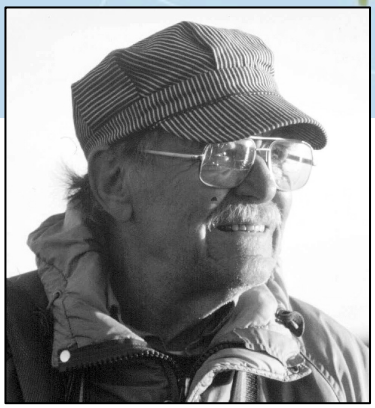
Looking back to look forward:

What Beringia's past may tell us about its future

Understanding history is important

- Past events created and organized diversity
- Beringia has shaped diversity across the Holarctic
- Historical perspectives constrain the realm of probable responses to current and future change

Dual roles for Beringia - land bridge and refugium

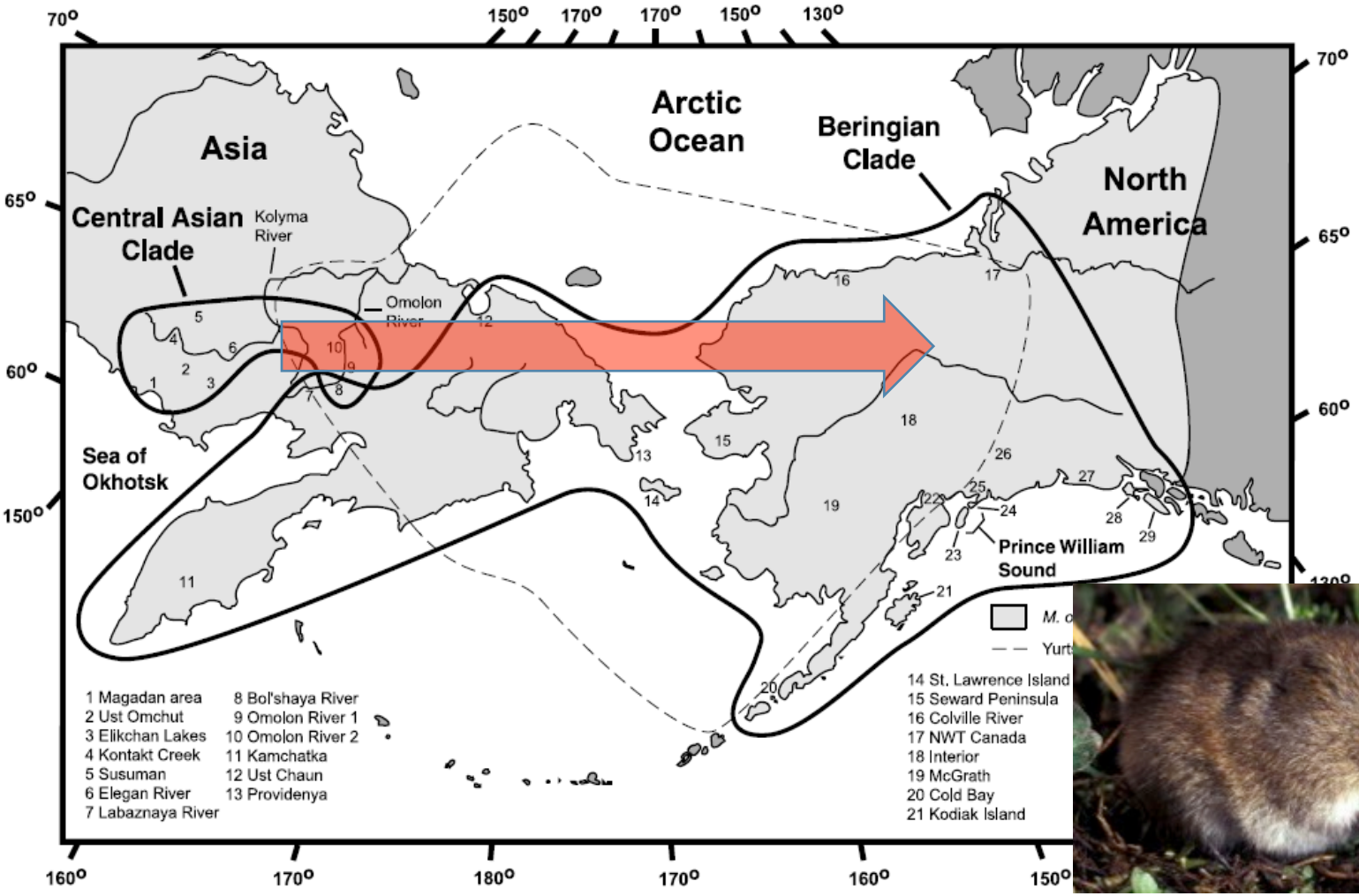


David Hopkins

Robert Hoffmann

Andrei Sher

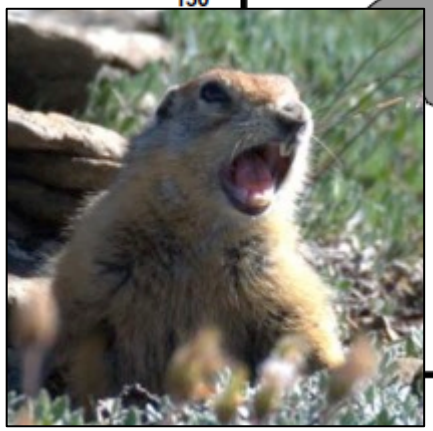
Phylogeographic perspectives confirm major themes of Beringian biogeographic history,...

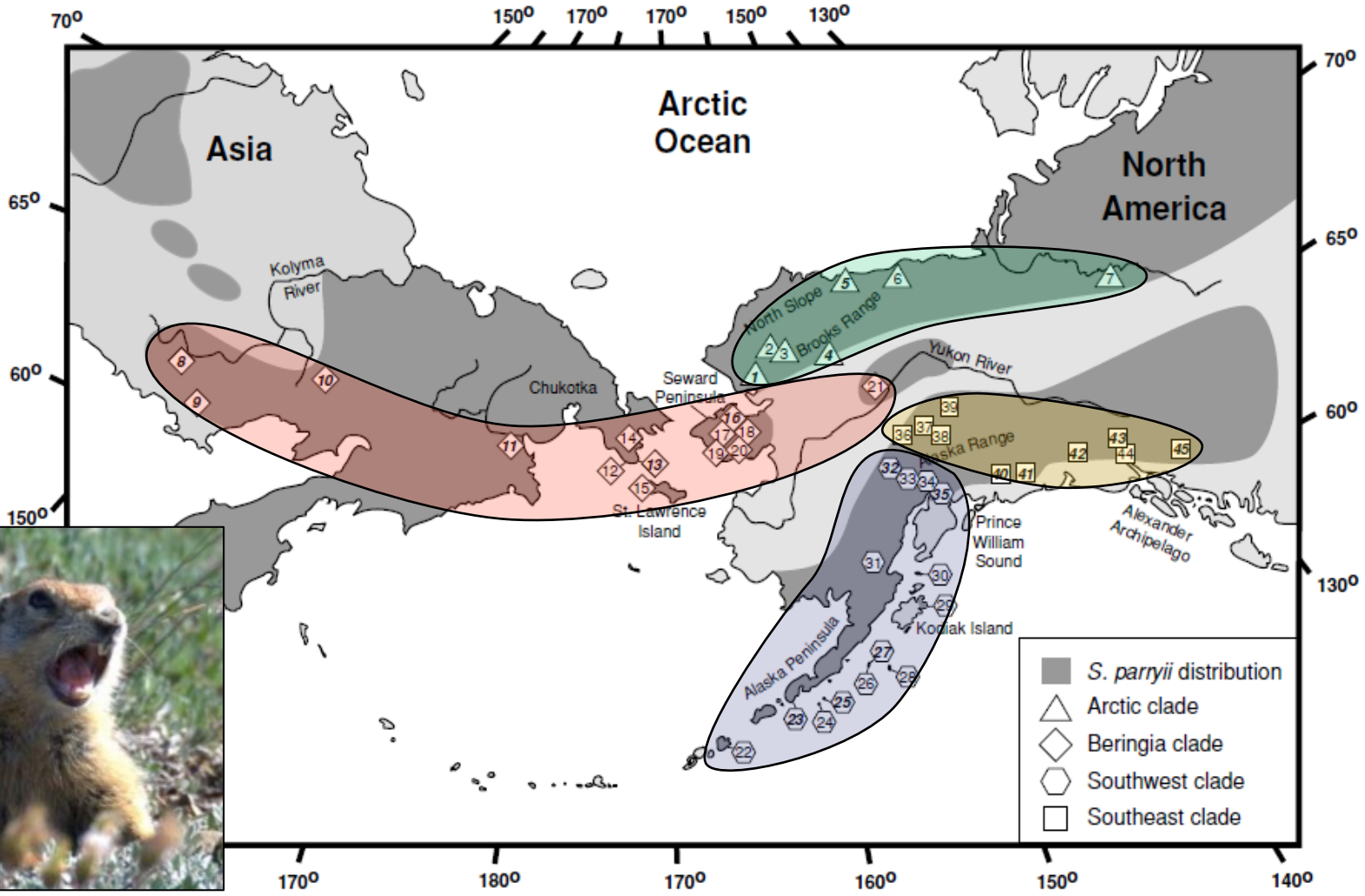


e.g., tundra vole

Galbreath and Cook, 2004
Molecular Ecology

… but also open the door to understanding fine-scale complexity and underlying histories.



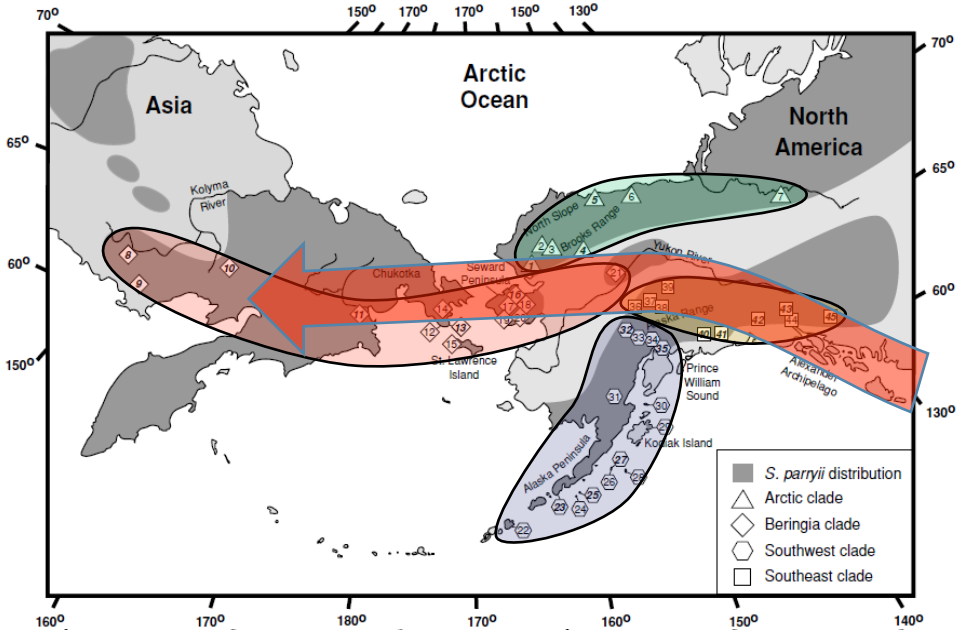


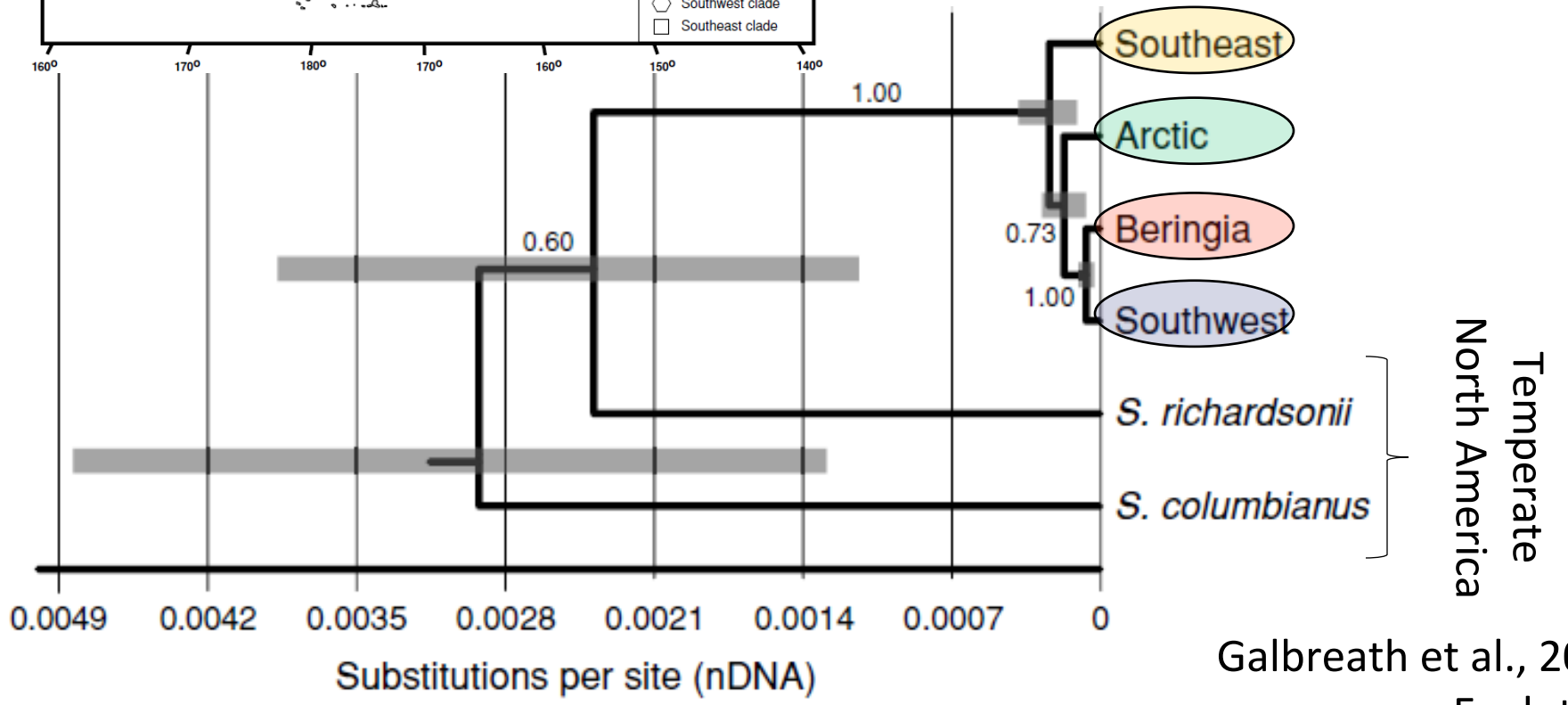
e.g., Arctic ground squirrel

Galbreath et al., 2011
Evolution

Phylogeographic perspectives reveal:

Direction and timing of geographic range shifts

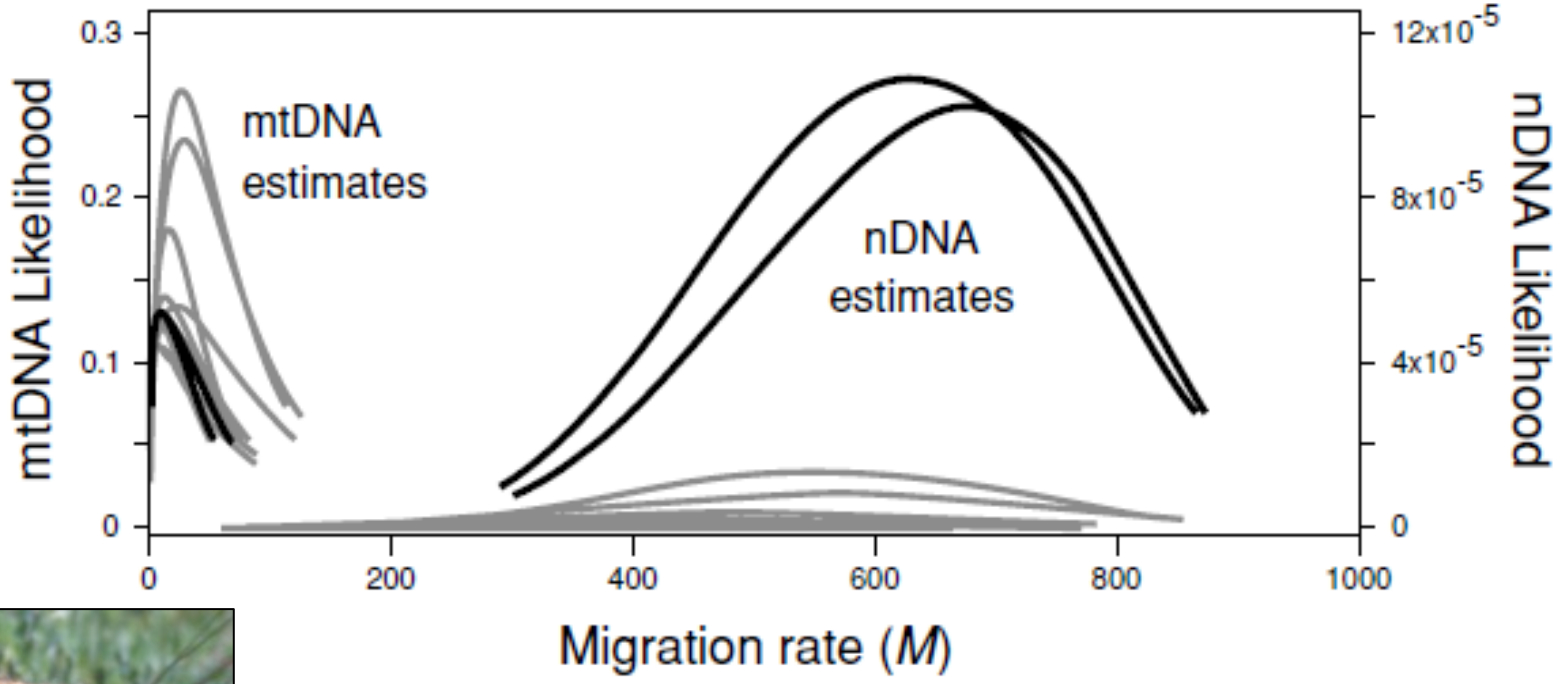




Galbreath et al., 2011 Evolution

Phylogeographic perspectives reveal:

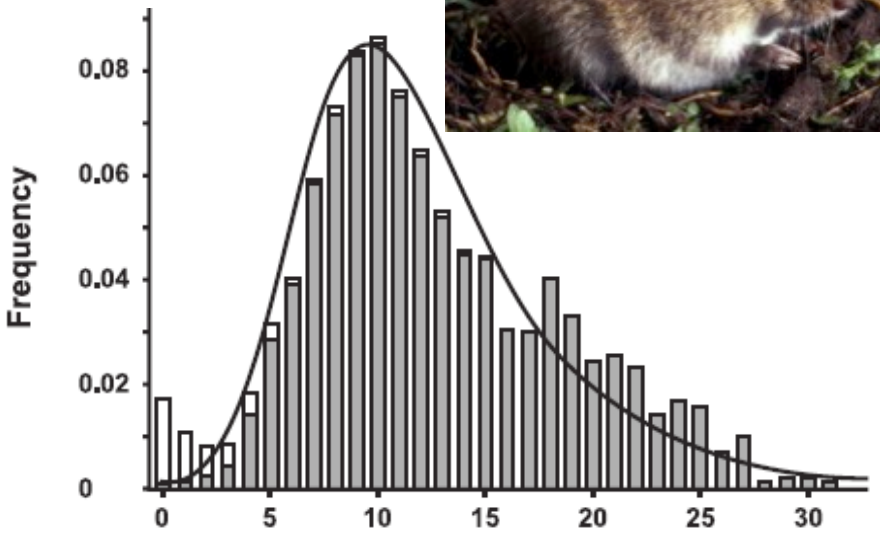
Population dynamics – e.g., male-biased dispersal



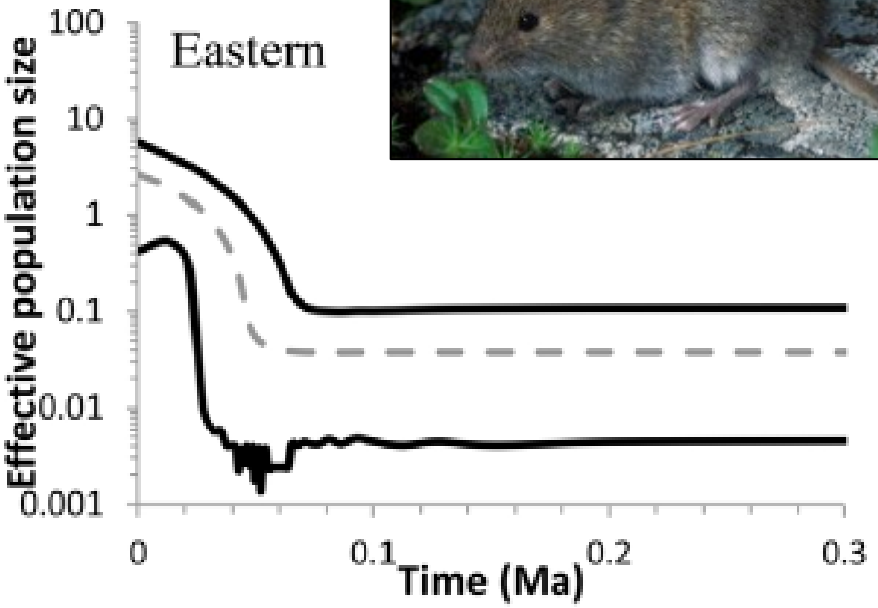
In arctic ground squirrels, maternally inherited mitochondrial DNA reveals different patterns of gene flow relative to nuclear DNA (Galbreath et al. 2011)

Phylogeographic perspectives reveal:

Population dynamics – e.g., changing population size



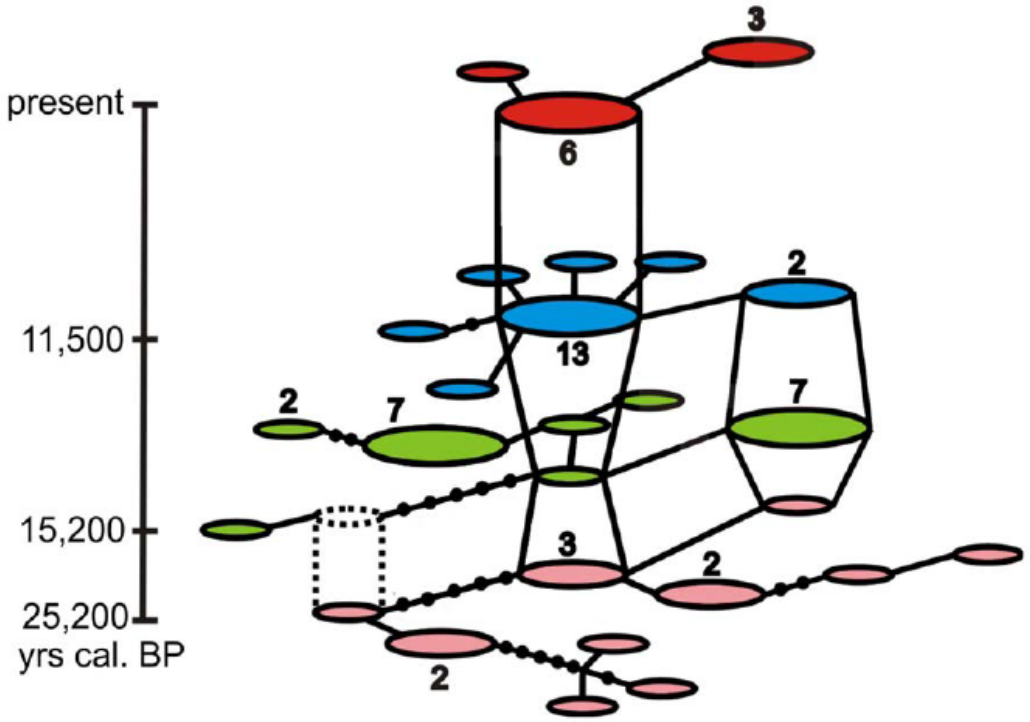
e.g., tundra vole
Galbreath and Cook, 2004
Molecular Ecology



e.g., northern red-backed vole
Kohli et al., 2014
Journal of Biogeography

Phylogeographic perspectives reveal:

Genetic consequences of demography and dispersal



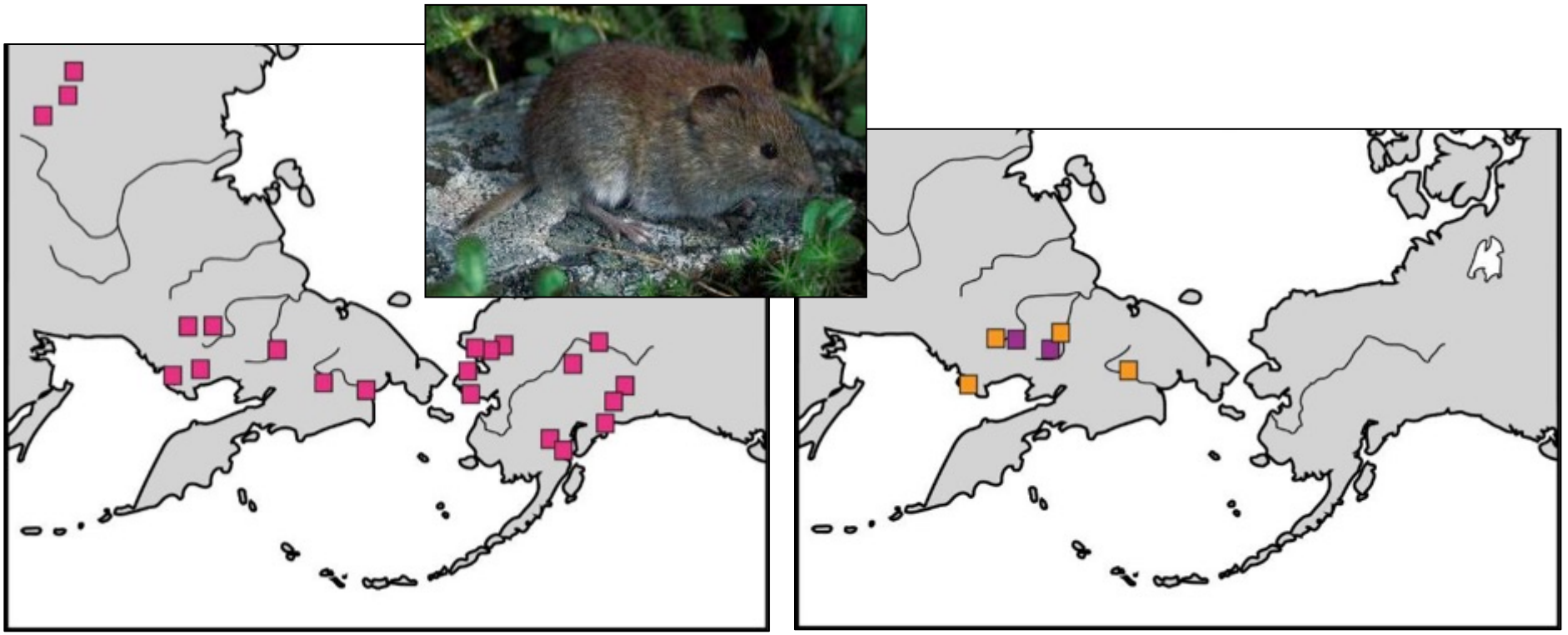
e.g., collared lemming
Prost et al., 2010
PLOS One

Declining diversity through time associated with climate warming; uses for ancient DNA from fossils

Phylogeographic perspectives reveal:

Interspecific interactions and community assembly

- parasites may “miss-the-boat” or track colonizing hosts
  e.g., *Arostrilepis* tapeworms of northern rodents

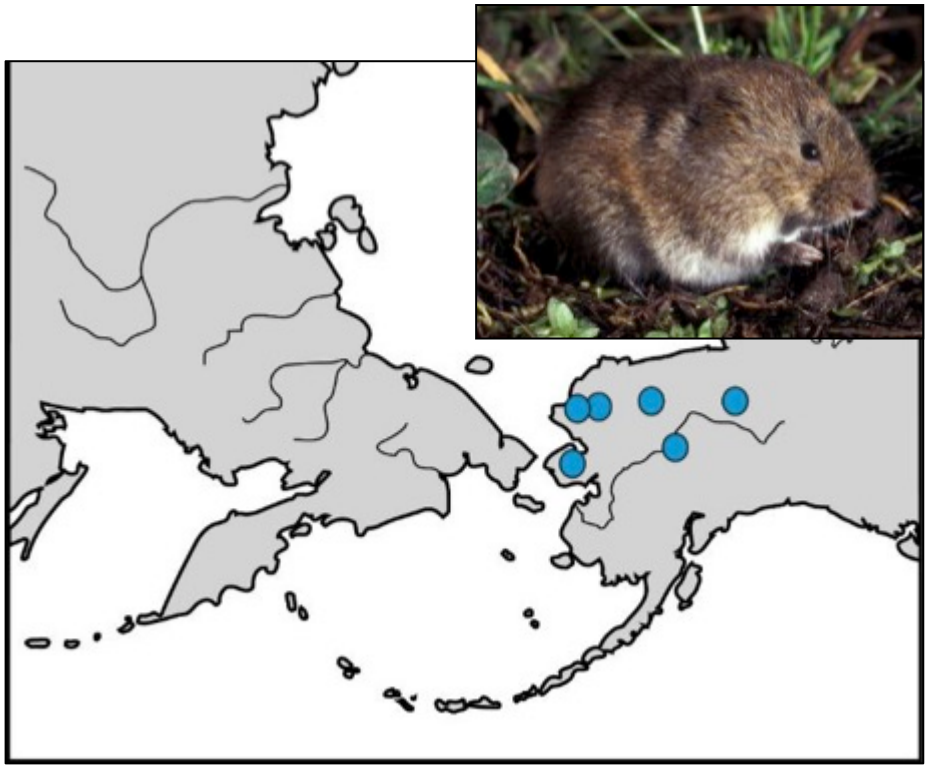


Arostrilepis species of red-backed voles

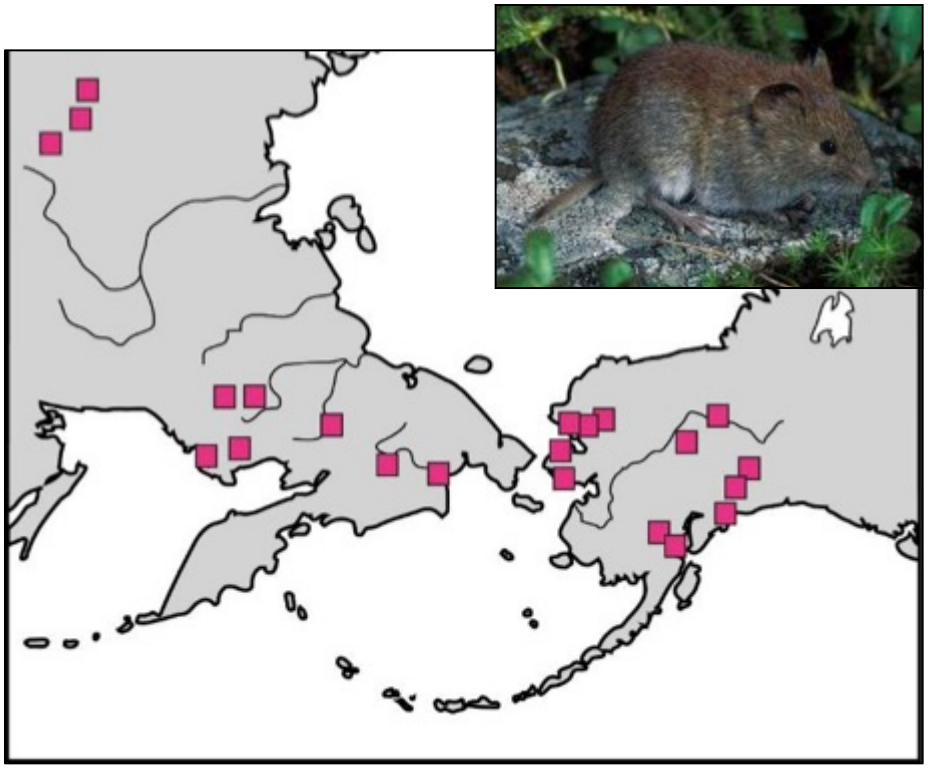
Phylogeographic perspectives reveal:

Interspecific interactions and community assembly

- host-switches may occur in response to novel host-parasite interactions



Introduction of a new host results in switch by local



Introduction of a new parasite results in switch to local hosts

Comparative studies of Beringian species...

- reveal the diversity landscape
  - e.g., suture zones vs. species-specific structure
- categorize general species responses and ecologically dynamic geographic areas
  - e.g., range retraction vs. expansion
- predict potential for and consequences of interspecific interactions
  - e.g., shifting distributions lead to reassembly of communities

How do we develop the historical perspective?

"a compelling assignment for the field of comparative phylogeography will be to **map the spatial and temporal dimensions of Earth's remaining genealogical capital on all of the world's continents and oceans**"

- John Avise (2008; PNAS)

Comprehensive population-level sampling of diversity

- integrated field surveys - collaboration
- archives – vouchers, tissues, digital databases

Multi-taxon, multi-locus phylogeographic investigations

- next generation genomic tools

Beringian Coevolution Project

A model for integrated survey and historical discovery

Archives establish the specimen-base for diverse forward-looking investigations