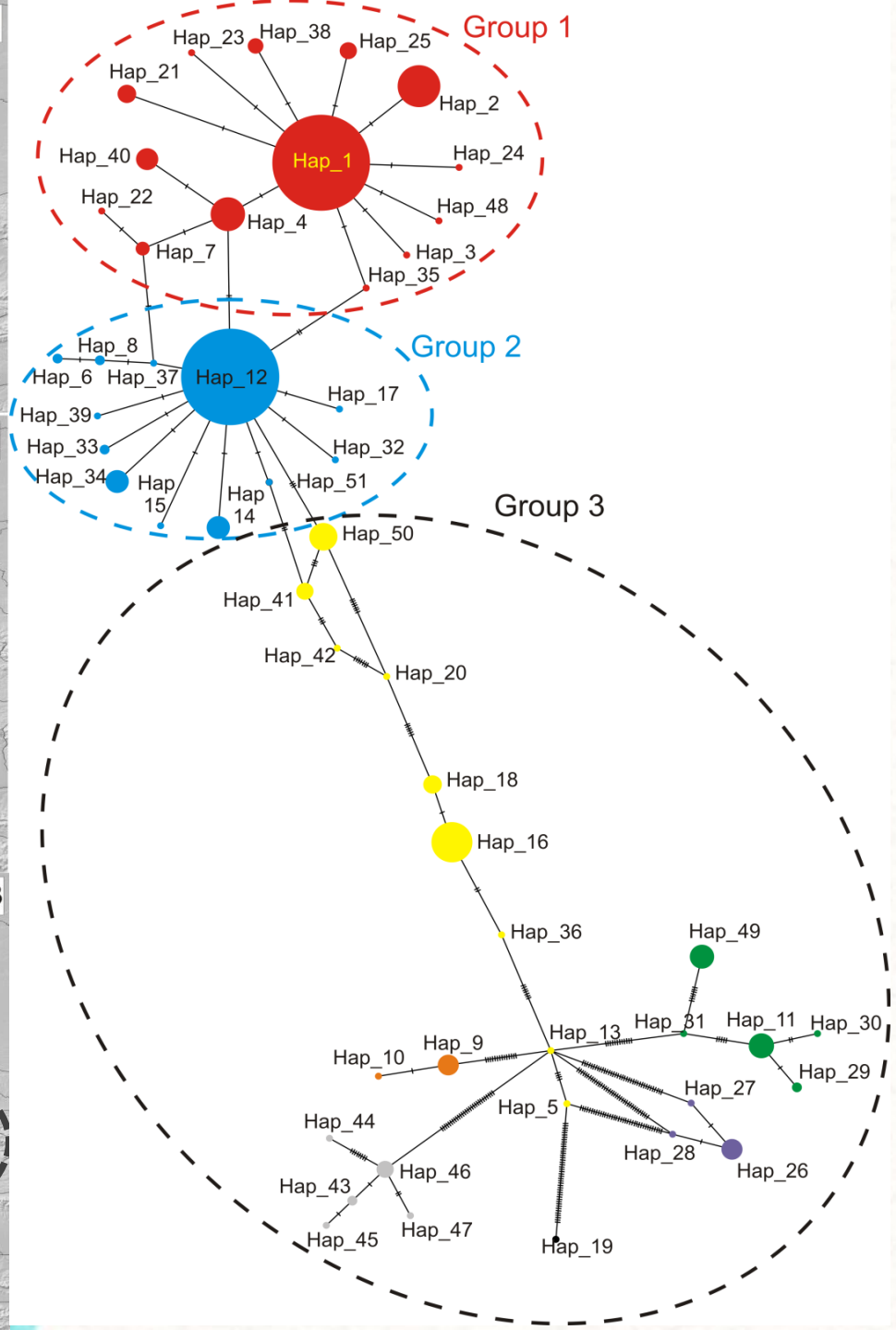
HI = 0.315
p = 0.572
SSD = 0.0002
P = 0.571

Tajima'.D = - 1.85
p = 0.005
Fu's F = - 9.84
p = 0.00



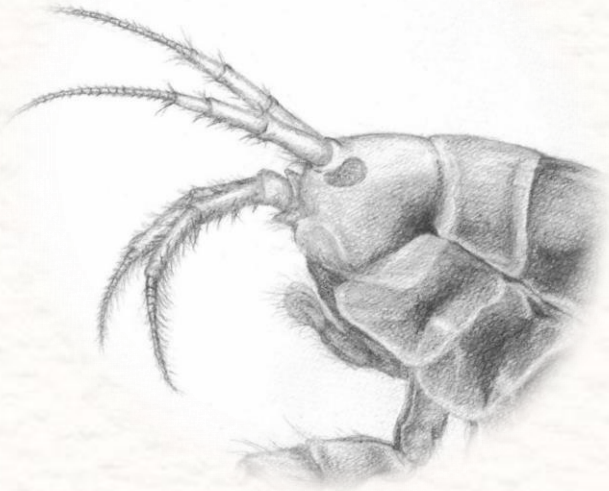






Pannonian diversity hotspot

Postglacial Expansion

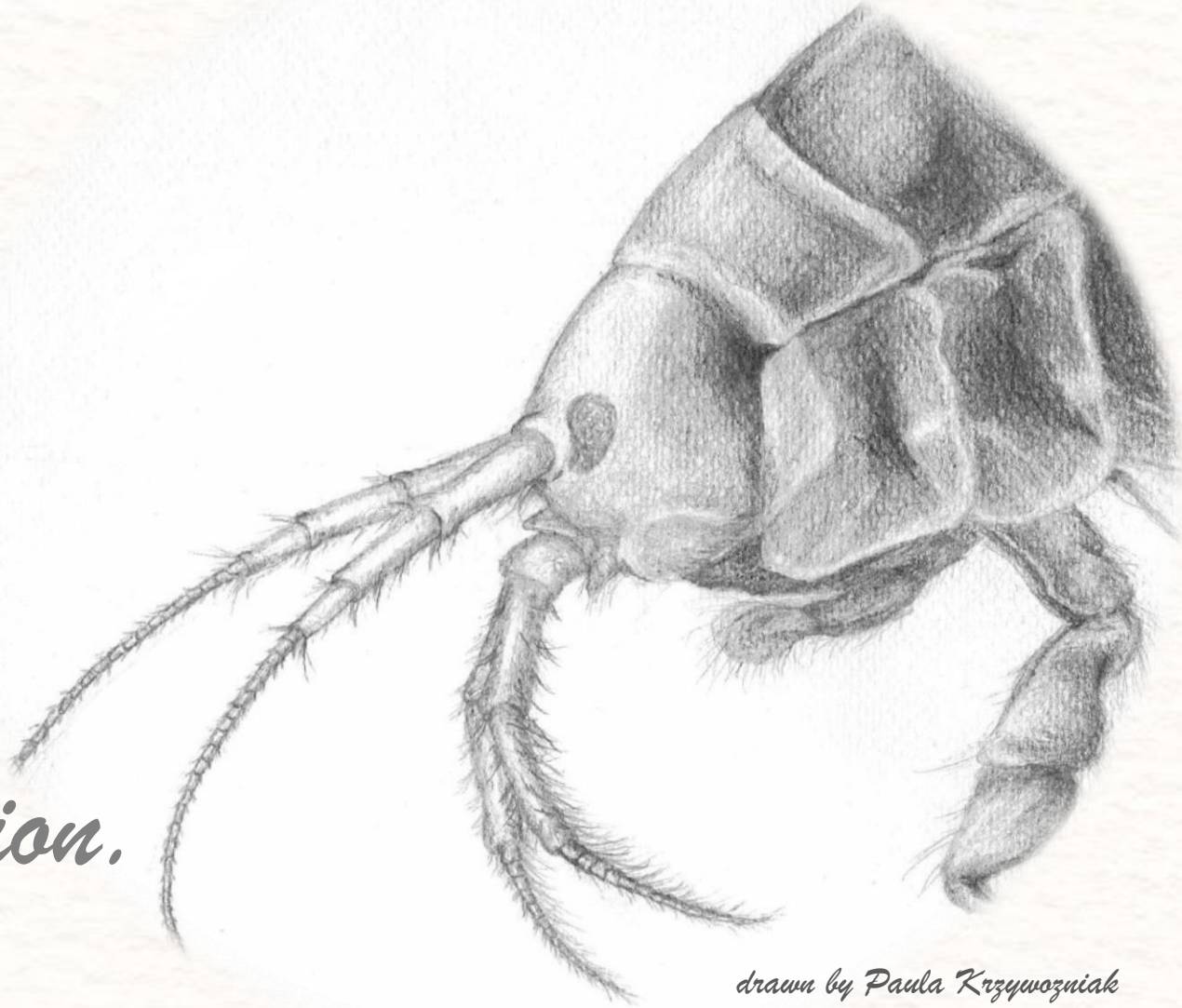


Conclusions

- Set of cryptic/pseudocryptic species
- Two diversity hotspots:
  - Balkan Peninsula
  - Pannonian Basin
- Long history of divergence since Early Miocene
- Neogene paleolake systems could promote divergence
- Postglacial expansion of two Pannonian haplotype groups
- Probably partially promoted by canal construction

***Gammarus roeselii* Gervais, 1835**

Thanks for your attention.



drawn by Paula Krzywozniak