

European Platform on Biodiversity Research Strategy Meeting
**"World Biodiversity and European Taxonomy. Strategies in
Taxonomy: Research in a Changing World"**
Průhonice, Czech Republic, May 2009

Genetic diversity of mammals in Europe and conservation

Jan Zima

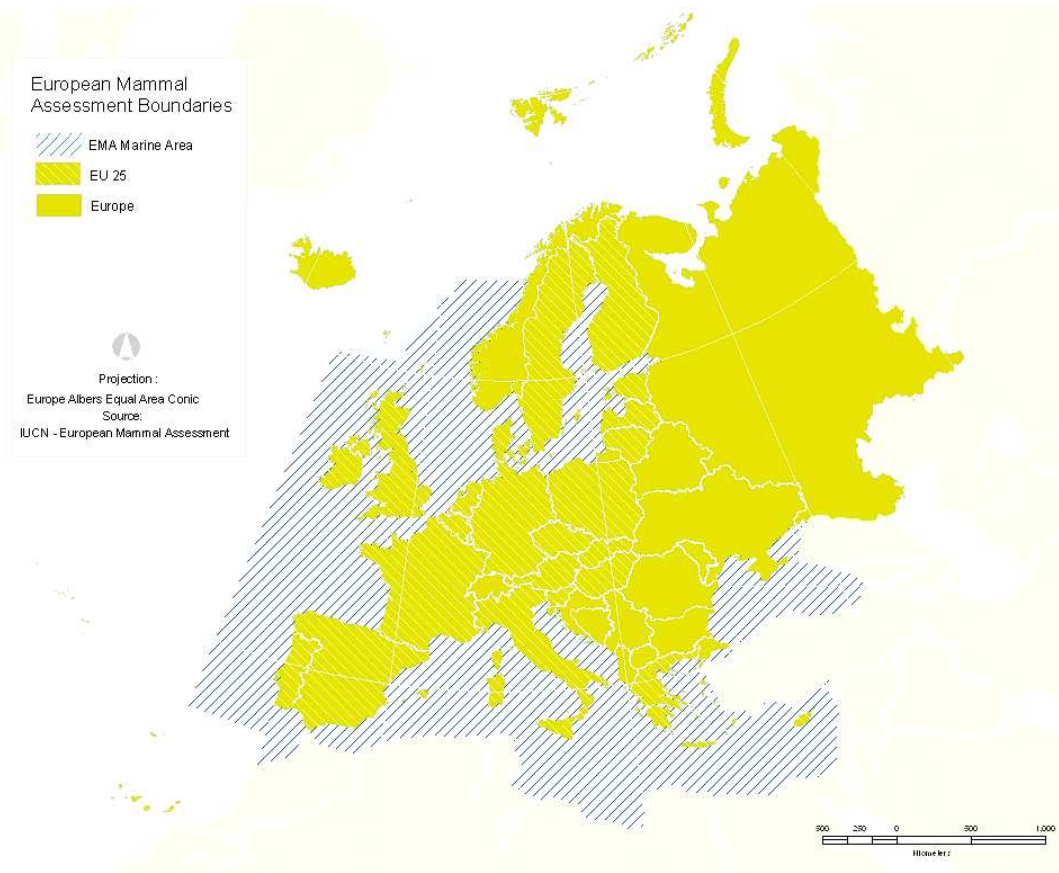
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jzima@brno.cas.cz



Talk Outline

- Fauna of European mammals
- Diversity and taxonomy of the European mammalian biota
- Sources and origins of the diversity
- Phylogeographic studies
- Northern and cryptic refugia
- Revealing traces of introduction attempts
- Hybridization and hybrid zones
- Conservation implications

Mammalian species richness in Europe (native species only)



European Mammal Assessment
2007

taxon	number of species
Rodentia	91
Lagomorpha	8
Eulipotyphla	36
Chiroptera	42
Artiodactyla	16
Cetacea	33
Carnivora (Fissipedia)	26
Carnivora (Pinnipedia)	8
TOTAL	260

Mammalian species richness in Europe

(introduced species included, cetaceans excluded)



taxon	number of species
Diprotodontia	1
Lagomorpha	10
Rodentia	106
Primates	1
Eulipotyphla	39
Chiroptera	42
Artiodactyla	26
Carnivora	25
TOTAL	250

Aulagnier et al.: Guide des mammifères d'Europe, 2008

Mammalian distribution mapping in Europe

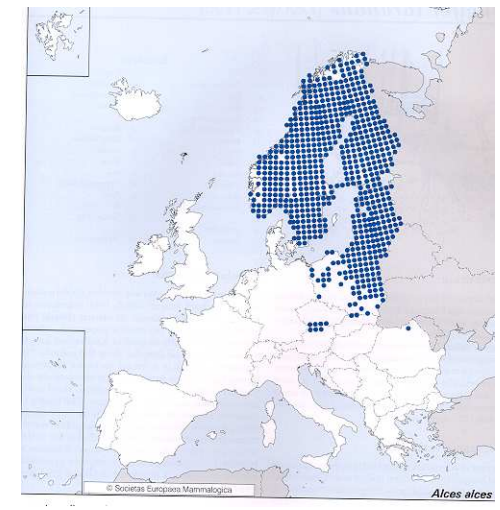
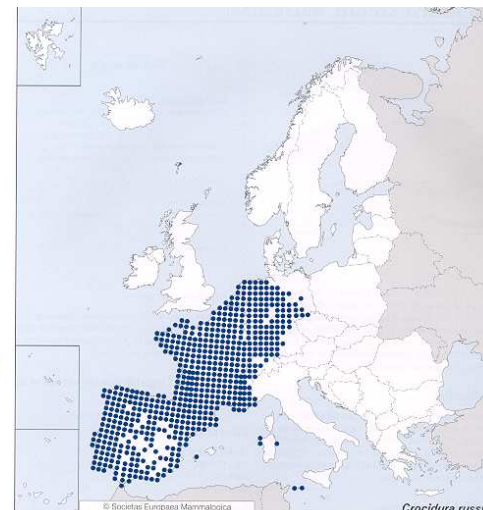
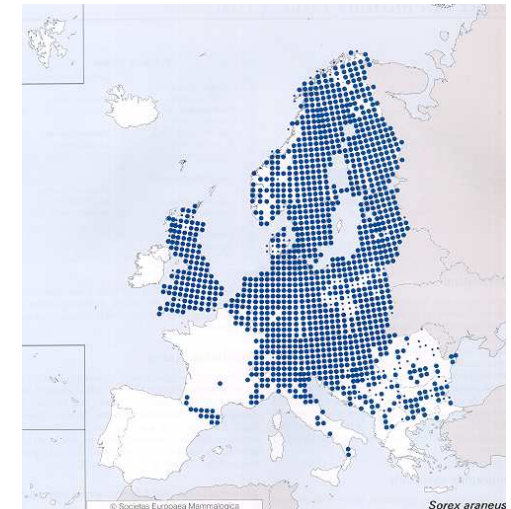
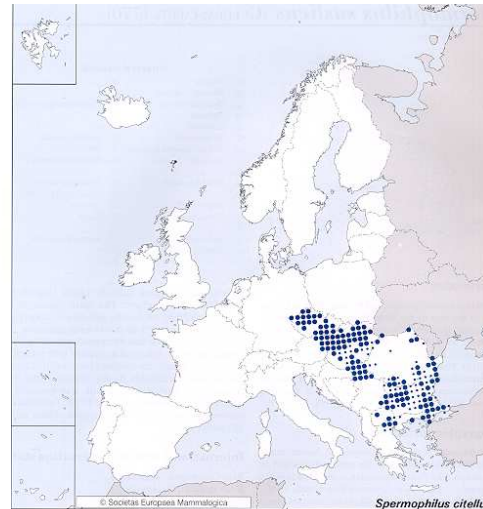
THE ATLAS OF EUROPEAN MAMMALS

A J Mitchell-Jones, G Amori,
W Bogdanowicz, B Kryštufek, P J H Reijnders,
F Spitzenberger, M Stubbe, J B M Thissen,
V Vohralík & J Zima

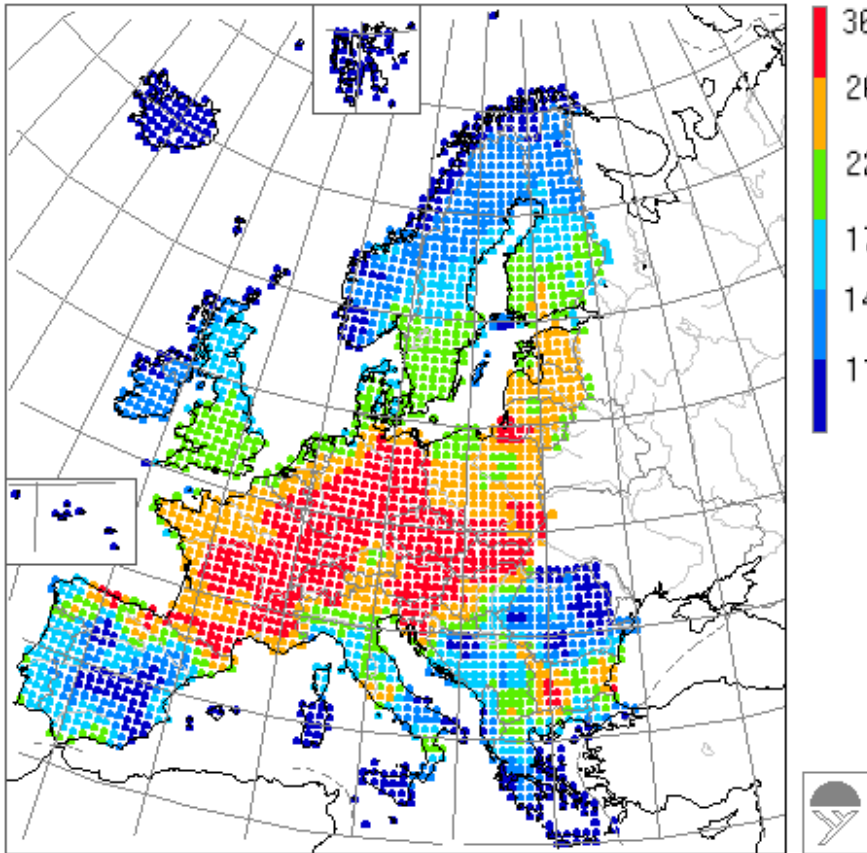


POYSER NATURAL HISTORY

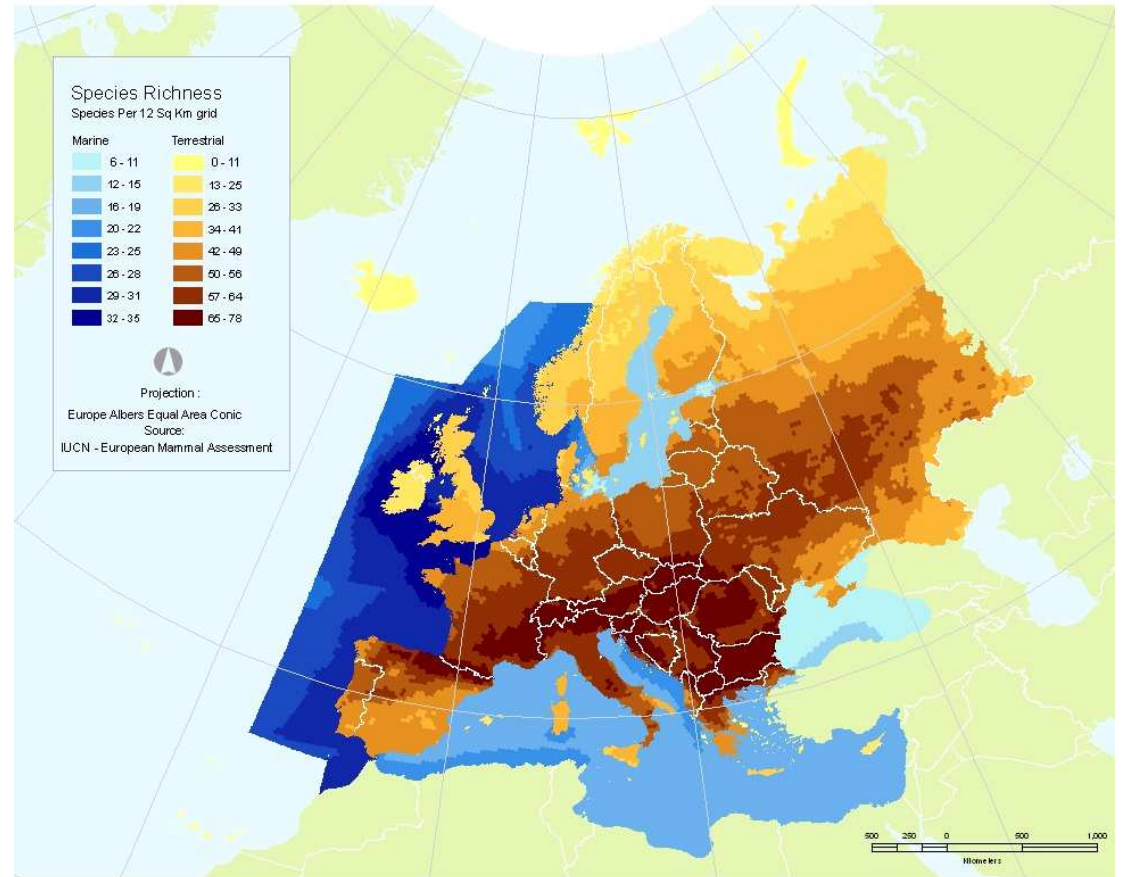
Published by T & A D. Poysner for the *Societas Europaea Mammalogica*



Species diversity of European mammals

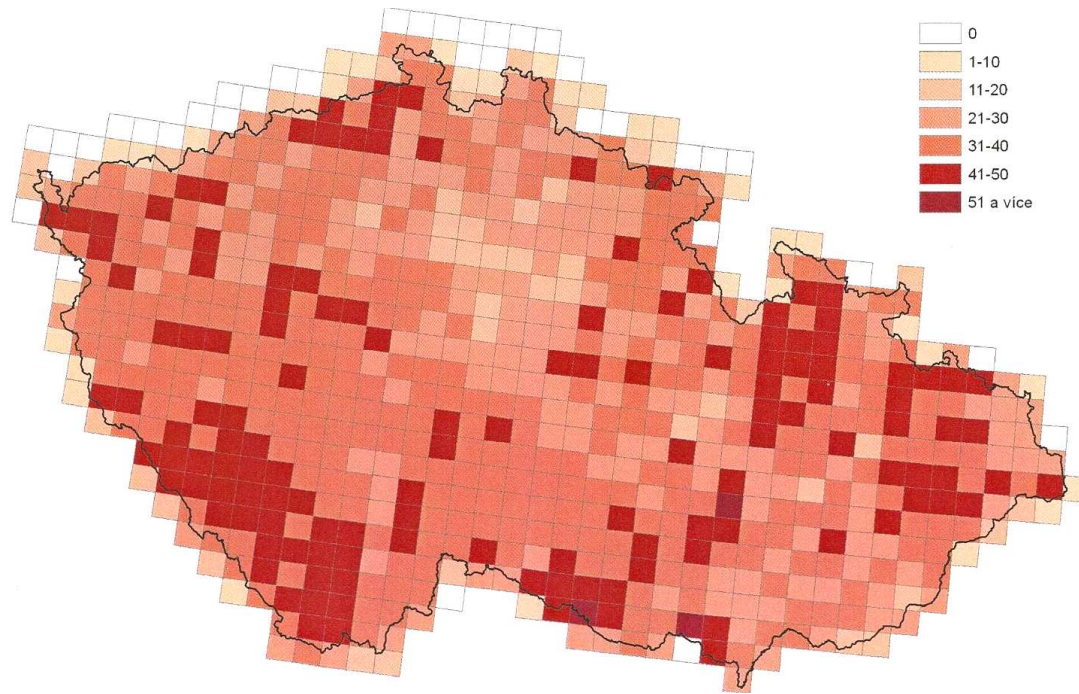


Mitchell-Jones et al. 1999,
Academic Press



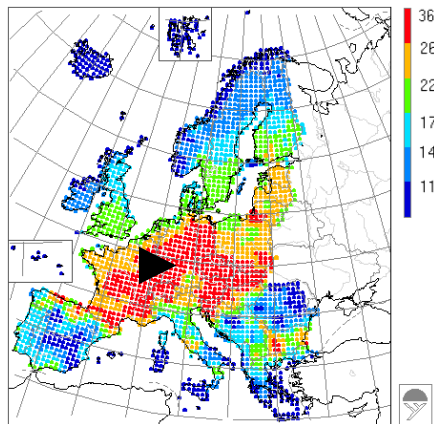
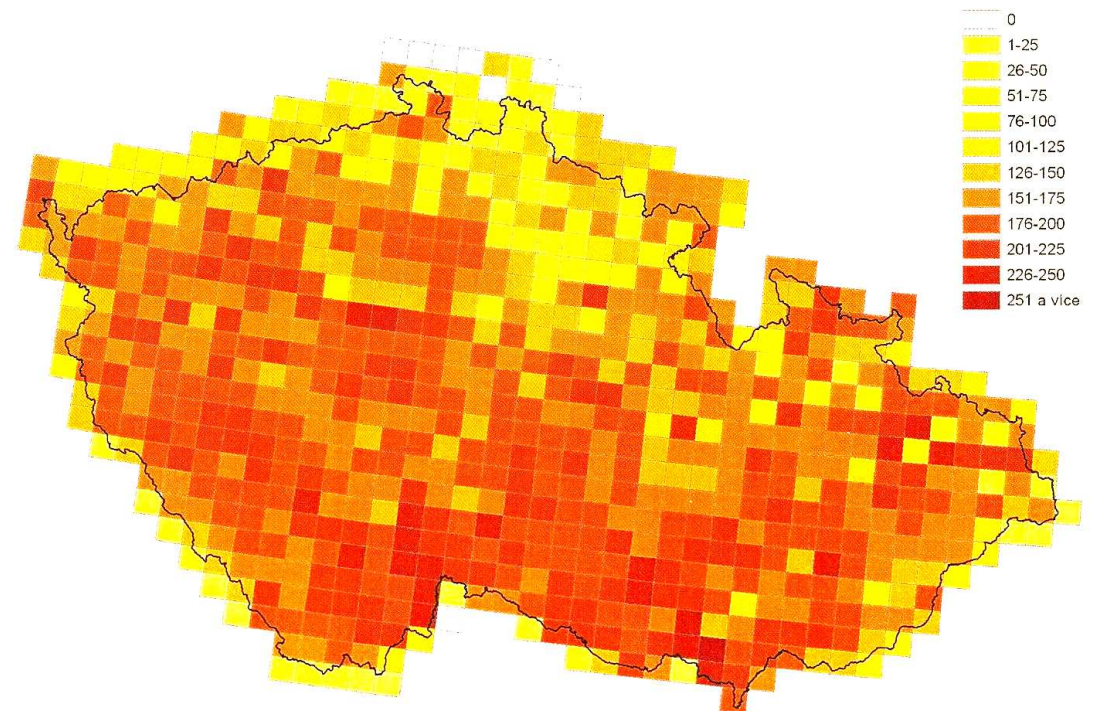
European Mammal Assessment
2007

Mammals

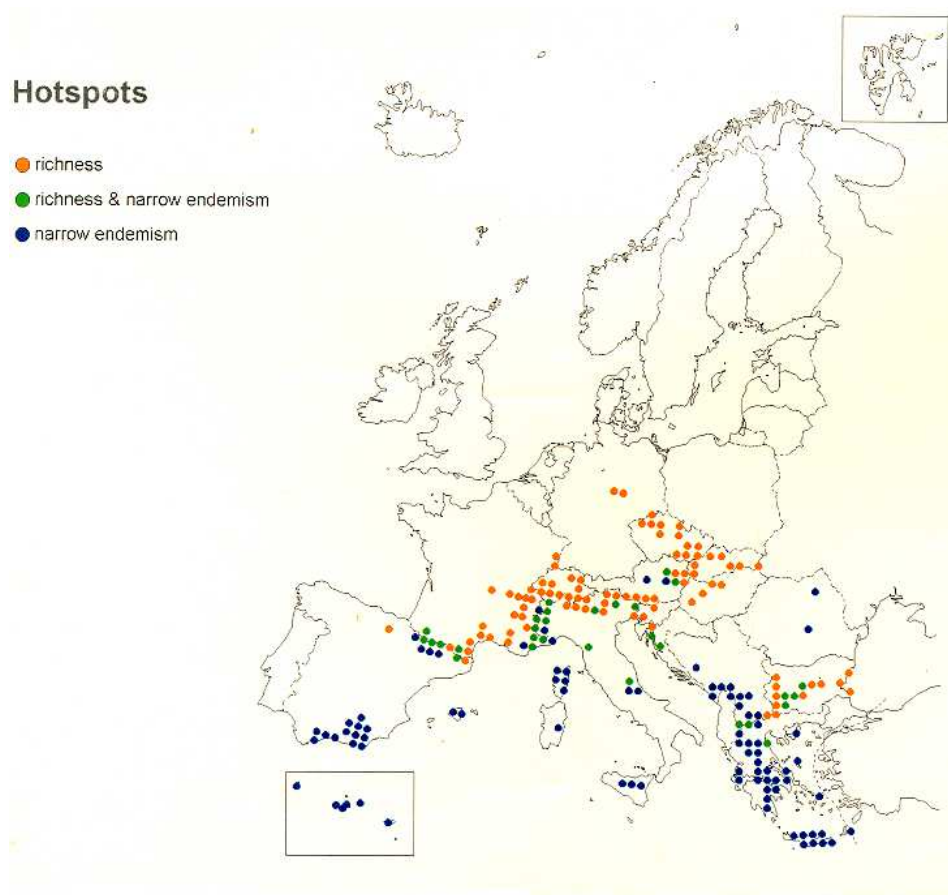


Species richness of the mammals and vertebrates in the Czech Republic (no. of species)

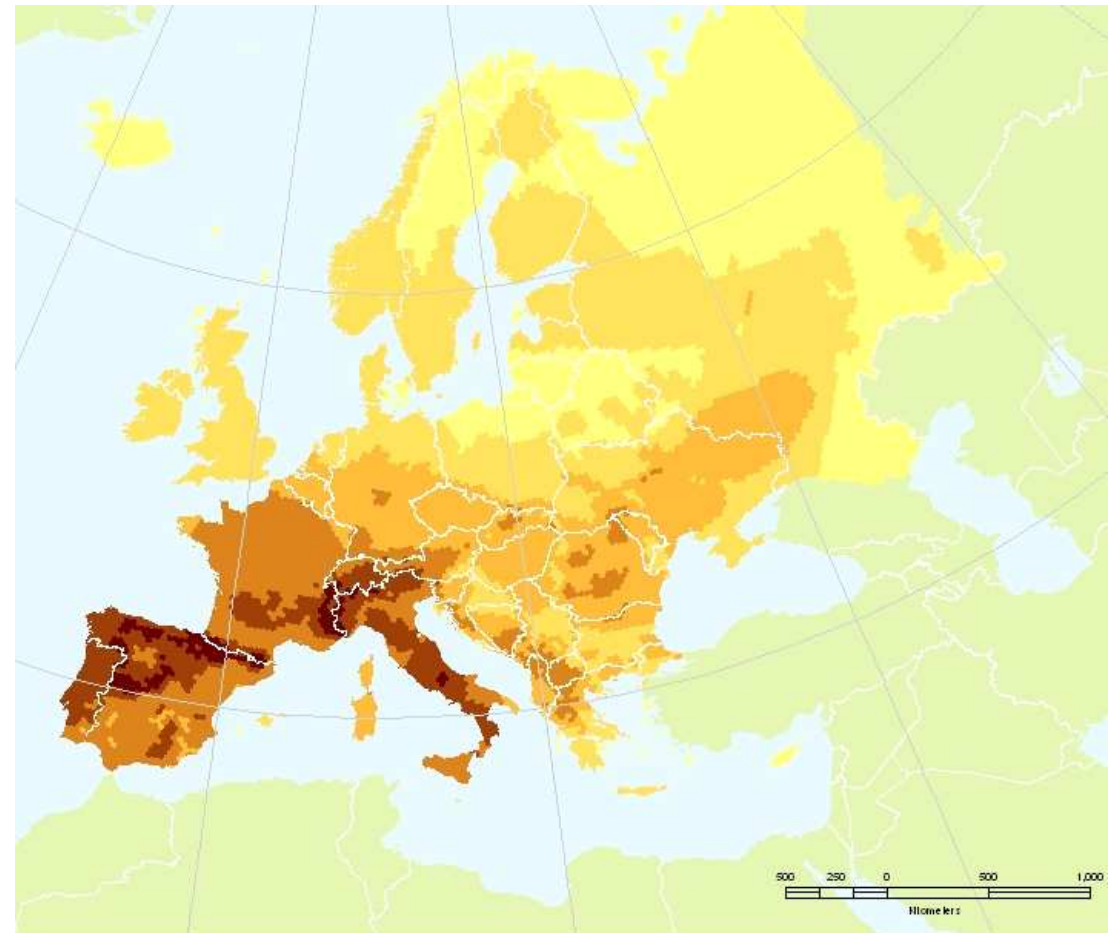
All vertebrates



Biodiversity hotspots and endemism in Europe



Williams 1999



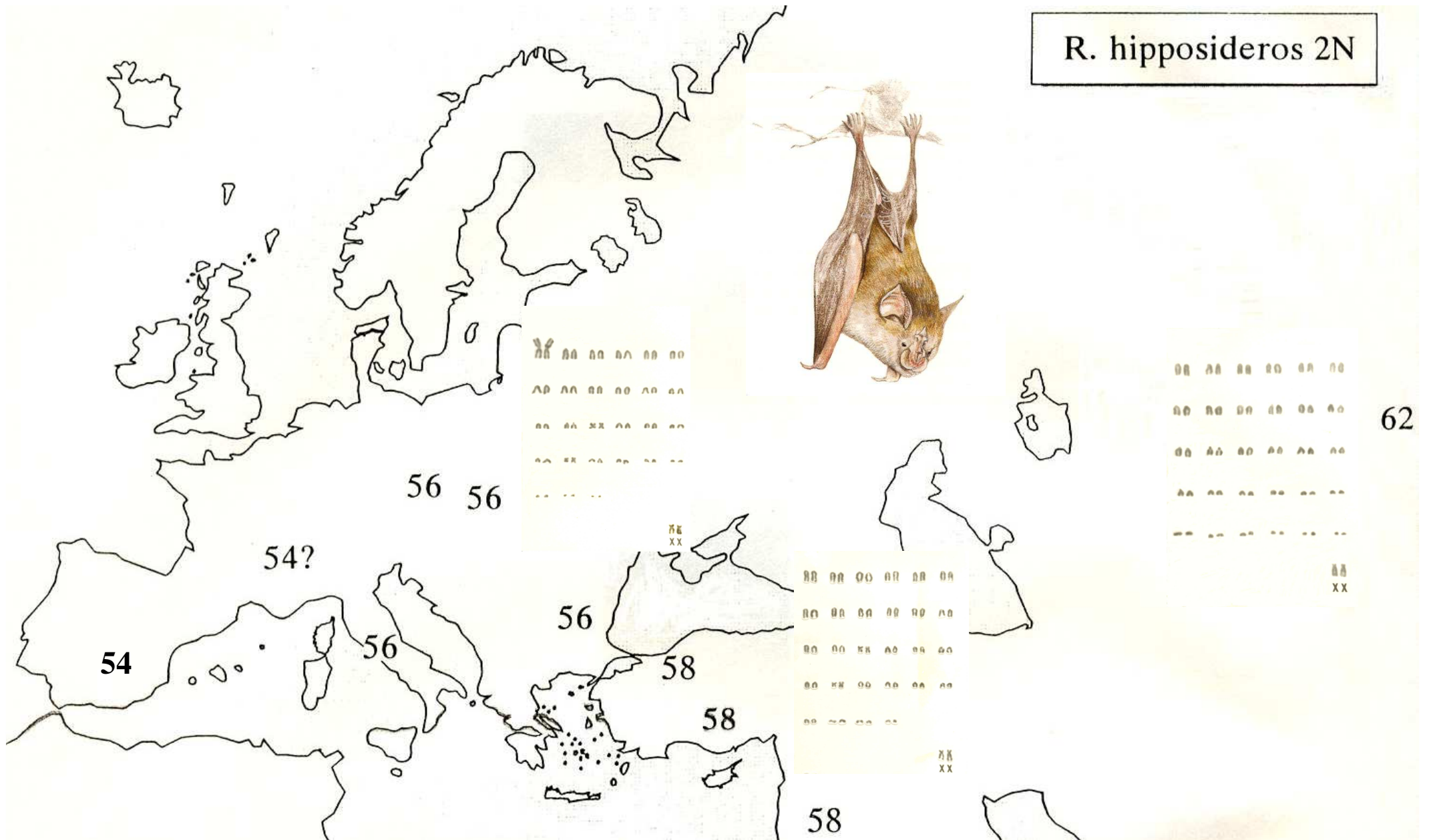
European Mammal Assessment
2007

Mammalian species richness in Europe

- 219 autochthonous species
- 31 introduced species
- 33 strictly marine species (cetaceans)

- 45 species differentiated recently

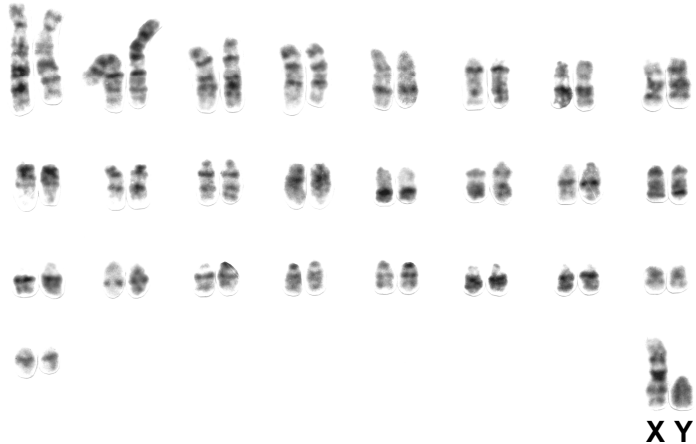
Karyotypic races in the lesser horseshoe bat (*Rhinolophus hipposideros*)



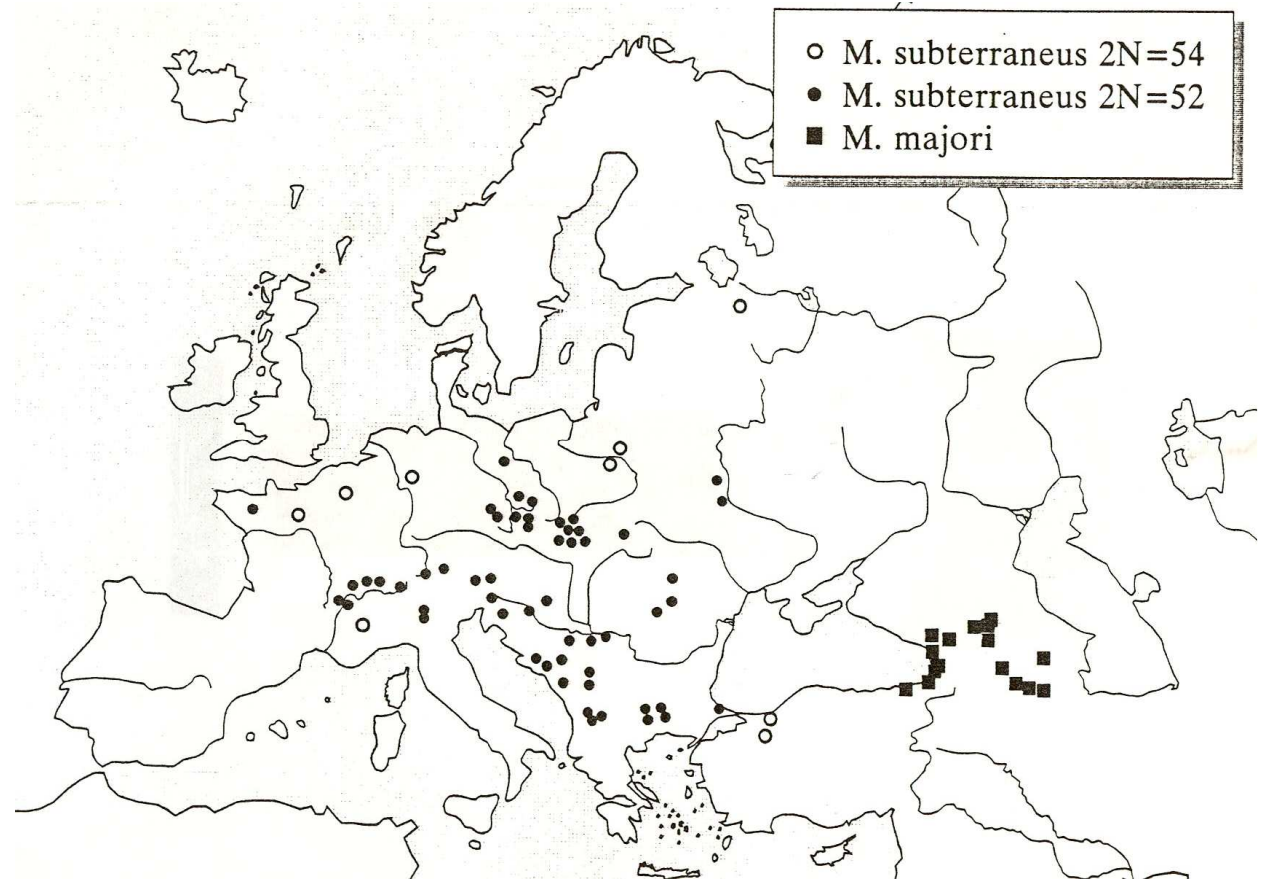
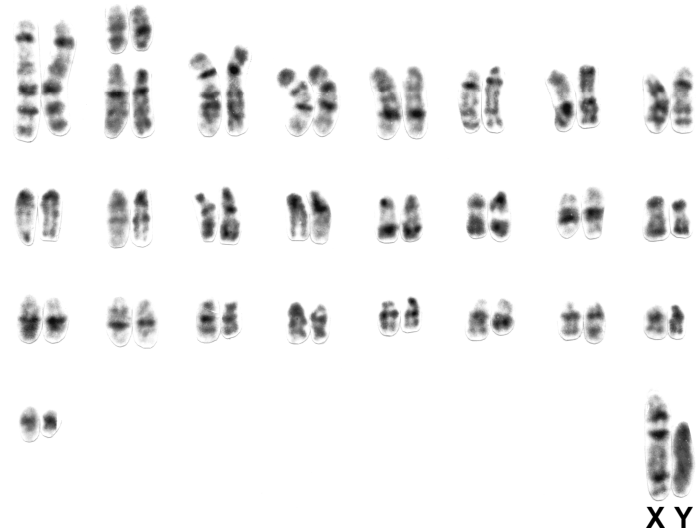
Karyotypic races in the European pine vole, *Microtus subterraneus*



● 52-chromosome race

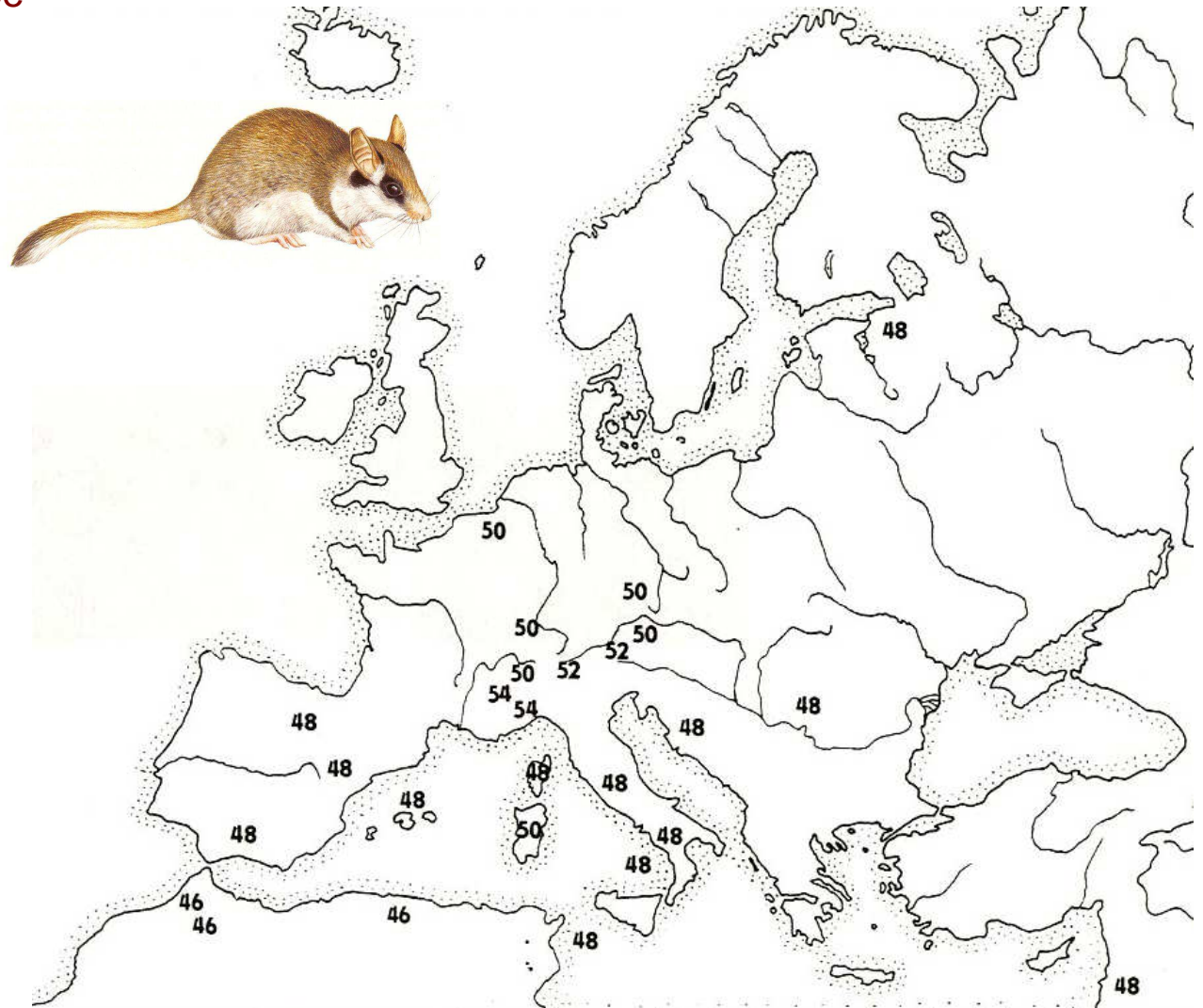
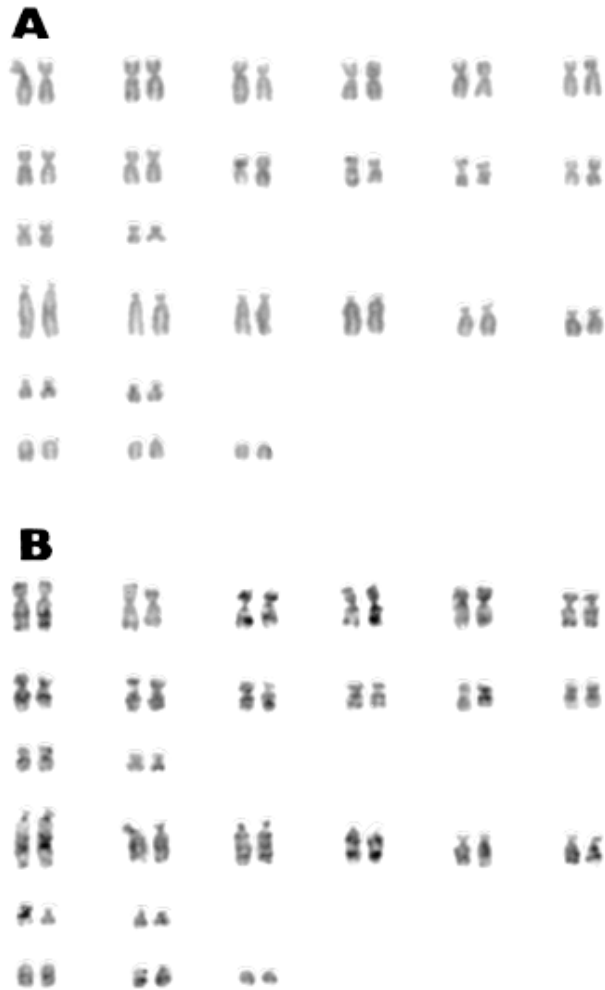


○ 54-chromosome race

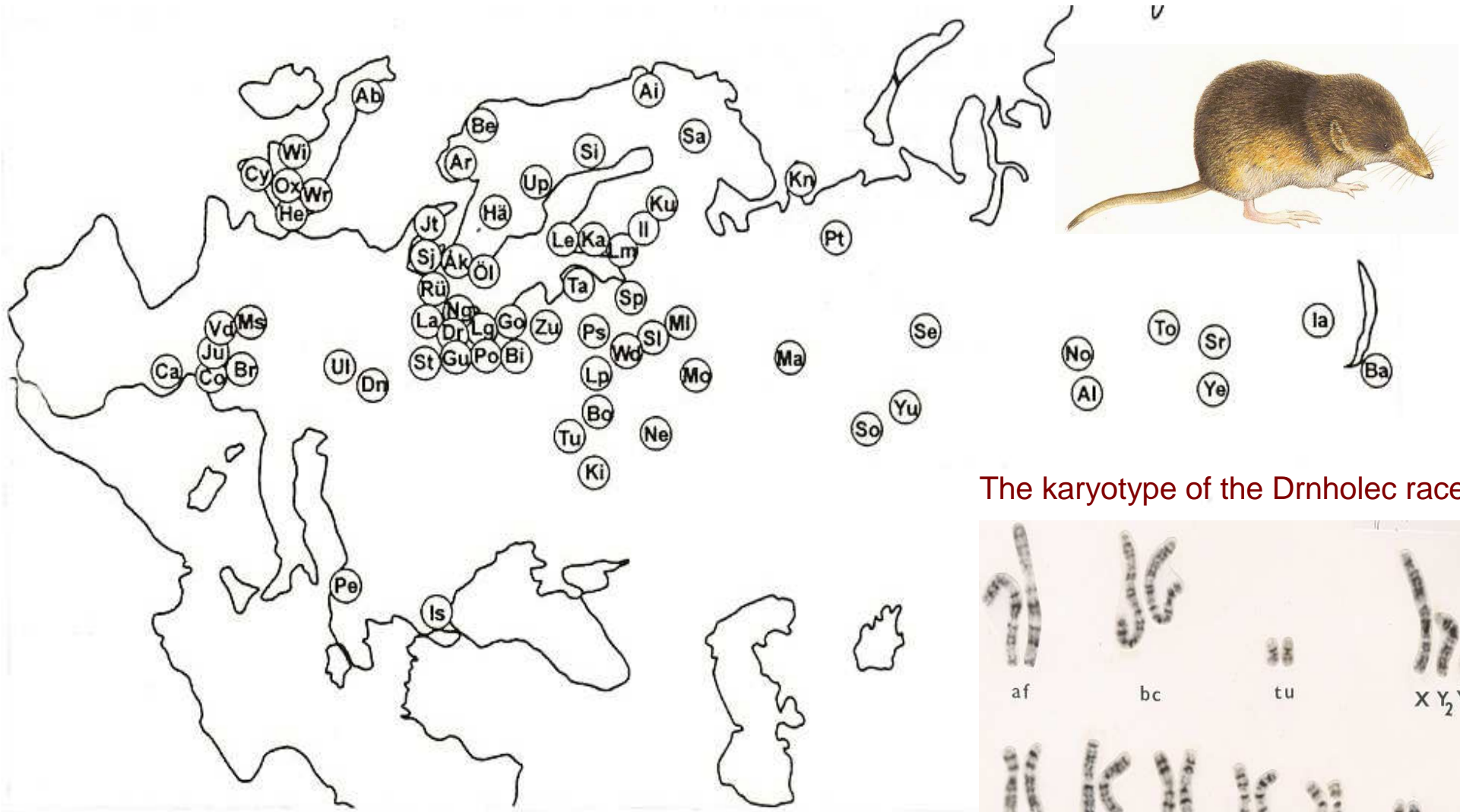


Karyotypic races in the garden dormouse (*Eliomys quercinus*)

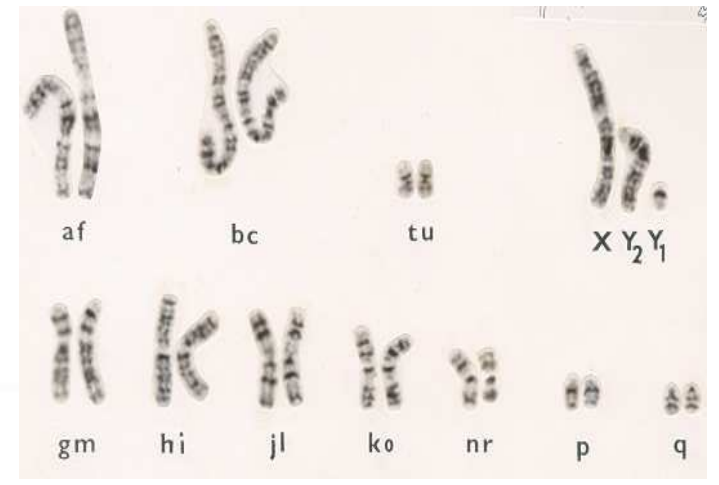
50- chromosome race from central Europe



Type localities of the karyotypic races of the common shrew (*Sorex araneus*)

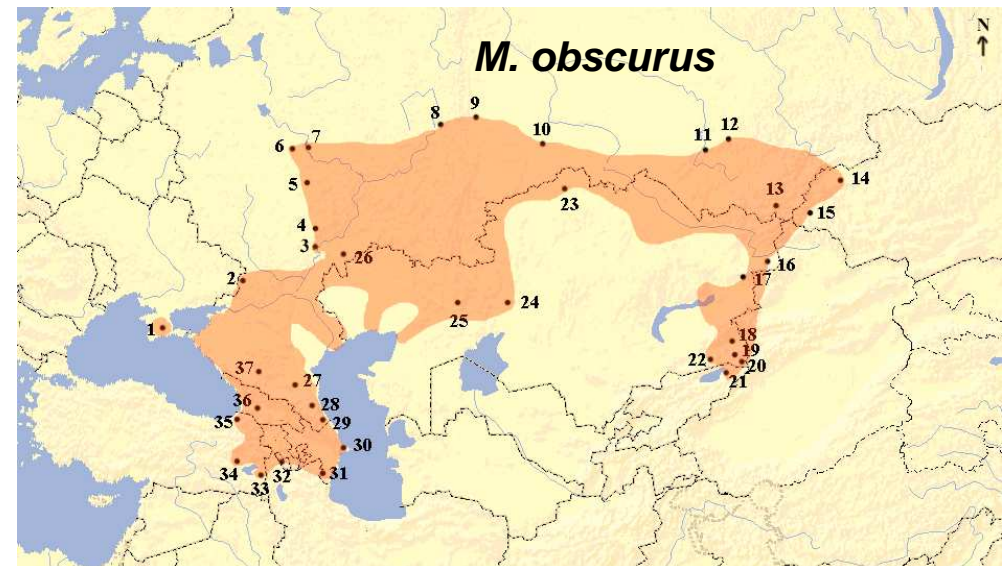
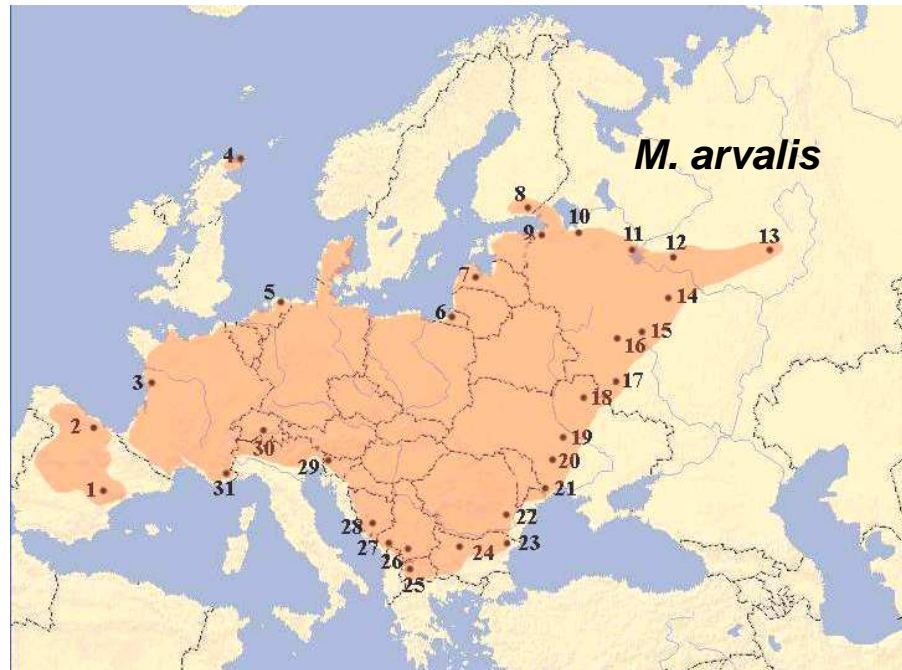
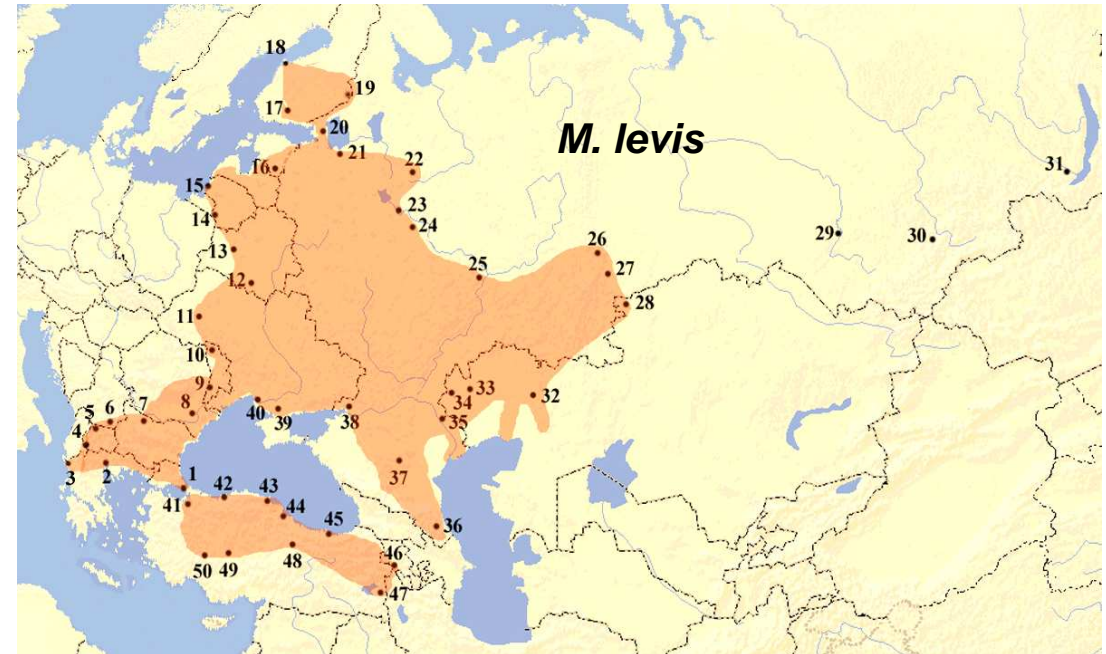


The karyotype of the Drnholec race

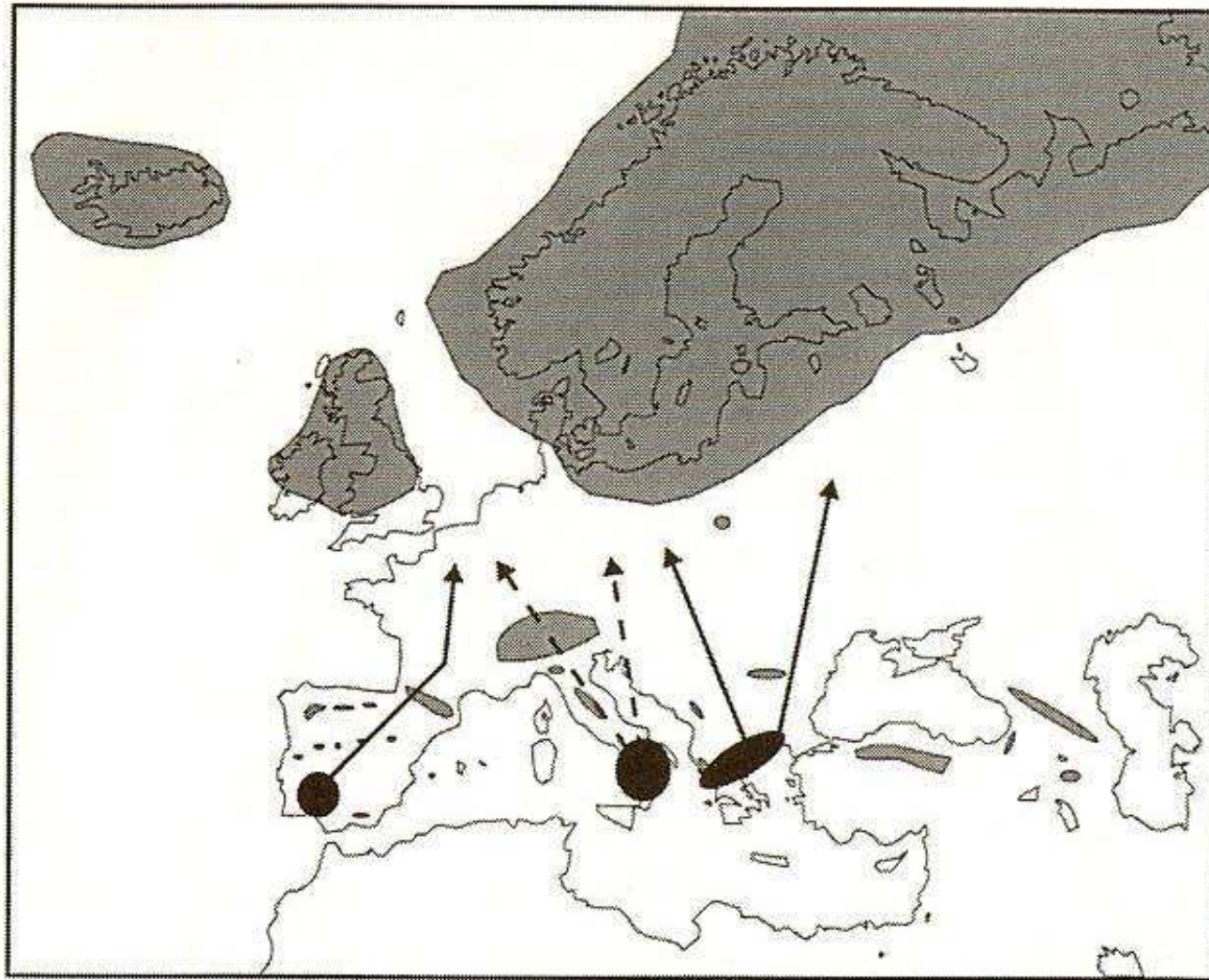


Distribution of cryptic species from the common vole group

Microtus arvalis

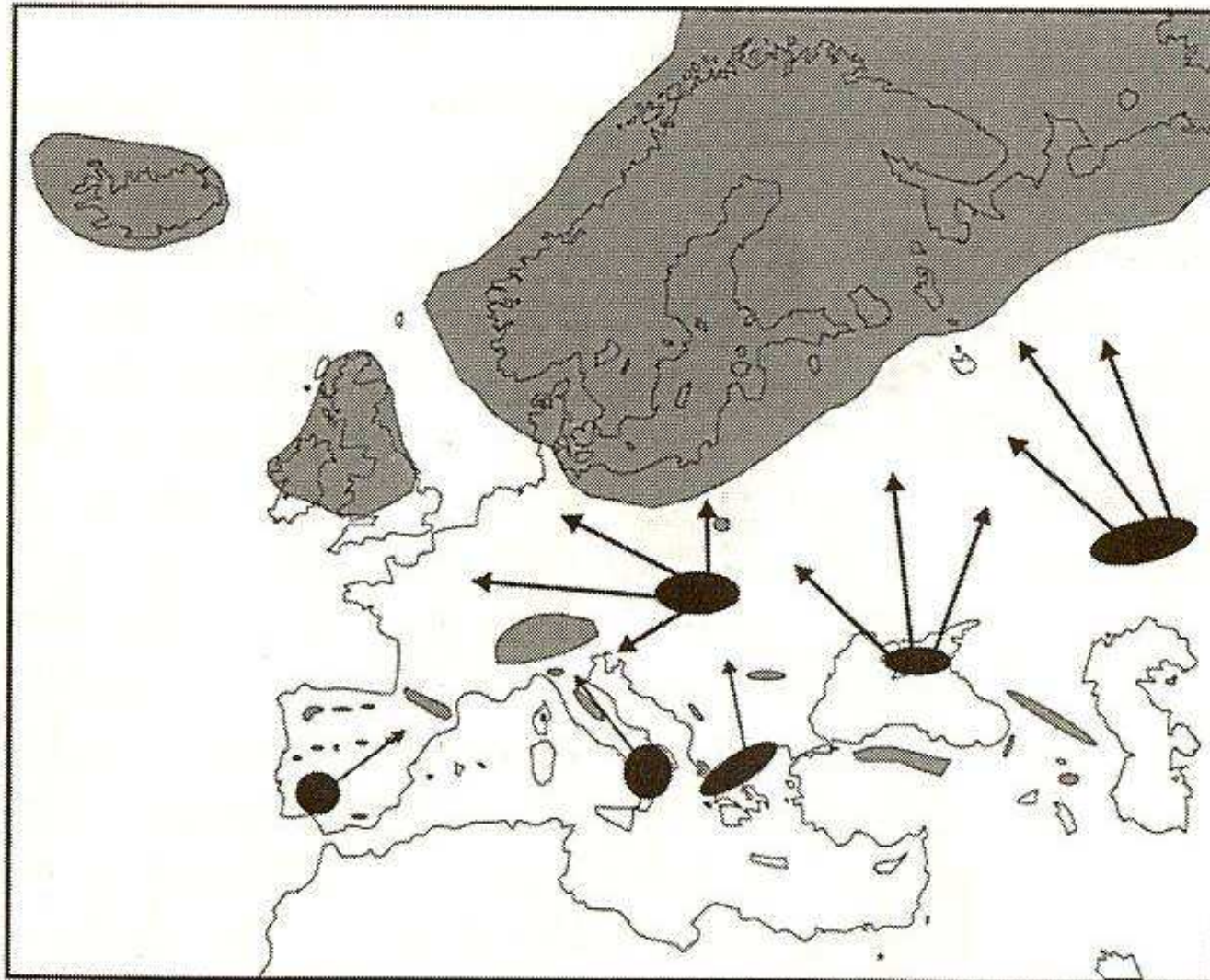


Traditional view of glacial refugia situated in the Mediterranean area

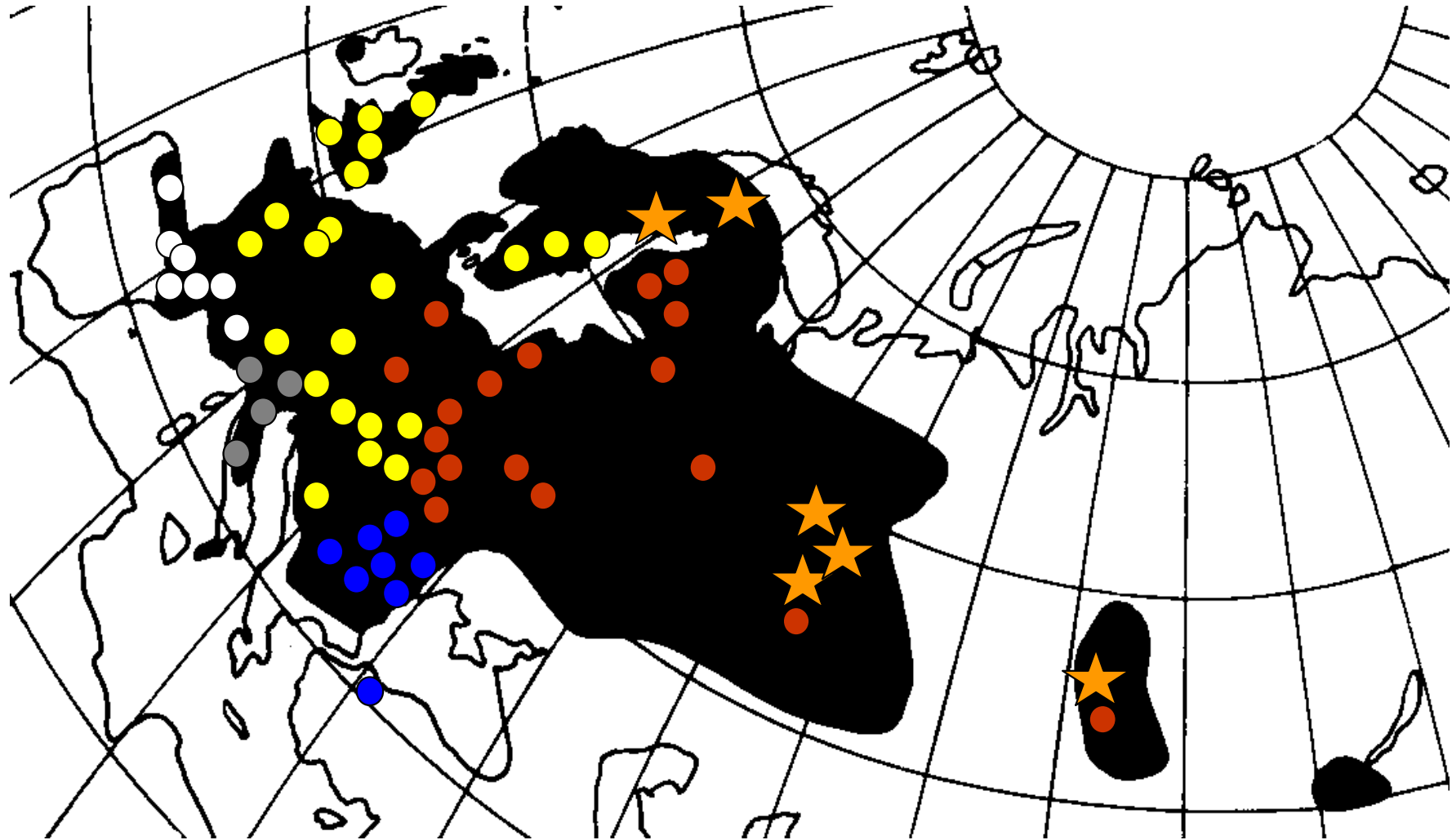


Alternative views of glacial refugia and postglacial colonization

Mediterranean Europe as an area of endemism for small mammals rather than source for northwards postglacial colonization

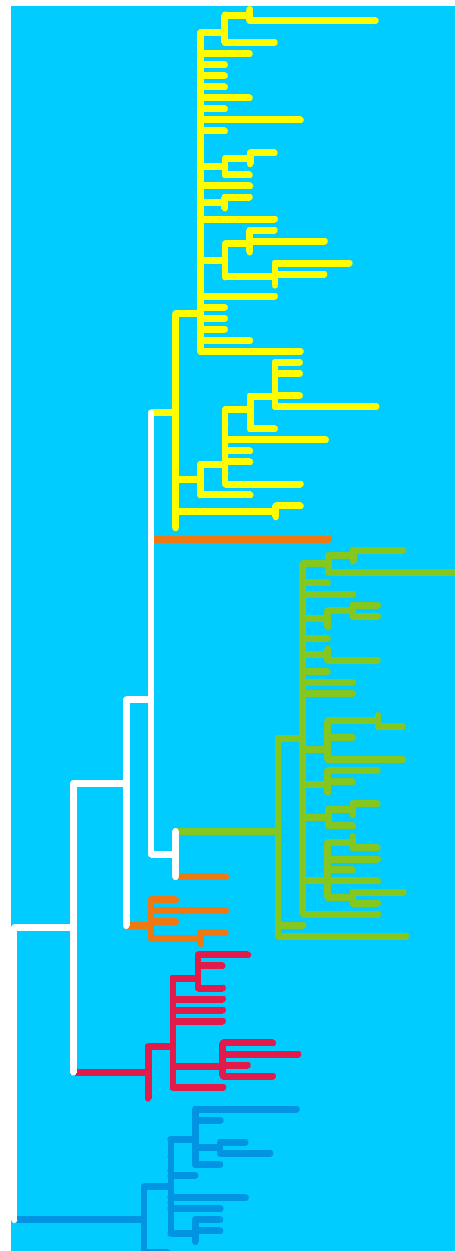


Originally identified phylogeographic clades in bank voles



Bilton et al. 1998, Proc. R. Soc. B;
Deffontaine et al. 2005, Mol. Ecol.

New data: Maximum likelihood tree of Central and South-eastern European populations of bank voles

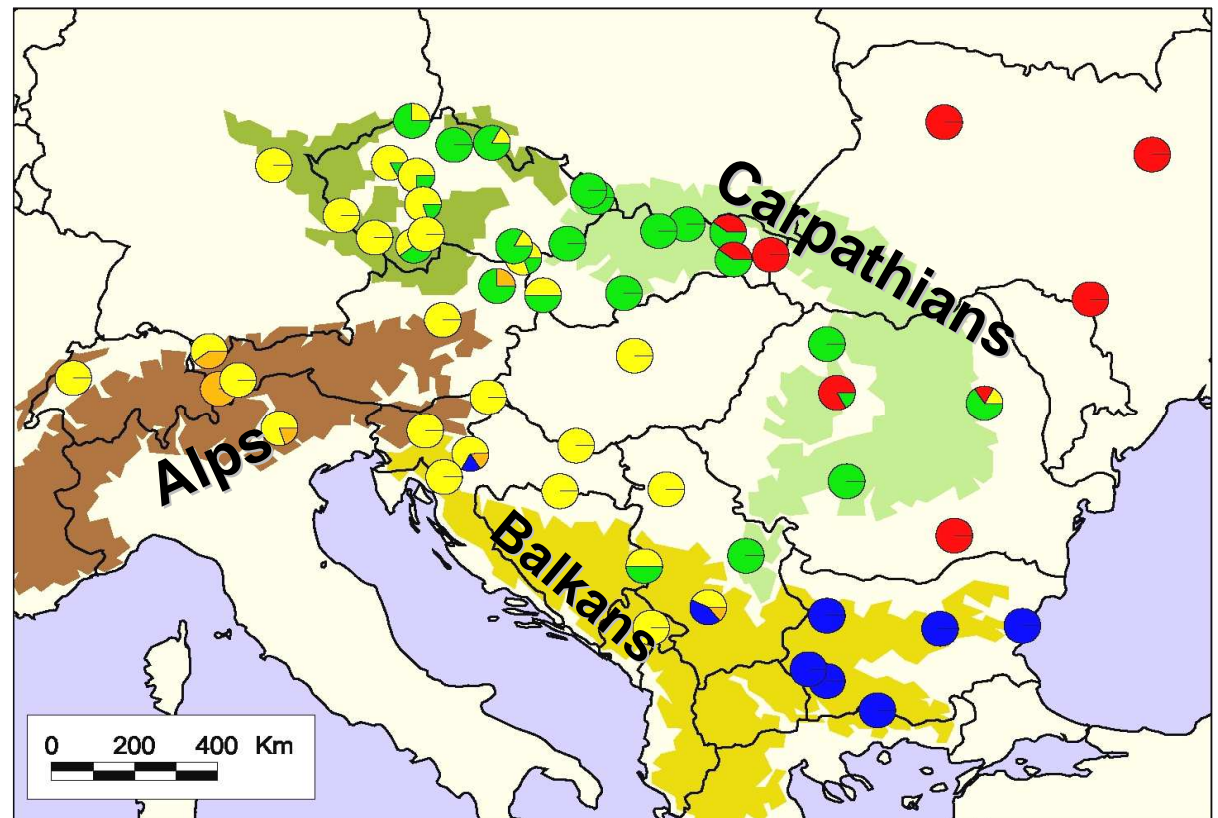


W Balkan /
Central European

Carpathian

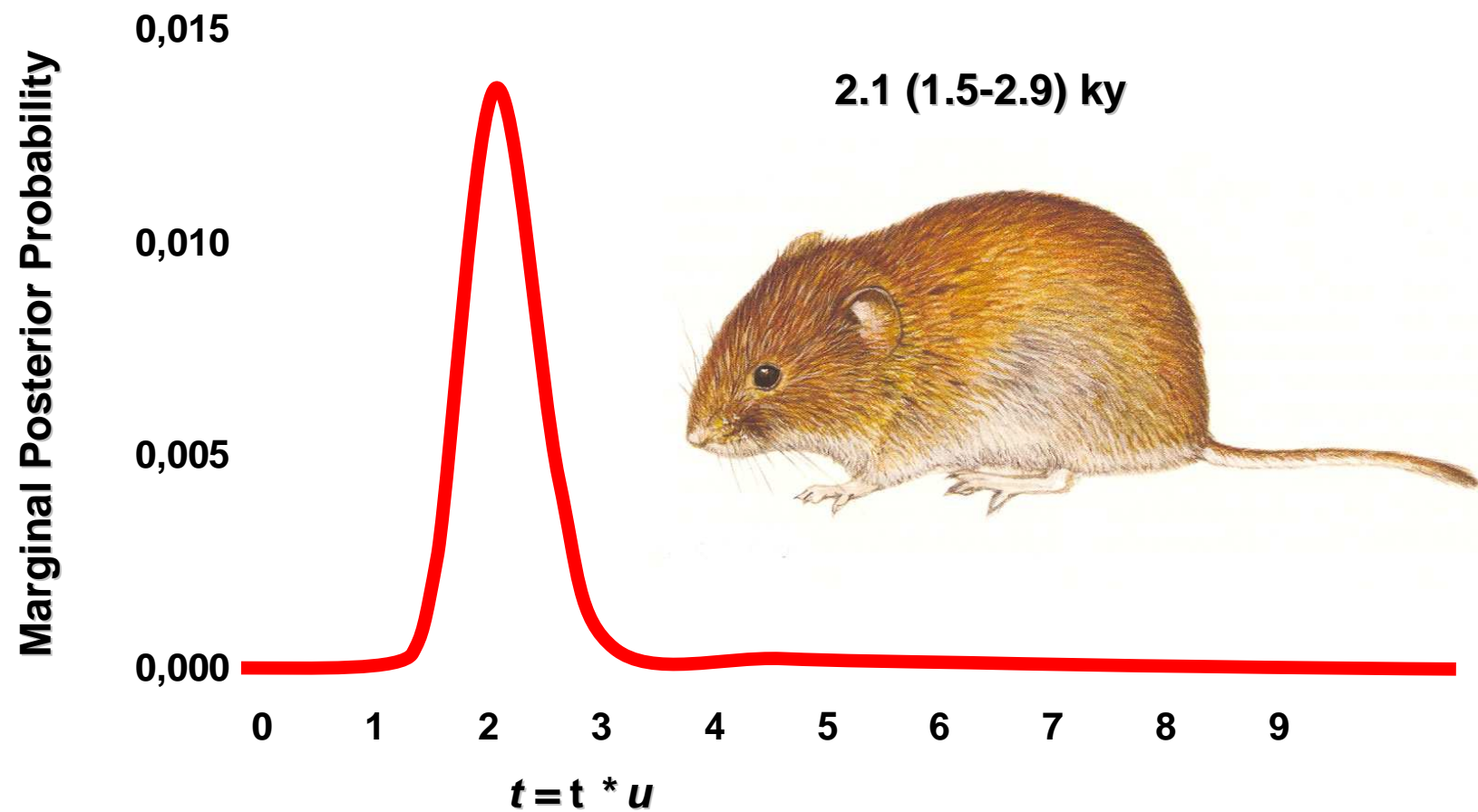
Eastern

E Balkan



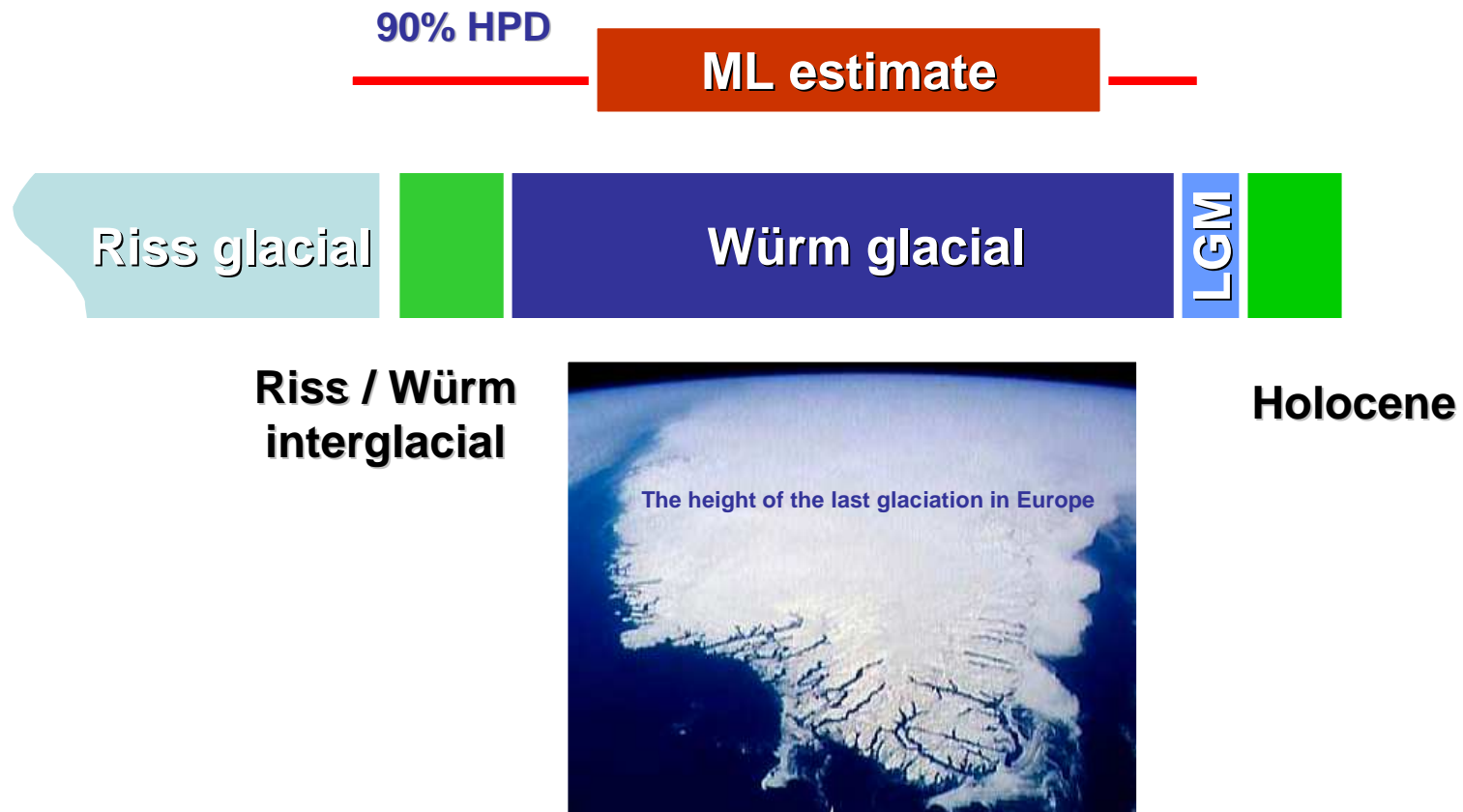
Estimates of the divergence time

Isolation with migration model, Bayesian coalescent method (MCMC)

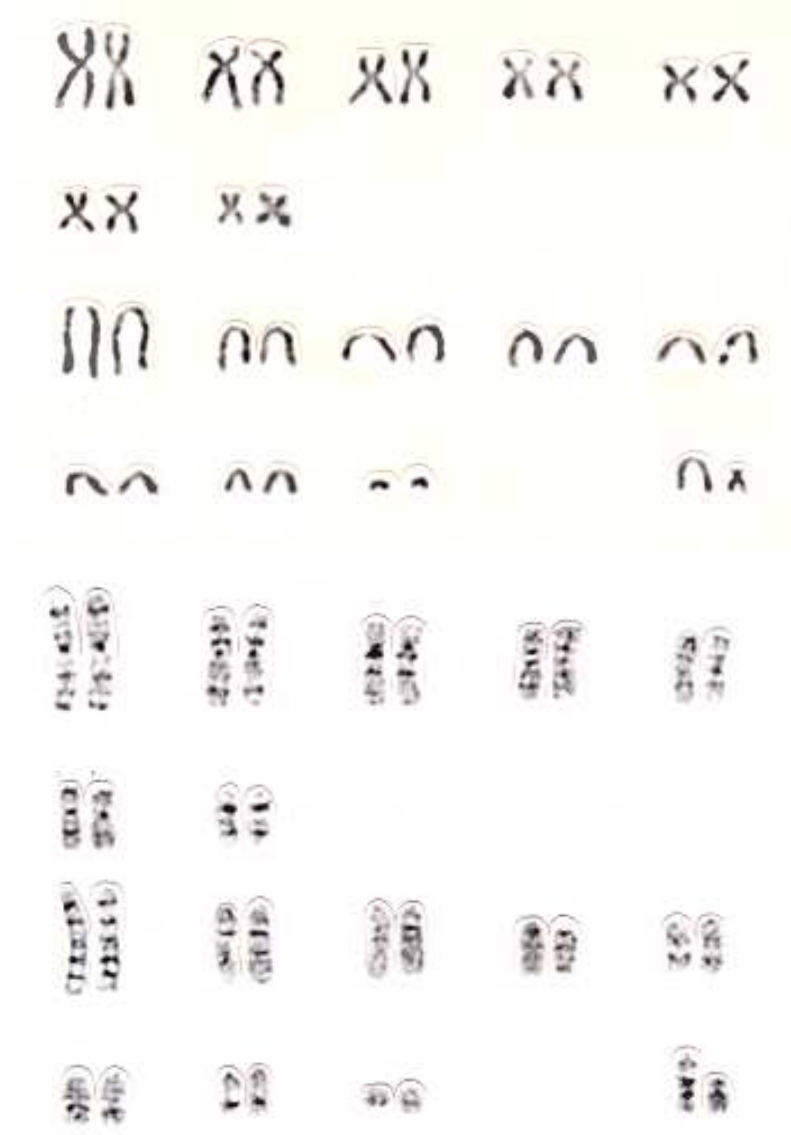
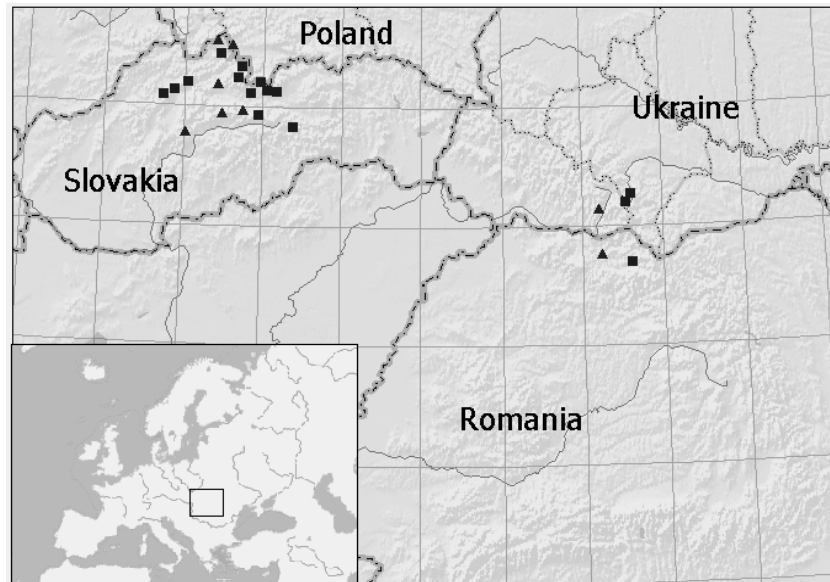


Estimates of the divergence time

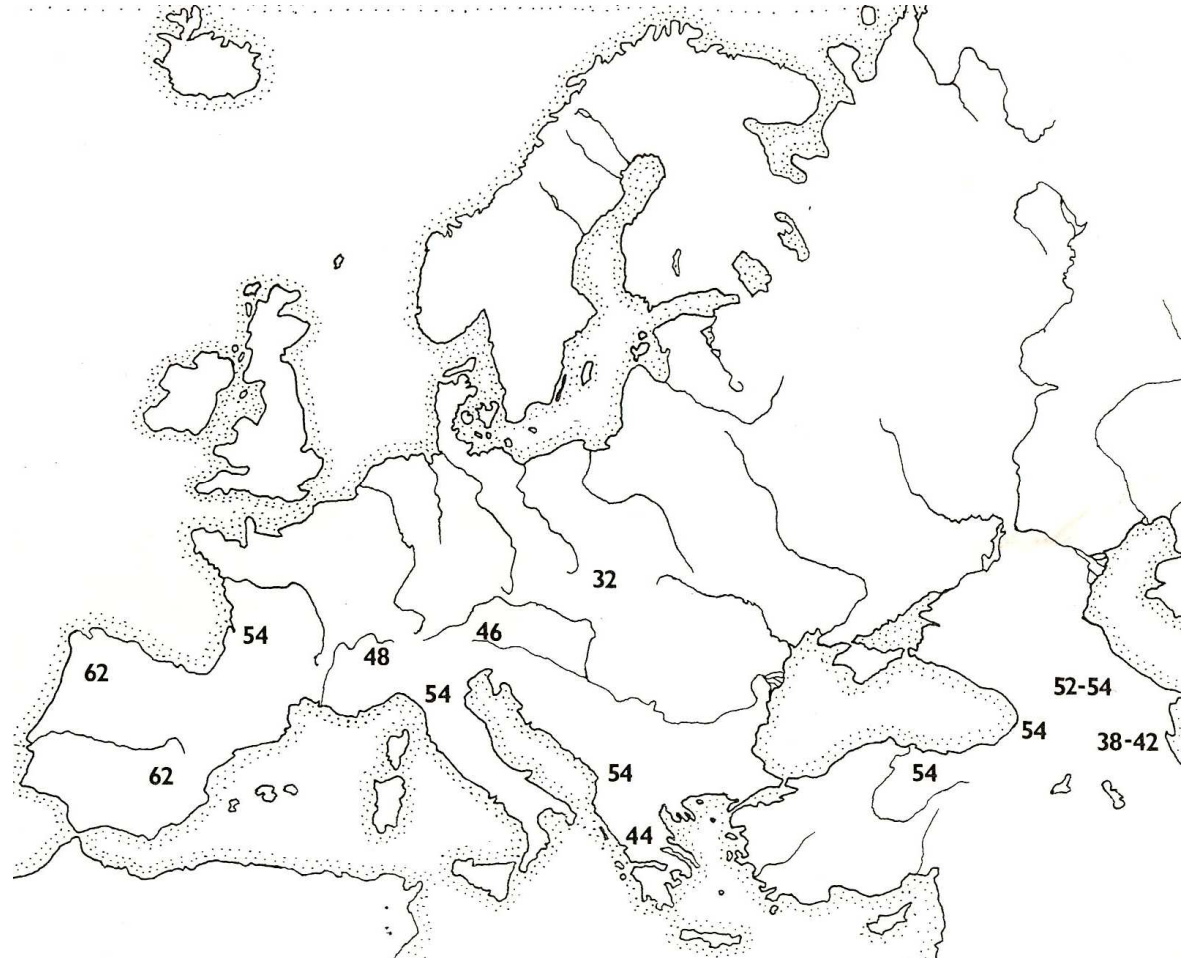
Range of rodent molecular clocks: 3.6% to 13% sequence divergence / MY



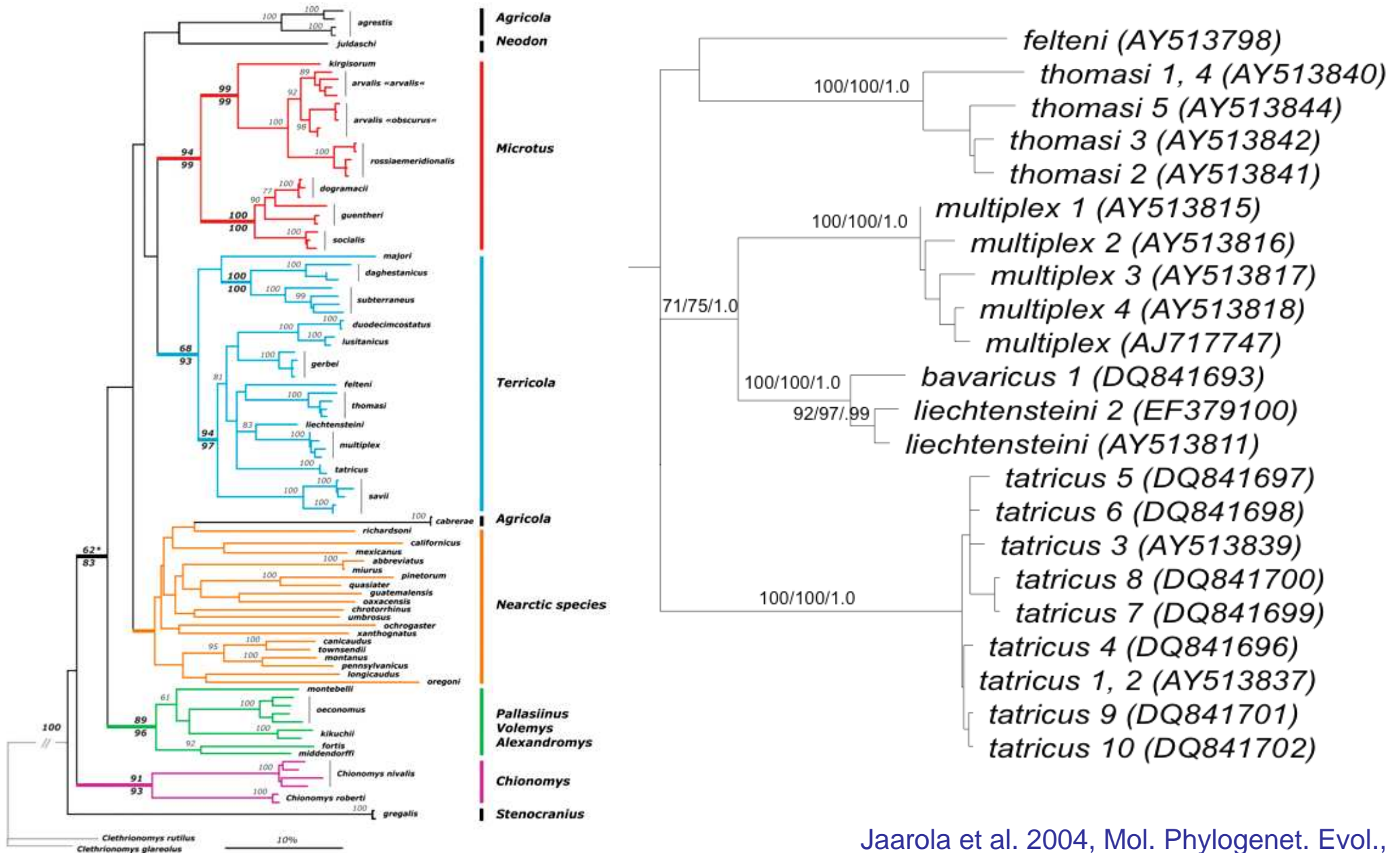
Tatra pine vole, *Microtus tatricus*: the only mammal endemic to the Carpathian Mountains



Distribution of chromosome diploid number among European pine voles (subgen. *Terricola*)

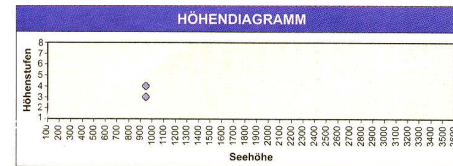
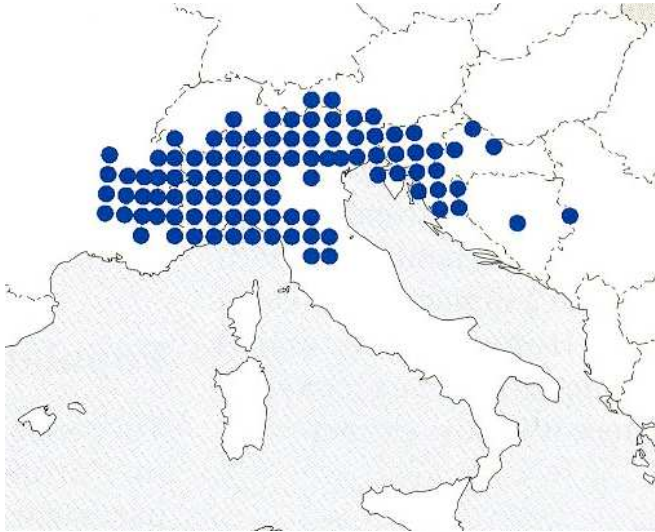


Phylogenetic relationships among voles of the genus *Microtus*, the position of the *Terricola* clade, and phylogenetic relationships of *M. tatricus* and *M. bavaricus*

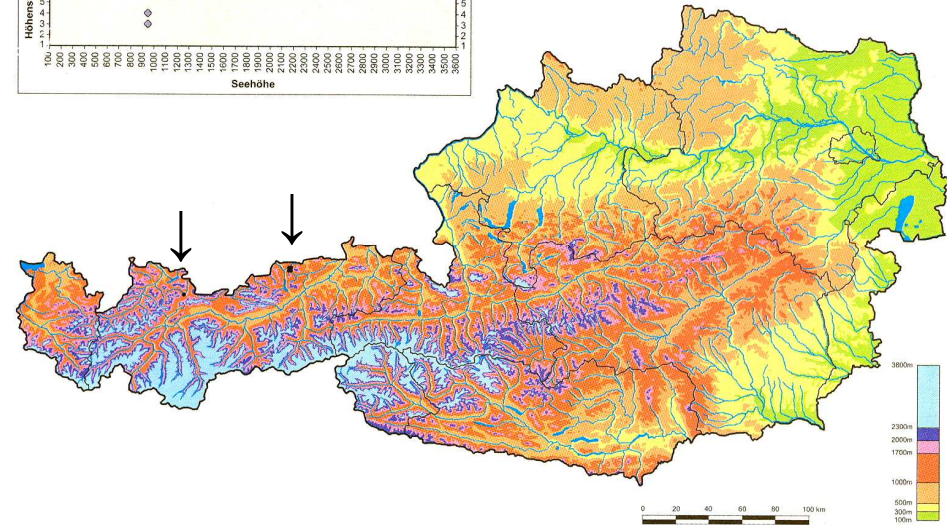


Jaarola et al. 2004, Mol. Phylogenet. Evol.,
Martínková et al. 2007, Folia Zool.

Distribution of the pine vole species endemic to the Alps

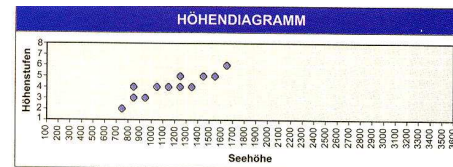
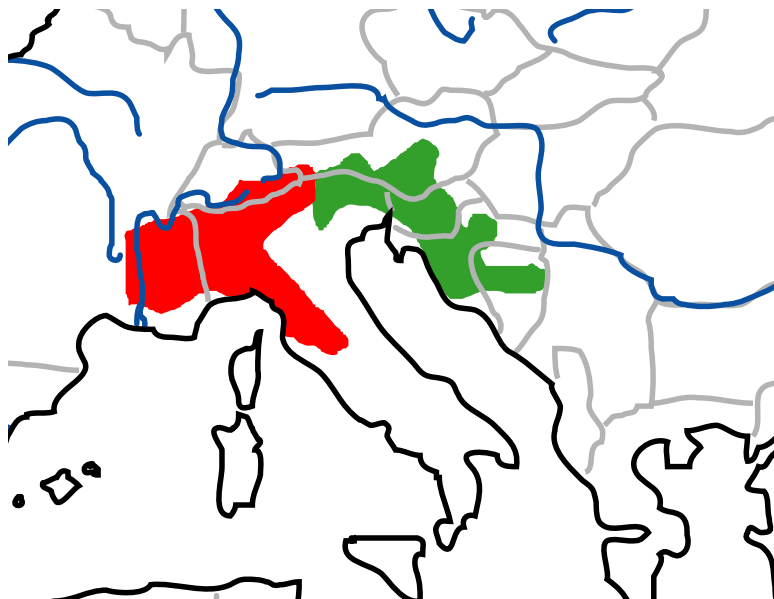


M. bavaricus

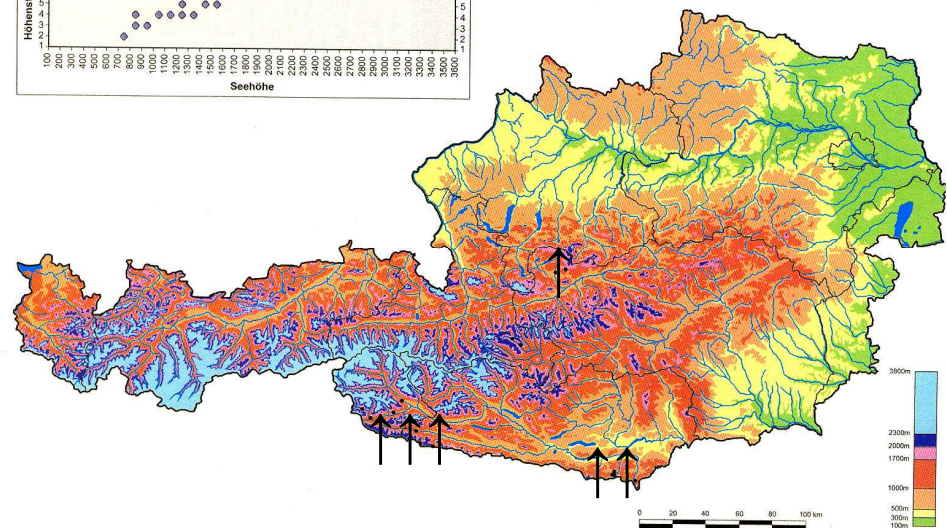


Aktuelle Verbreitung der Bayerischen Kurzhohrmaus *Microtus bavaricus*

M. multiplex -liechtensteini

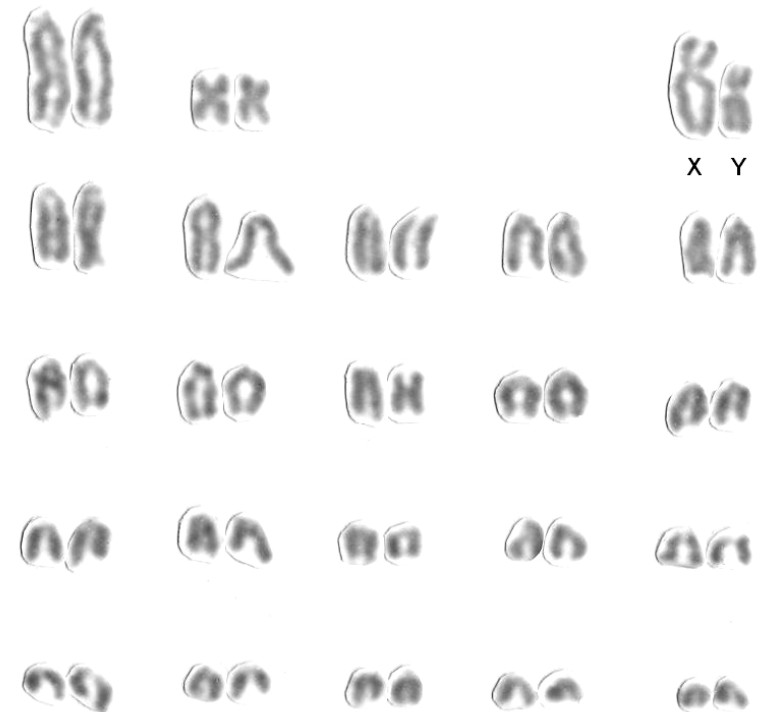
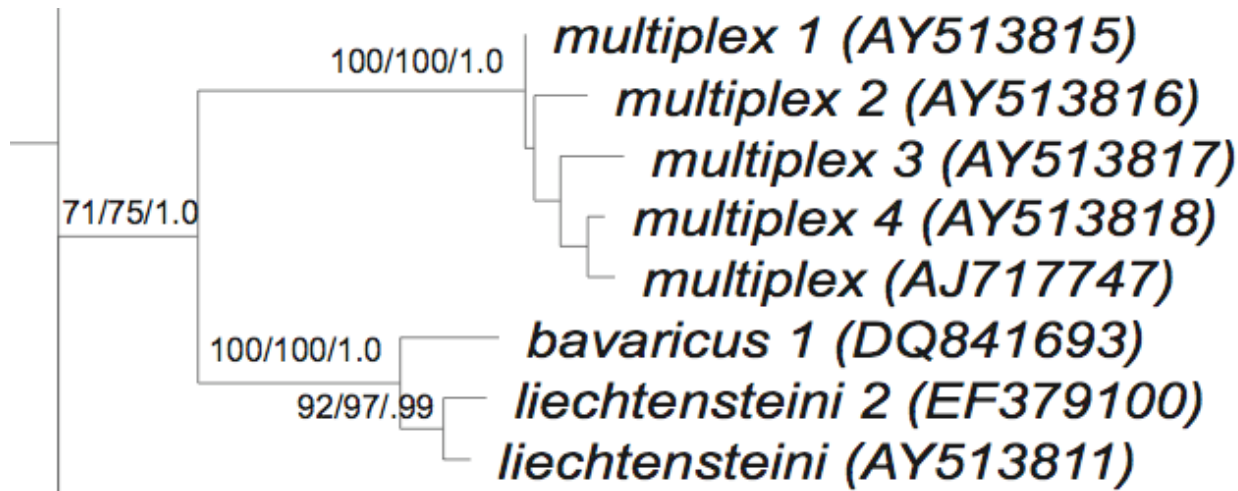
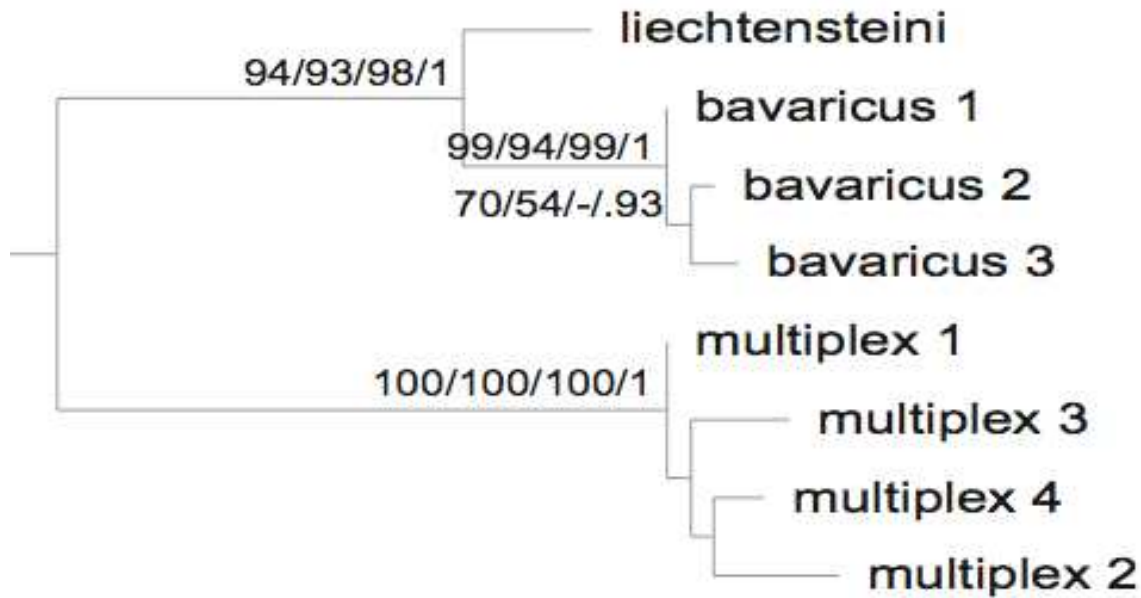


M. liechtensteini

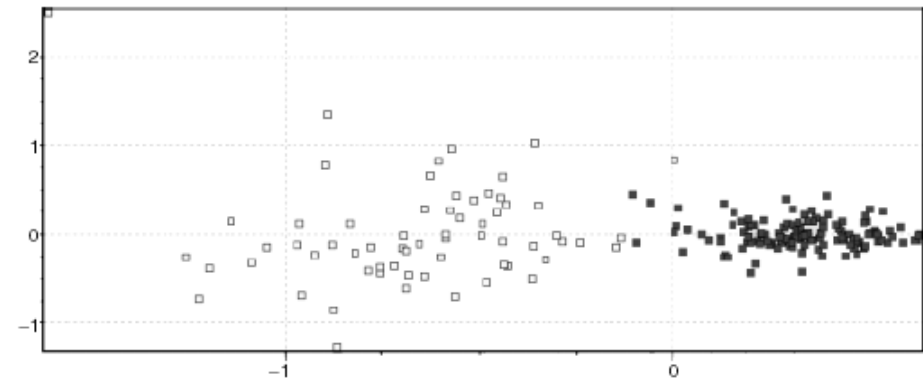
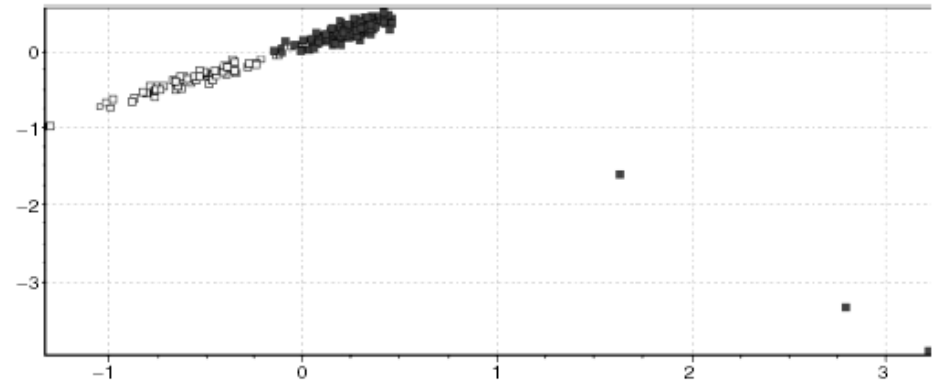
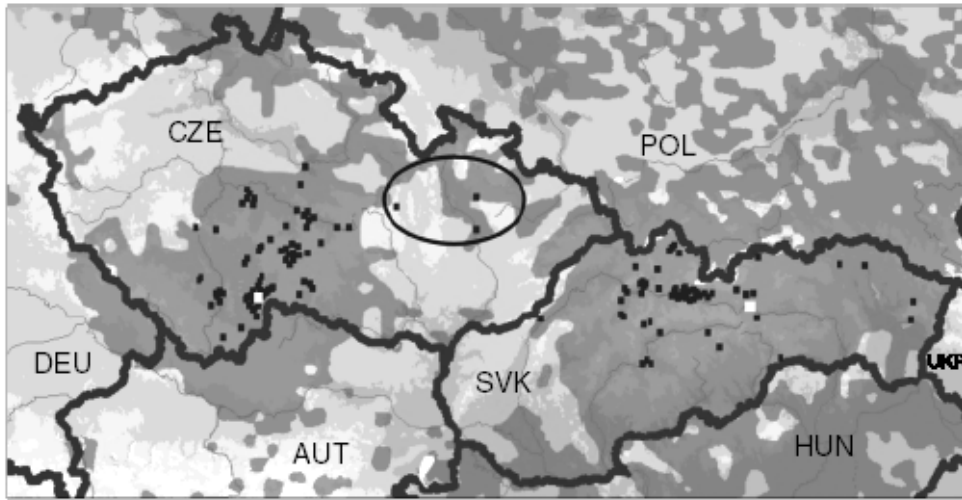


Aktuelle Verbreitung der Illyrischen Kurzhohrmaus *Microtus liechtensteini*

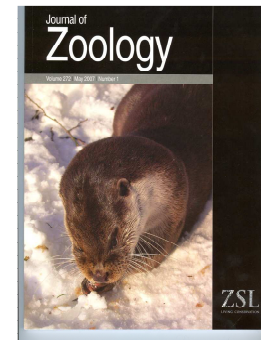
Phylogenetic position of the Bavarian pine vole and its karyotype (2n=46)



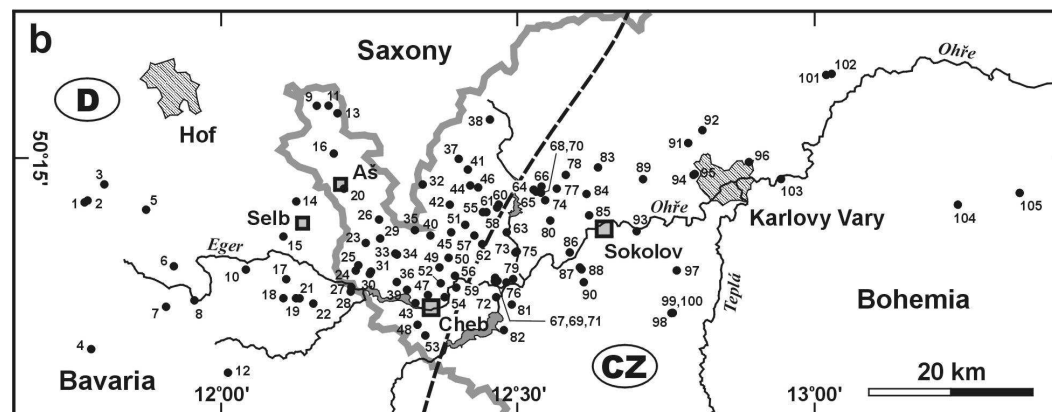
Genetic structure and evidence for recent population decline in Eurasian otter



Hájková et al. 2006, J. Zool.

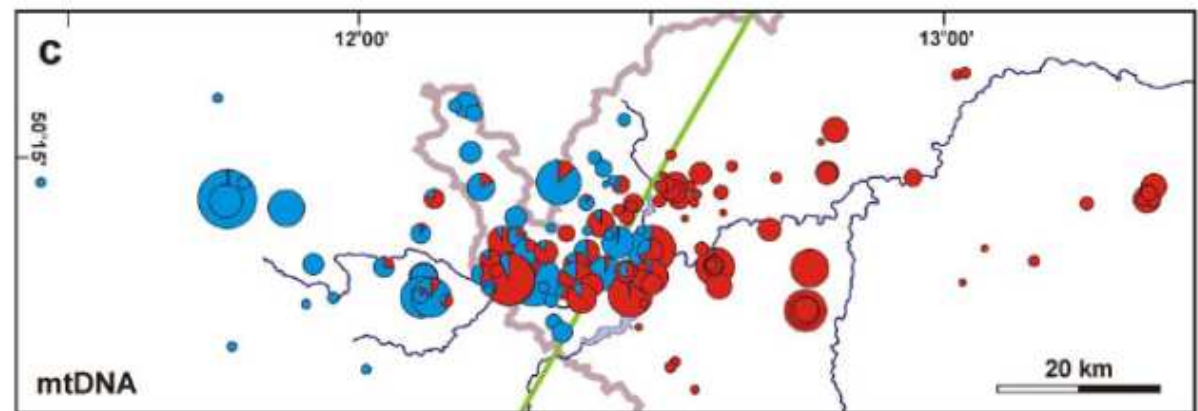
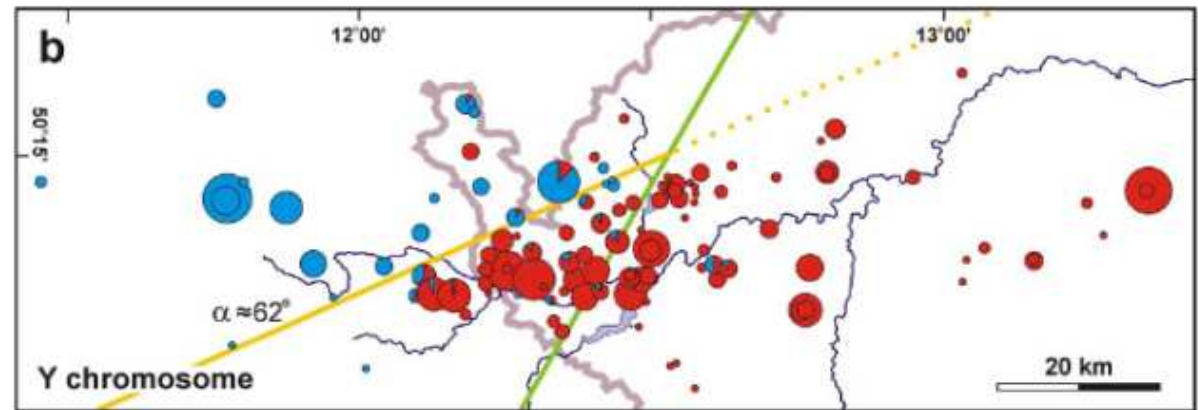
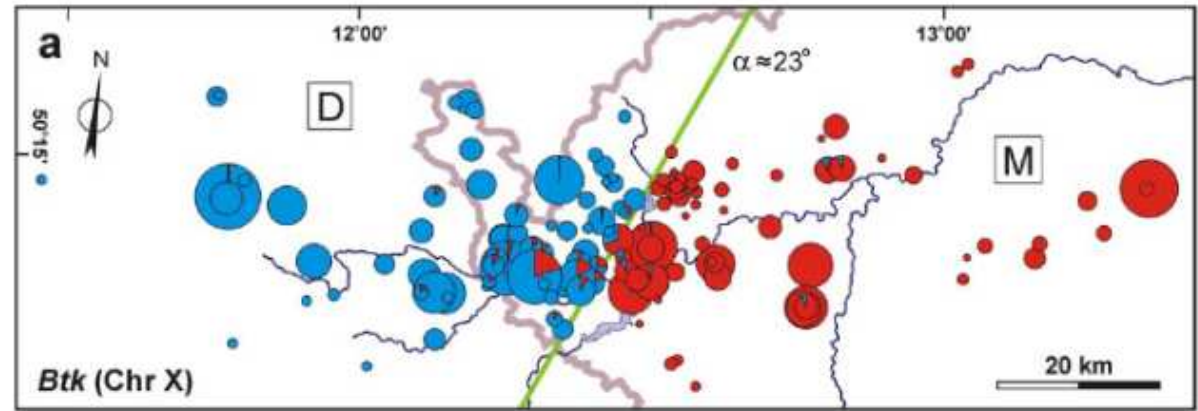


The hybrid zone between *Mus musculus* and *M. domesticus* in Europe



Macholán et al. 2007
Evolution

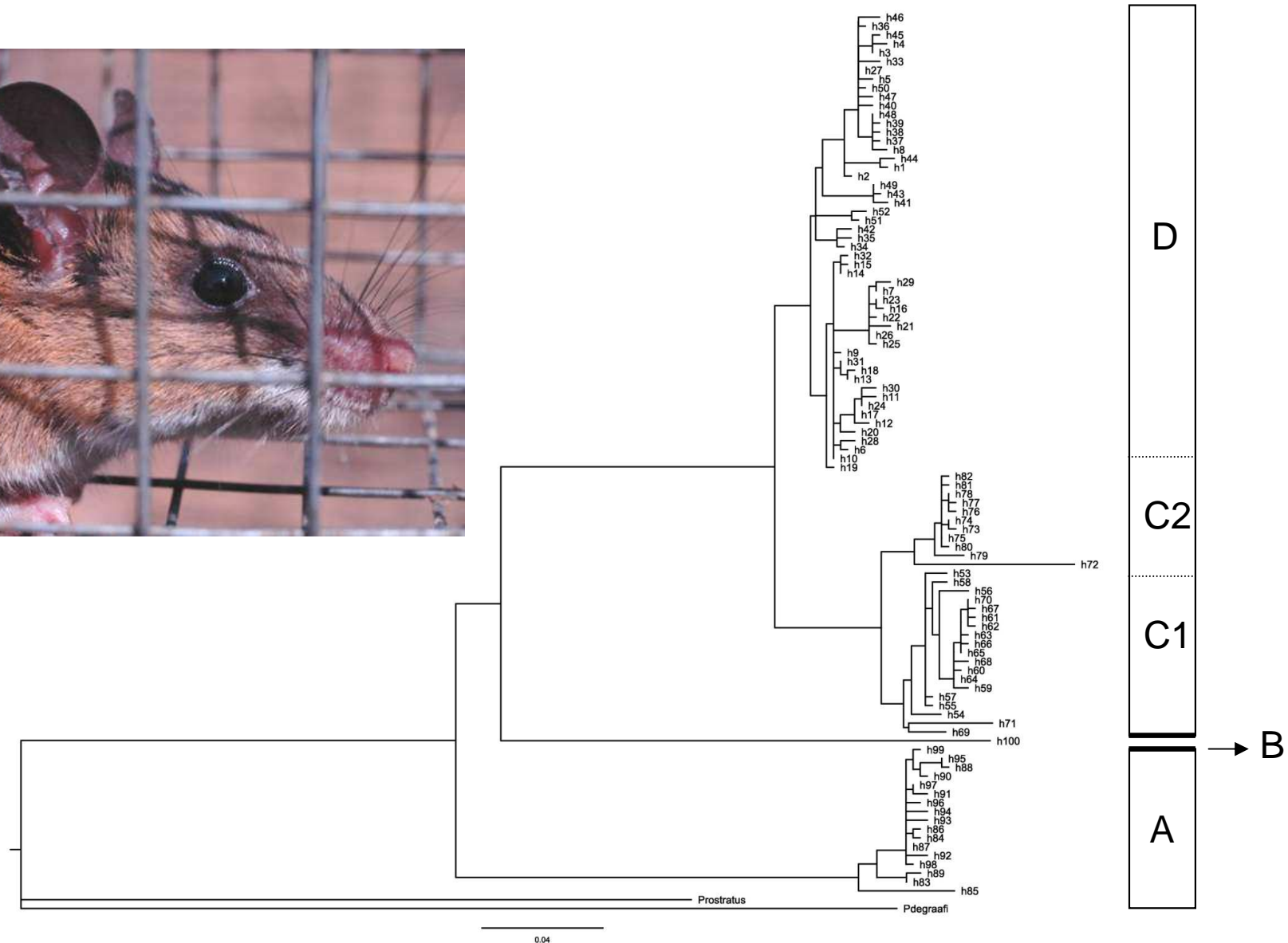
Clines in the hybrid zone and frequency discontinuities for various genetic markers



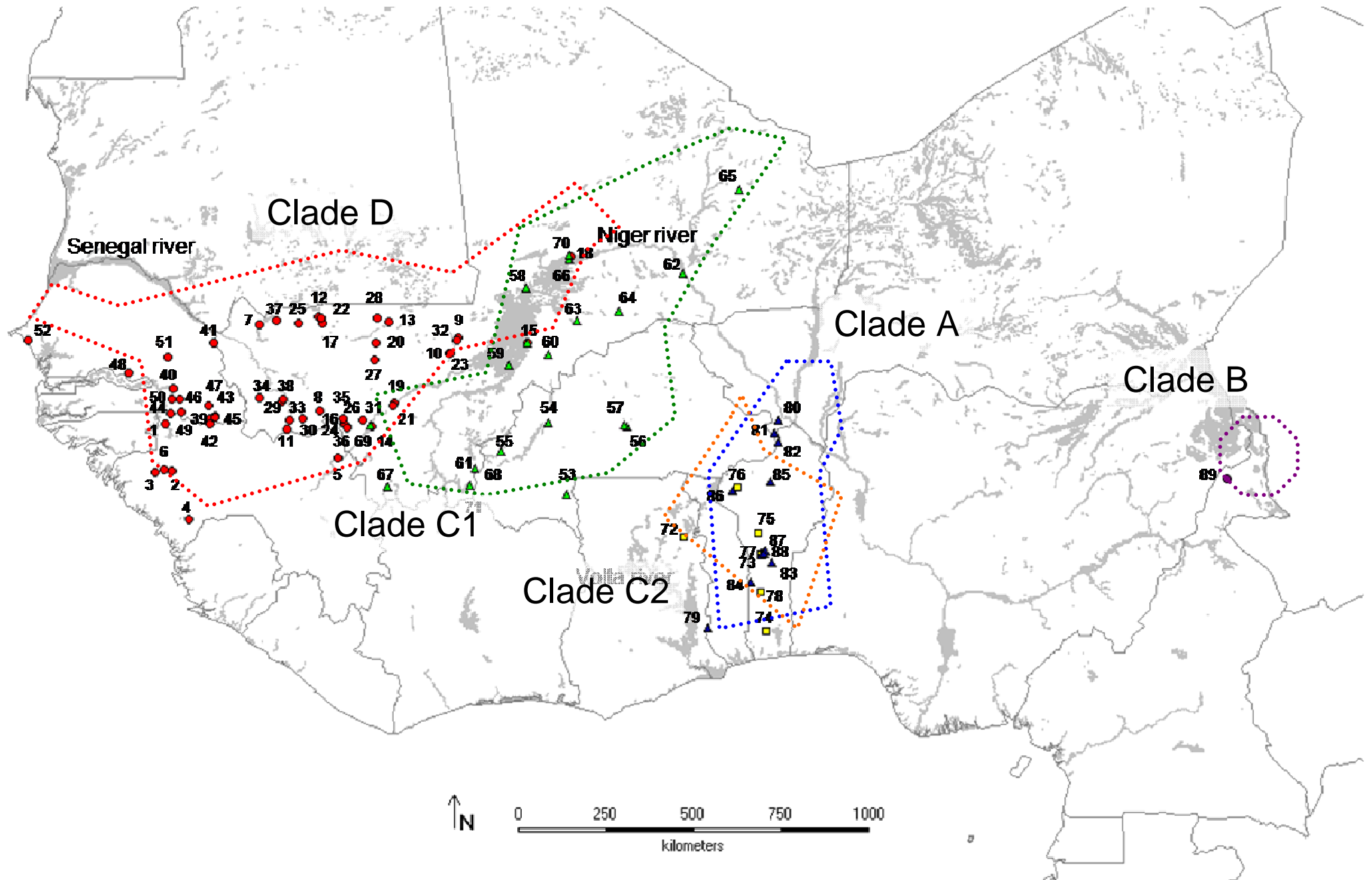
Phylogeographic studies of mammals in tropical regions



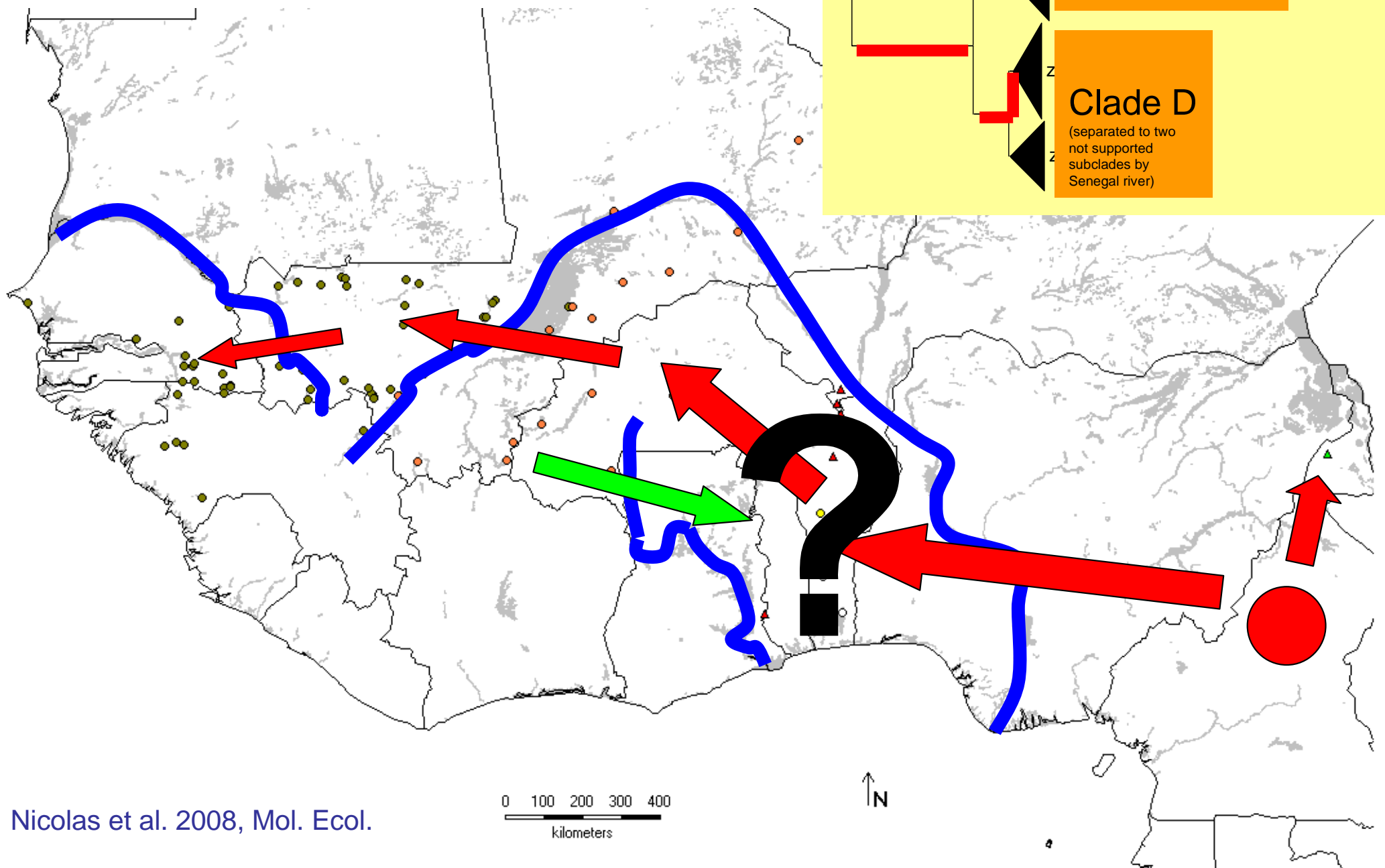
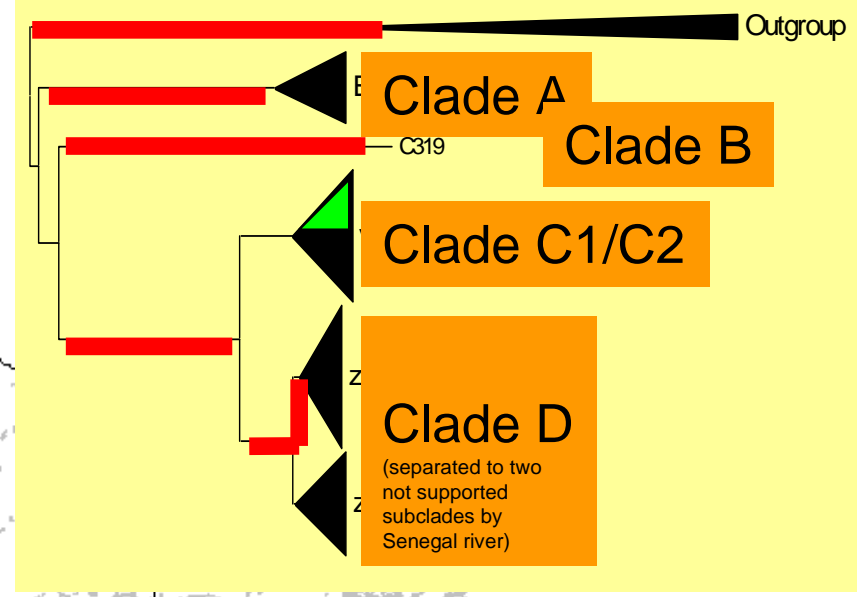
Phylogenetic relationships within populations of a rodent genus *Praomys* in western Africa



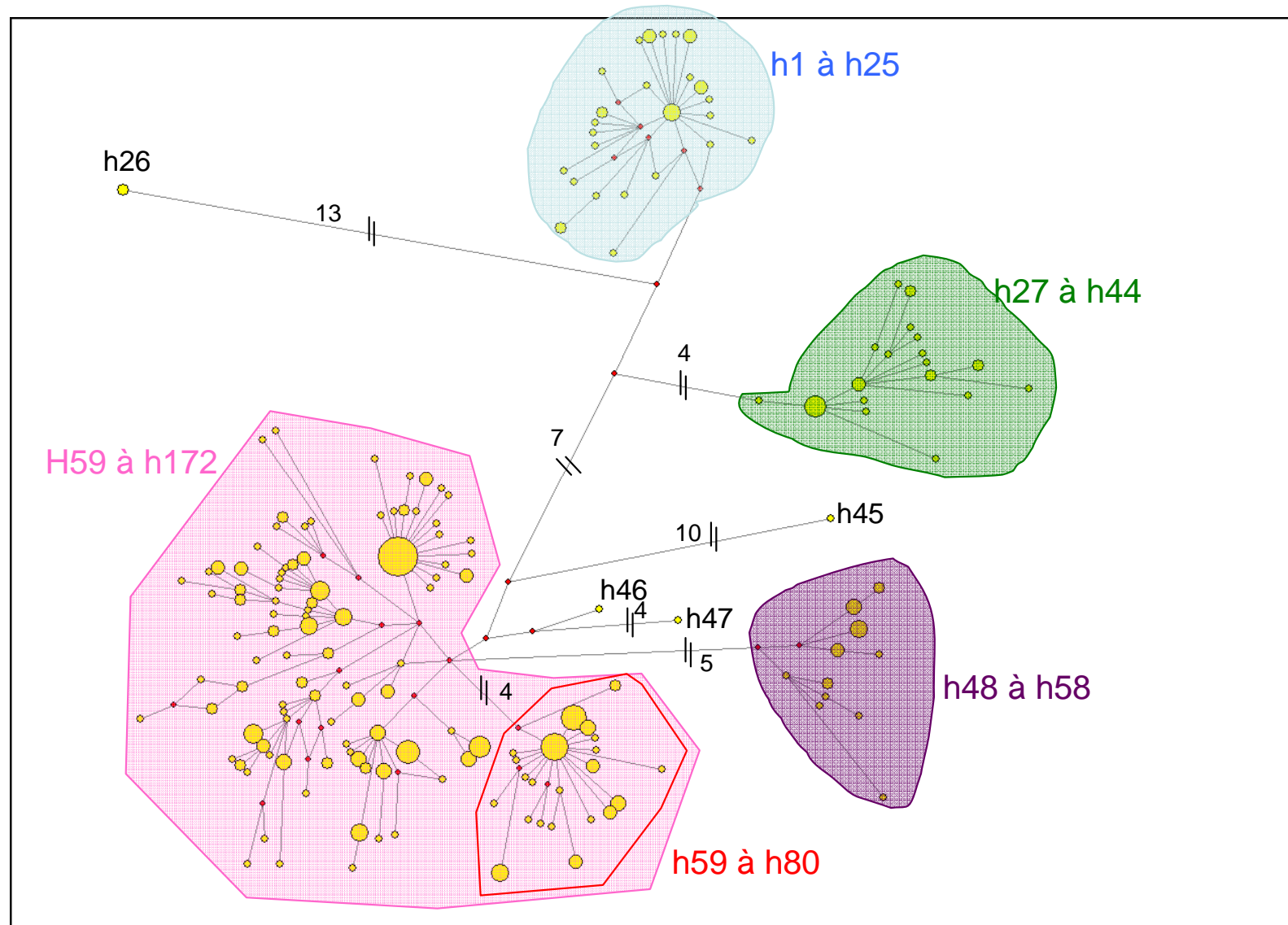
Geographic distribution of the clades



Possible phylogeographic scenario



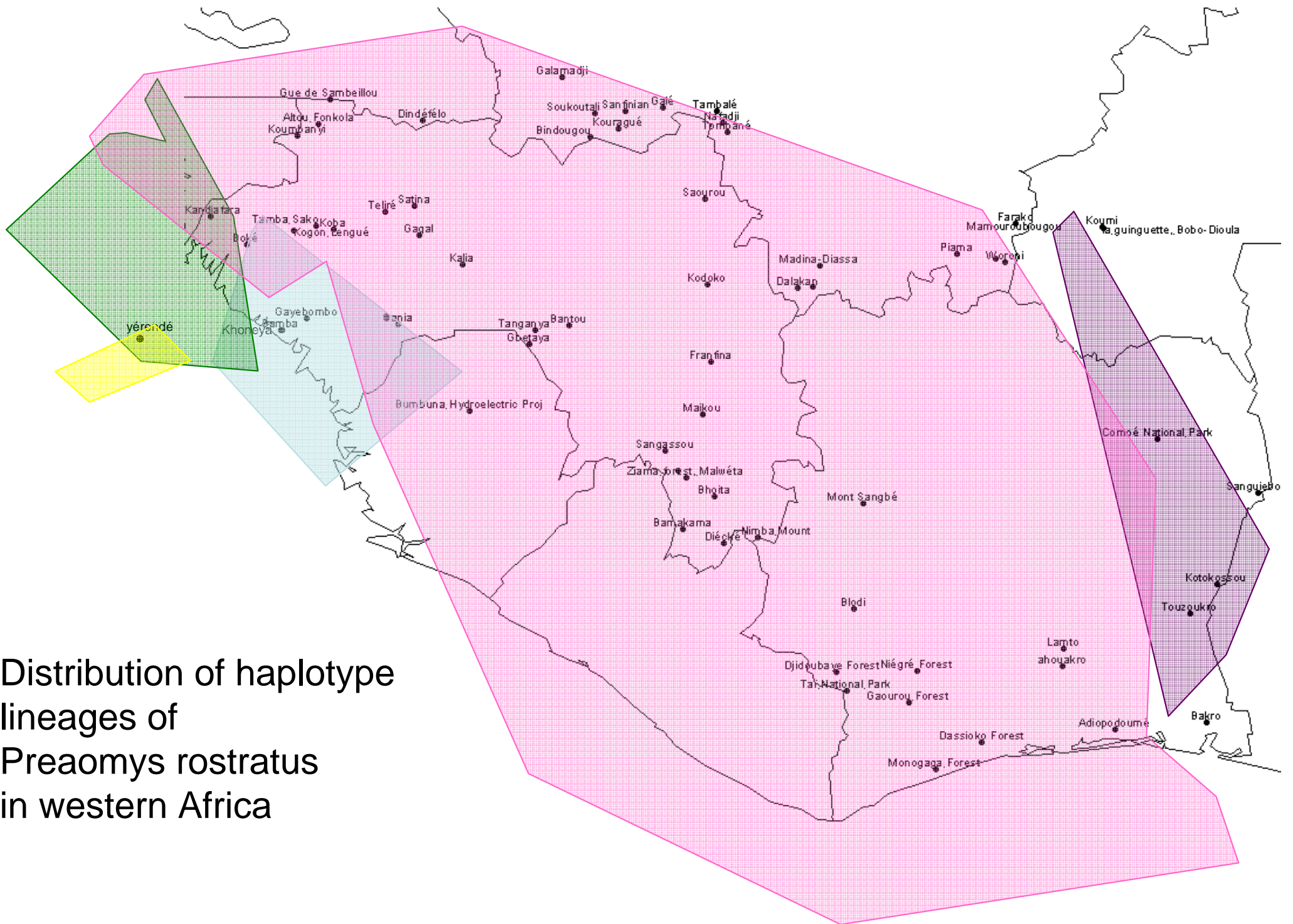
Median Joining Network of haplotypes found in *Praomys rostratus* in western Africa



The length of branches is proportional to the number of mutations

The size of circles is proportional to the number of individuals with respective haplotype

||

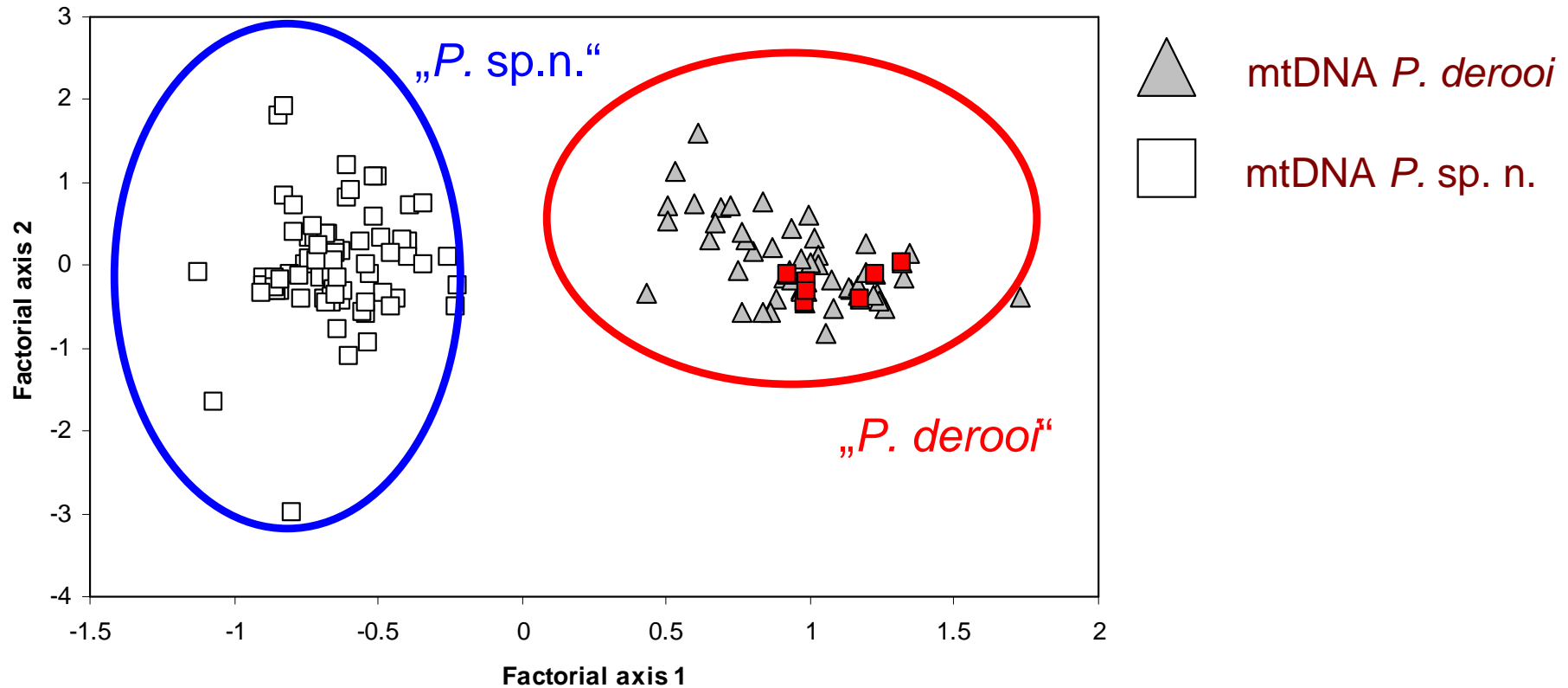


Distribution of haplotype lineages of *Preaomys rostratus* in western Africa

Possible taxonomic changes resulting from combined molecular analyses of mtDNA and microsatellites:

possible discovery of a new species and invalidation of *P. derooi*

weak congruence between both the sets of data



■ mtDNA = *P. sp. n.*, microsatellites (+ phenotype, habitat etc.) = *P. derooi*

Conclusions and Recommendations

- Even in the well-studied groups as mammals, the taxonomy is still in progress and many changes are steadily introduced.
- The current concepts of the species are not always sufficient to recognize reliably the species status. Well-supported phylogenetic lineages should be handled as valid species. Forget the subspecies?
- Support should be given to conservation genetic research.
- Conservation of sites of high scientific interest such as cryptic refugia or hybrid zones should be considered seriously.
- Experience gained in European research should be applied in other regions and training capacities should be provided to local students.
- Conservation legislation should not generate administrative obstacles preventing to perform the research work effectively.

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Miloš Macholán

Adam Konečný

David Bilton

Boris Kryštufek

Anthony Mitchell-Jones

...

and many others