Collections data as an historical experiment

Jenny L. McGuire

mcguire.gatech.edu

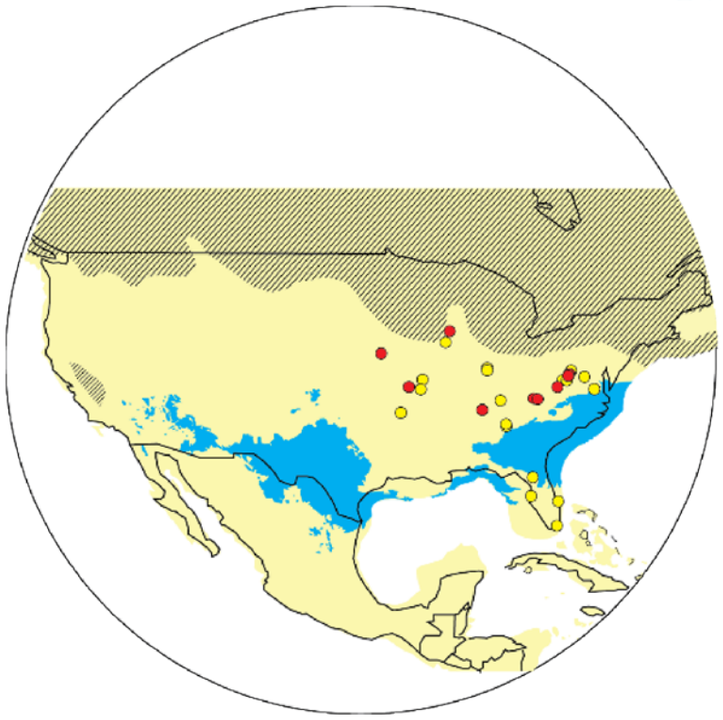
Spatial Ecology & Paleontology Lab (SEPL)

Georgia Tech Earth and Atmospheric Sciences

Georgia Tech School of Biological Sciences

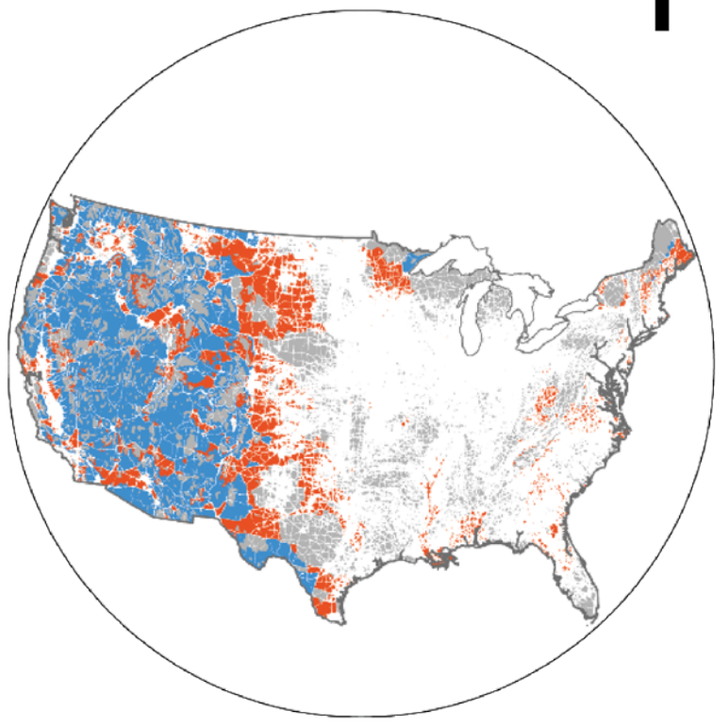
Performing historical experiments

Conservation Paleontology



Insights/perspectives

Hypotheses/approaches



Quaternary Paleoecology

Spatial Ecology/
Conservation Biology

Museum data are critical to my research at many levels

Collections Database
MUSEUM OF VERTEBRATE ZOOLOGY

Search | Portals | My Stuff | About/Help

[Show/Hide Search Terms]

Found 7658 specimens. Tools: Map, Customize, or Download

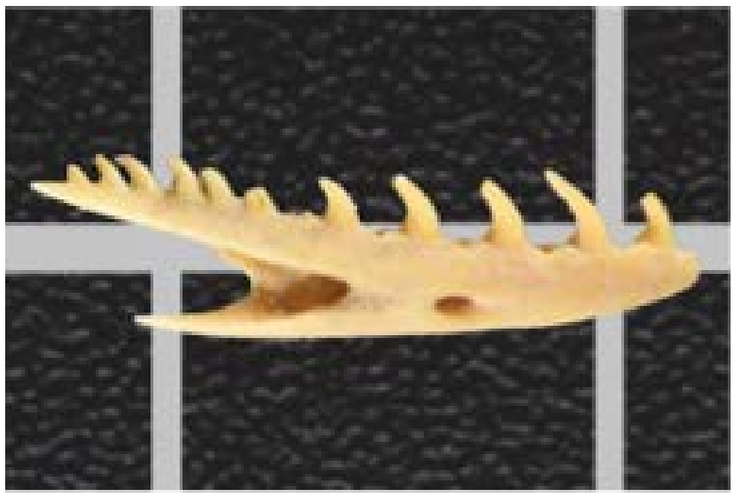
Specimen Results

GUID	Identified As	country	state/province	specific locality	verbatim date
MVZ:Mamm:100030	Microtus californicus californicus	United States	California	Arroyo Mocho, 7 mi SE Livermore	14 Mar 1943
MVZ:Mamm:100959	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	27 May 1943
MVZ:Mamm:100960	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	27 May 1943
MVZ:Mamm:100961	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	28 May 1943
MVZ:Mamm:100962	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	28 May 1943
MVZ:Mamm:100963	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	28 May 1943
MVZ:Mamm:100964	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	29 May 1943
MVZ:Mamm:100965	Microtus californicus californicus	United States	California	mouth of El Toro Canyon	29 May 1943

Specimen-based research

Natural Trap Cave, WY (150,000-modern)

Microfauna: >16,000 specimens



Fossil identifications

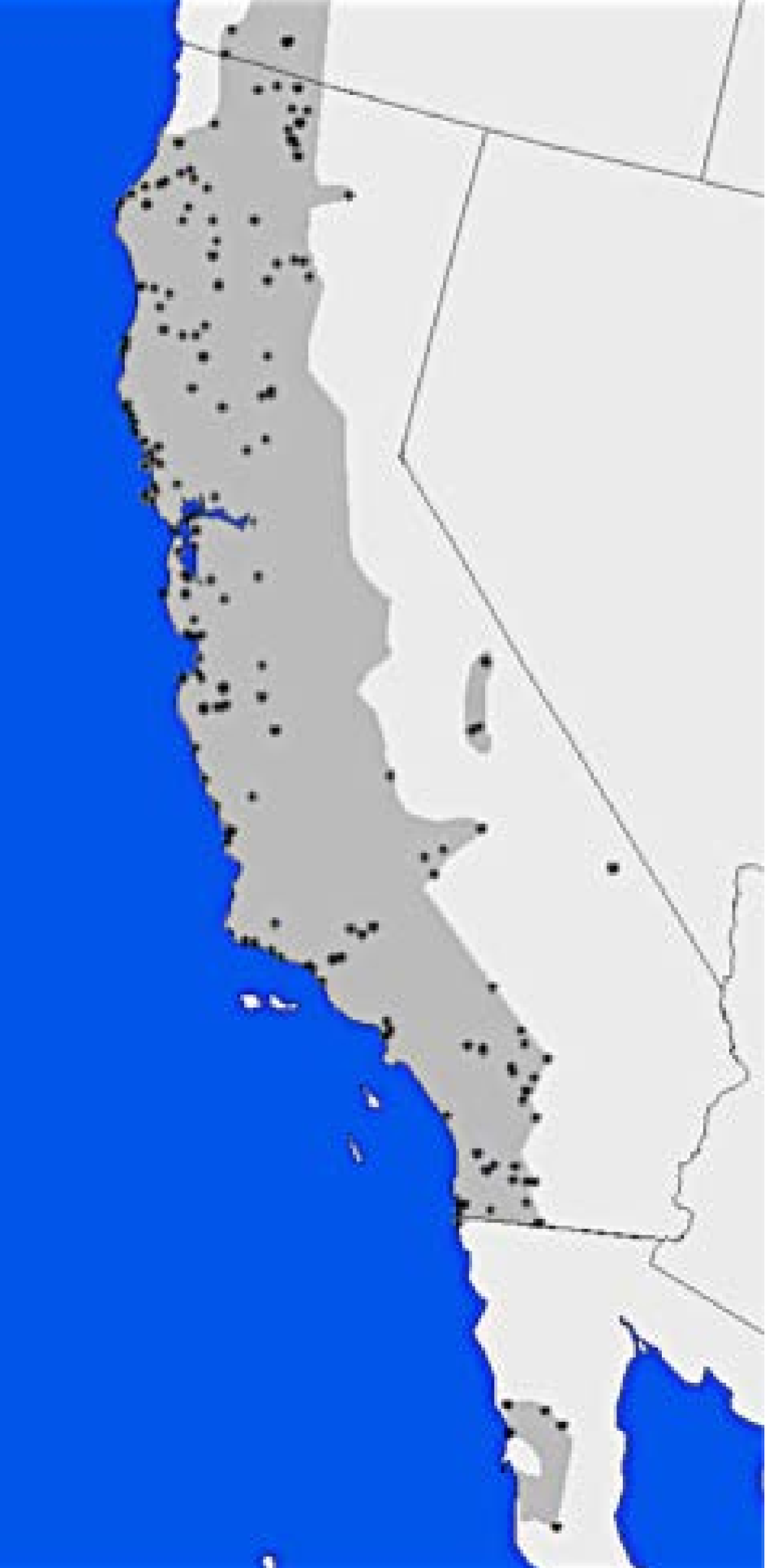
exemplar specimens

- Taxonomic
  - species
  - subspecies
  - full populations to account for intraspecific variation
- Element
  - dental
  - cranial
  - postcranium
  - CT-scan

Natural Trap Cave, WY (150,000-modern)

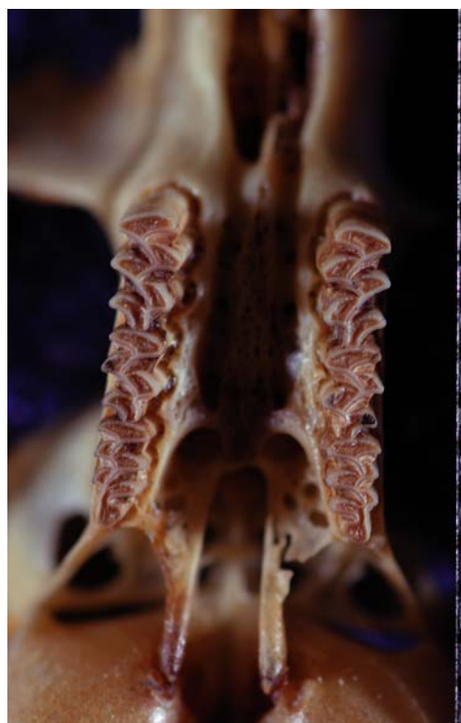
How do communities recover following top-down extinctions?

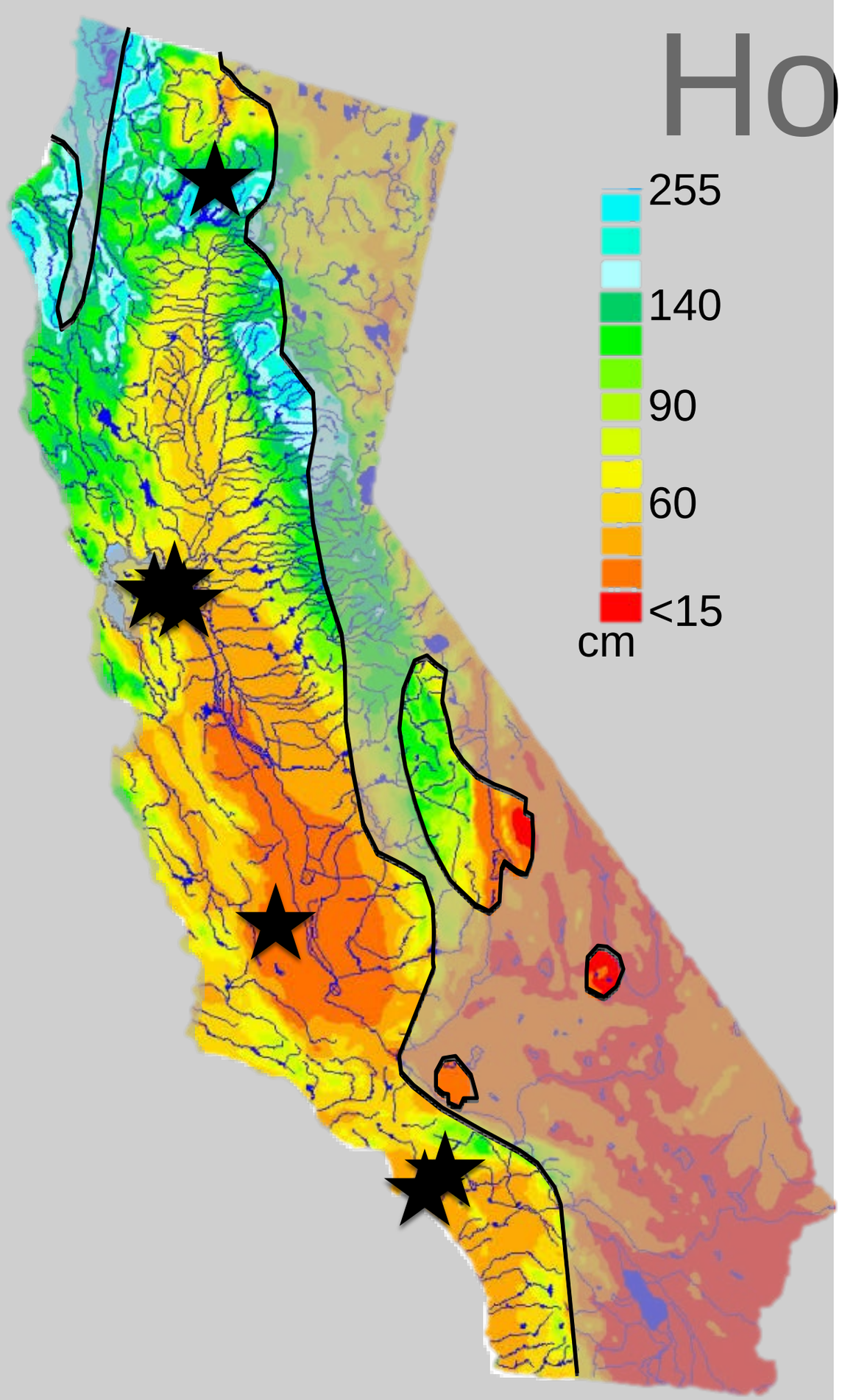
Do generalist or specialist species fill newly opened niches ?



How does climate pattern morphological variation?

Microtus californicus
California vole

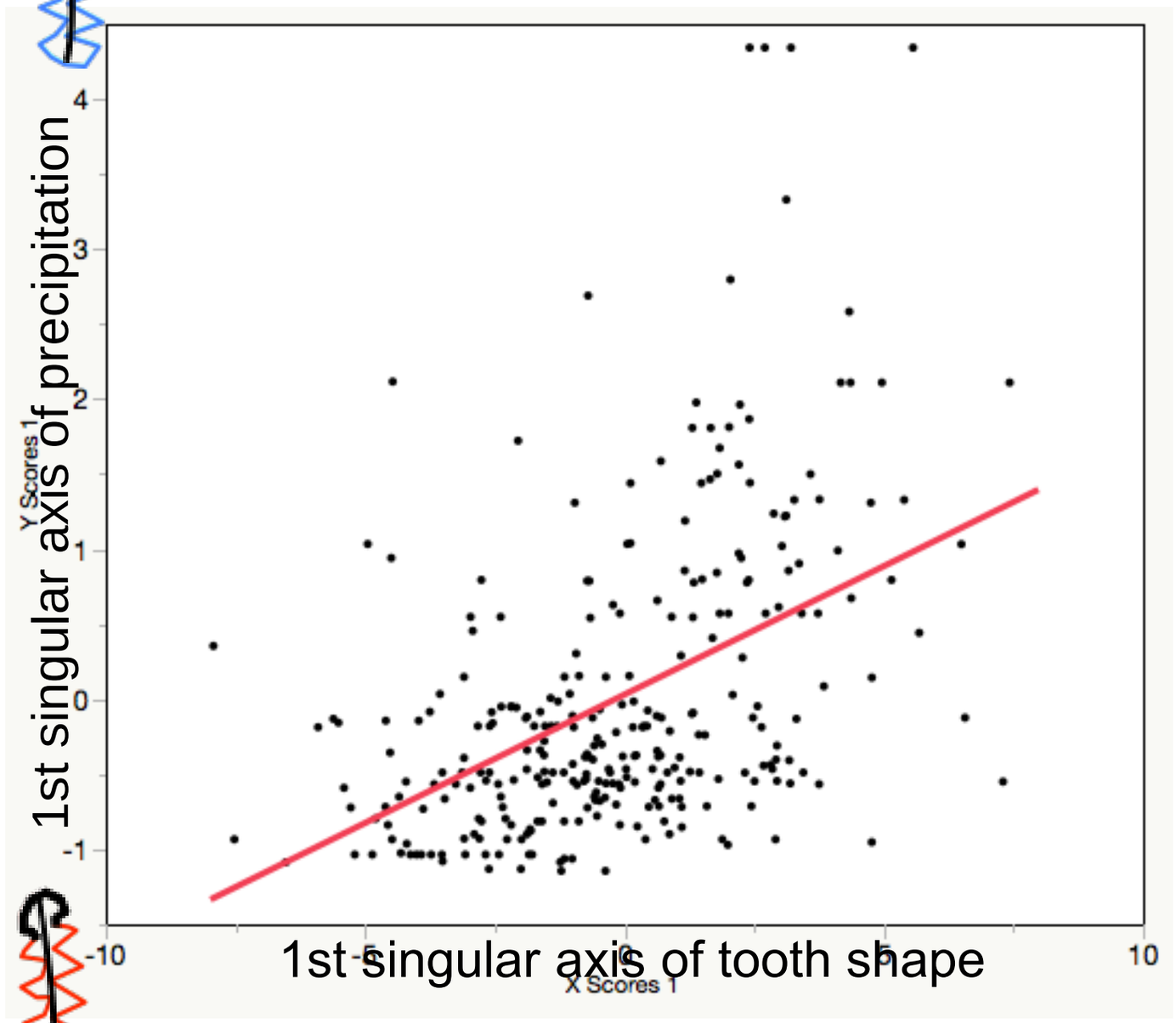


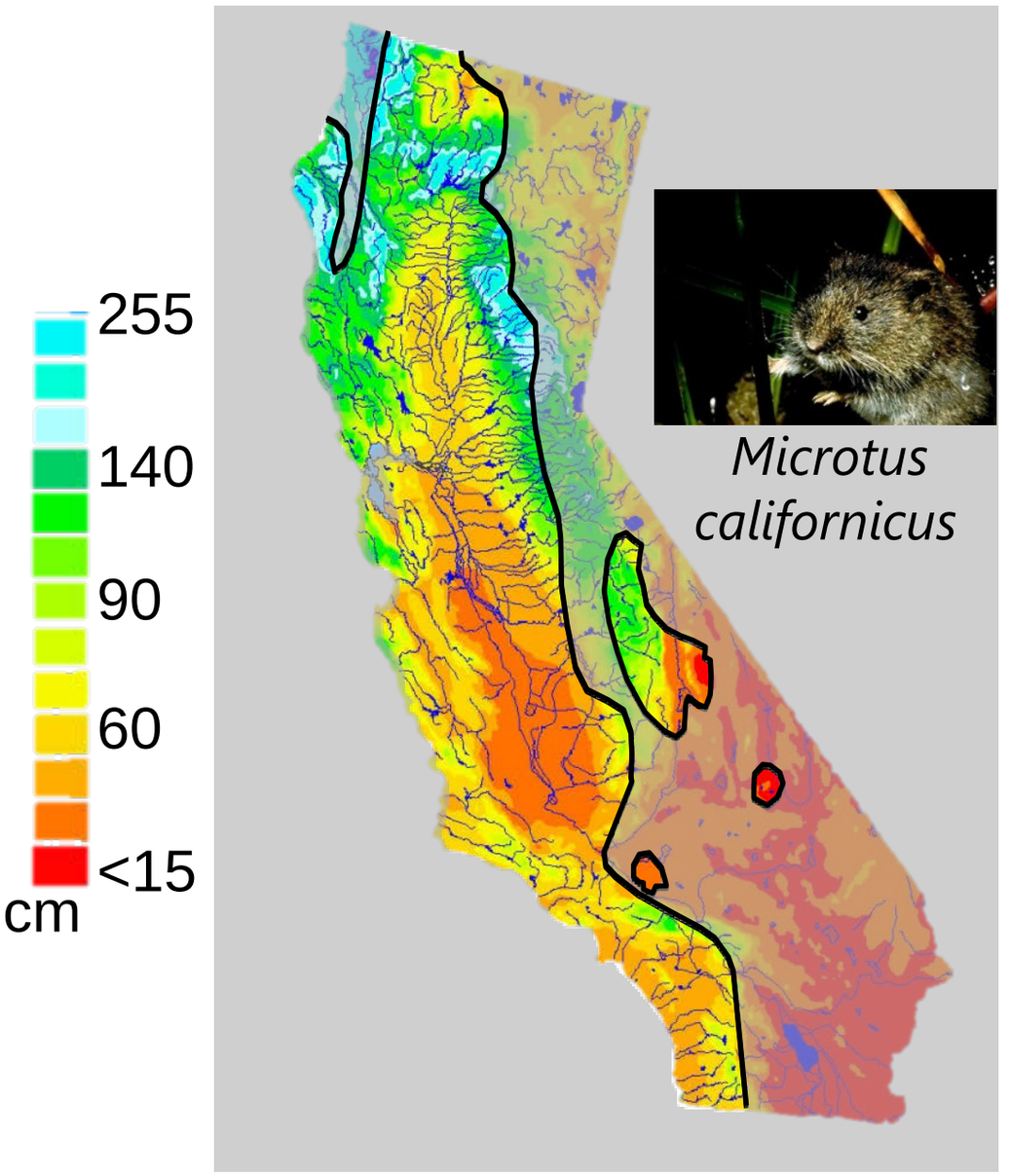


How does climate pattern morphological variation?

Microtus californicus
California vole

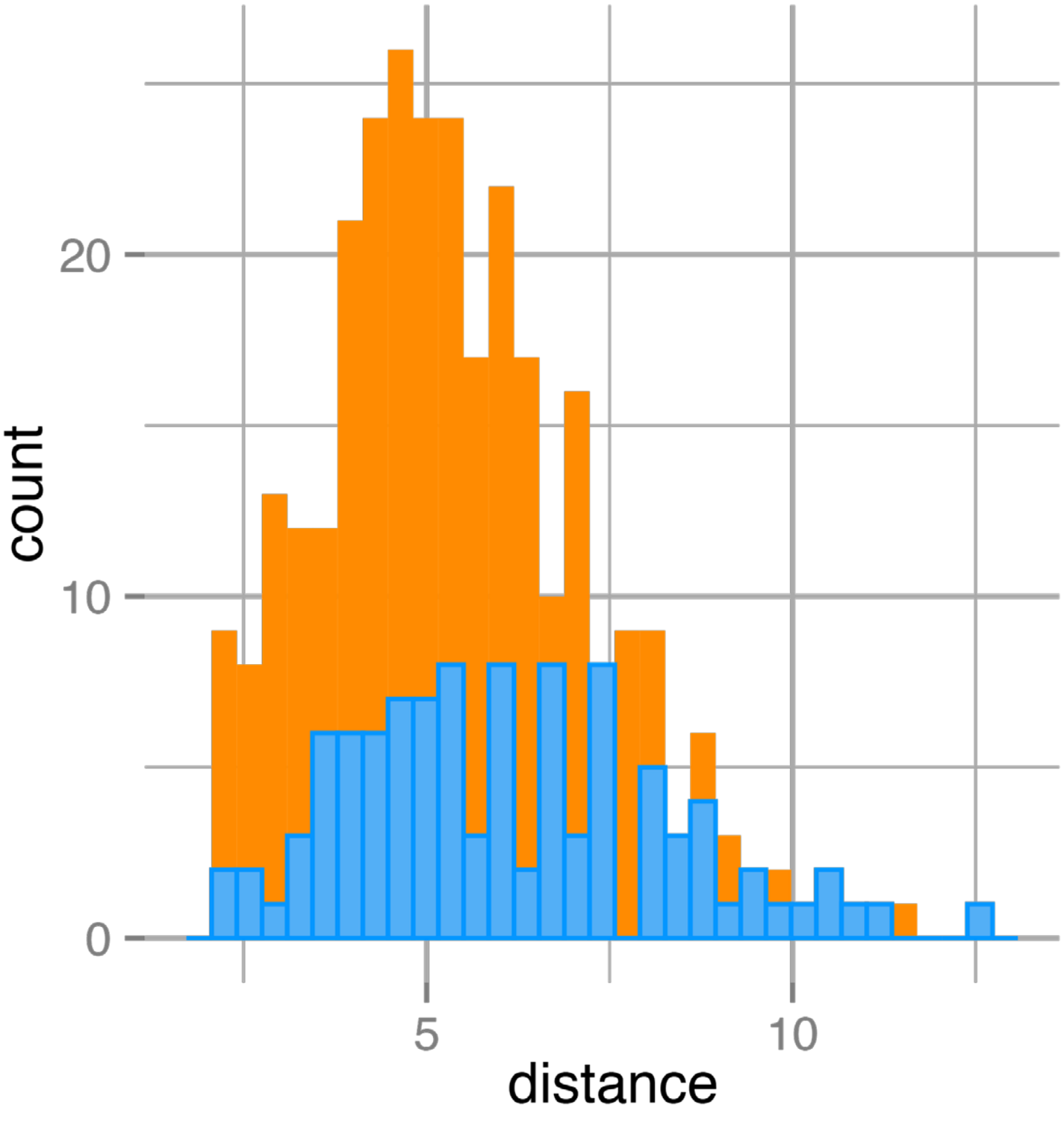
Microtus californicus tooth shape covaries with mean annual precipitation





6 singular axes (46% of shape variation) predict 42% of variation in mean annual precipitation

What happens to this climate-linked morphospace through time?



modern climate-linked morphospace has a **21% lower standard deviation** when compared to fossils

p=0.003

Less precipitation today than in the past

p=0.01

Challenges encountered

habitat data & field notes

M. Hildebrand
1948

8 mi. N, 13 mi. W Canby, 4700 ft., Modoc Co., Calif.

May 20

1655	♂	Neotoma cinerea	453-191-47-33	540 gm
1656	♂	Citellus beldingi	291-75-45-12	296 gm
1657	♀	Erethizon epixanthum	688-175-95-35	12½ lbs
1658	♂	Oberholseria chlorura	testes 8 mm	27.0 gm
1659	♂	Carpodacus cassini	" 7 mm	24.6 gm
1660	♀	Empidonax		10.3 gm
1661	♂	Spizella passerina	testes 7 mm	11.0 gm.

May 21

1662	♀	Eutamias amoenus	201-85-32-17	53.3 gm
1663	♀	Neotoma cinerea	337-(123)-45-34	365.8 gm
1664	♀	Eutamias amoenus	206-88-32-16	52.9 gm
1665	♂	Cyanocitta stelleri	testes 10 mm	117.9 gm
1666	♂	Certhia familiaris	" 7 mm	9.2 gm
1667	♂	Dendroica auduboni	" "	11.4 gm.
1668	♀	Penthestes gambeli	largest ovum 11 mm	12.9 gm
1669	♀	Eutamias amoenus	no emb., 211-95-33-17 (back broken)	51.7 gm
1670	♀	" "	no emb., 212-86-34-17	57.1 gm (1.9 gm put in log)
1671	♀	Citellus lateralis	6 emb. x 7 mm, 244-79-39-17	186.3 gm
1672	♀	" "	no emb., 242-85-40-16	133.4 gm
1673	♀	" "	6 emb. x 4 mm 251-84-38-17	162.6 gm

May 22

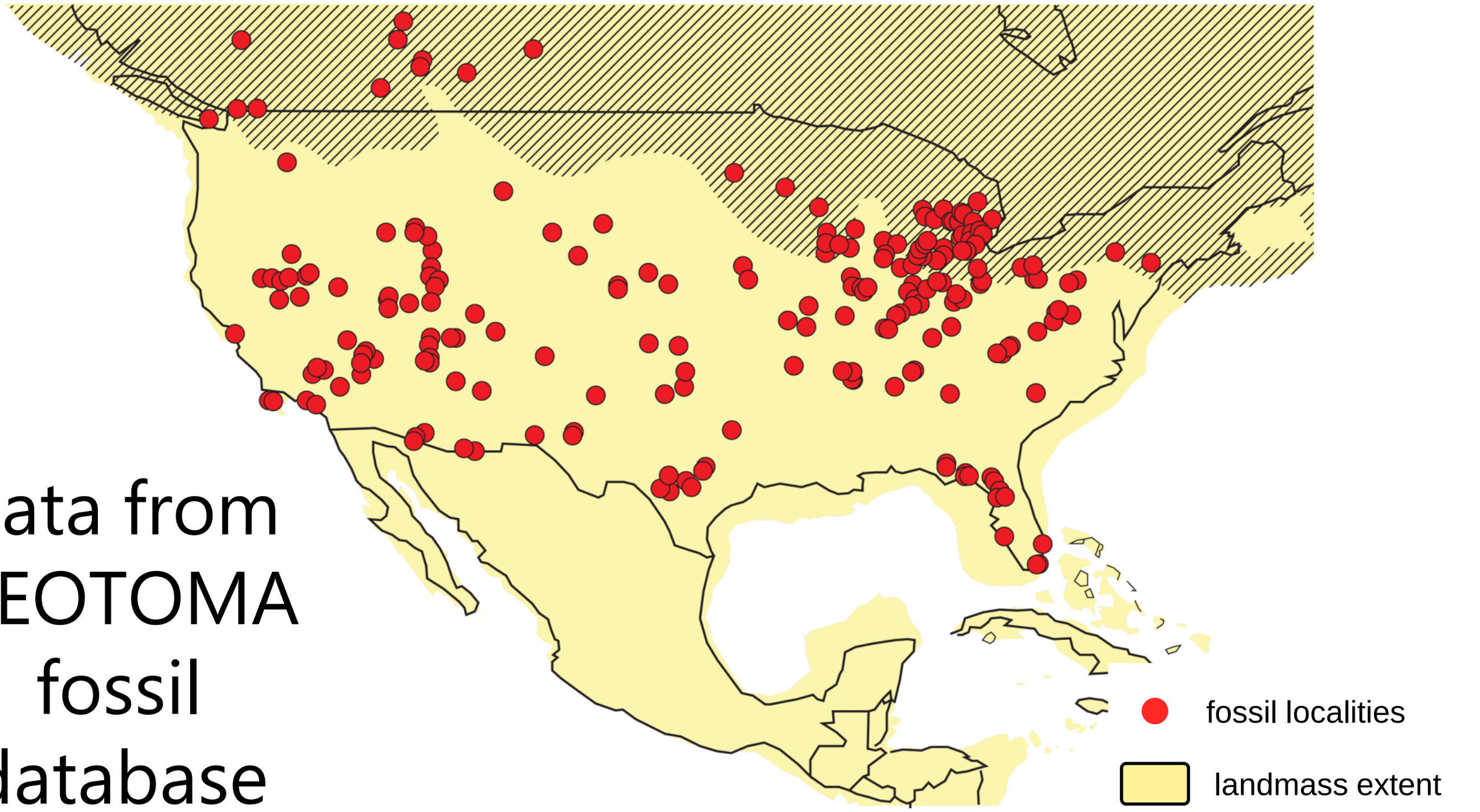
1674	♂	Empidonax	testes 4 mm.	11.1 gm
1675	♂	Peromyscus maniculatus	164-70-19-16	21.5 gm
1676	♀	" "	no emb. 162-69-20-17	20.7 gm
1677	♂	Neotoma cinerea	407-175-46-33	420.0 gm
1678	♀	" fuscipes	no emb 416-200-39-30	305.1 gm

MVZ scanned field notes

Databases based upon museum-gathered data

Last Glacial Maximum (18-21 kya)

vertebrate fossil localities are widespread



data from NEOTOMA fossil database

Davis, **McGuire**, & Orcutt, 2014 *Ecography*

correlatively-identified niches are not sufficient to predict distributions. consistent southerly bias in SDMs hindcast to the LGM

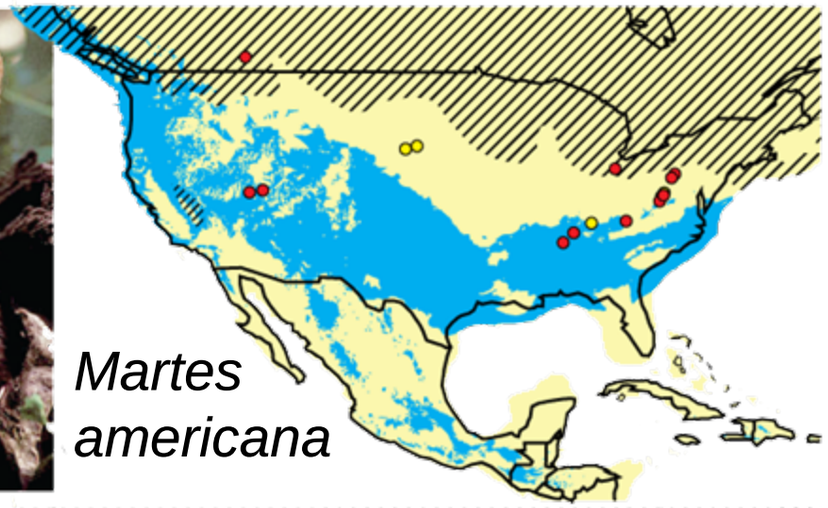
Fossil localities

Species distribution

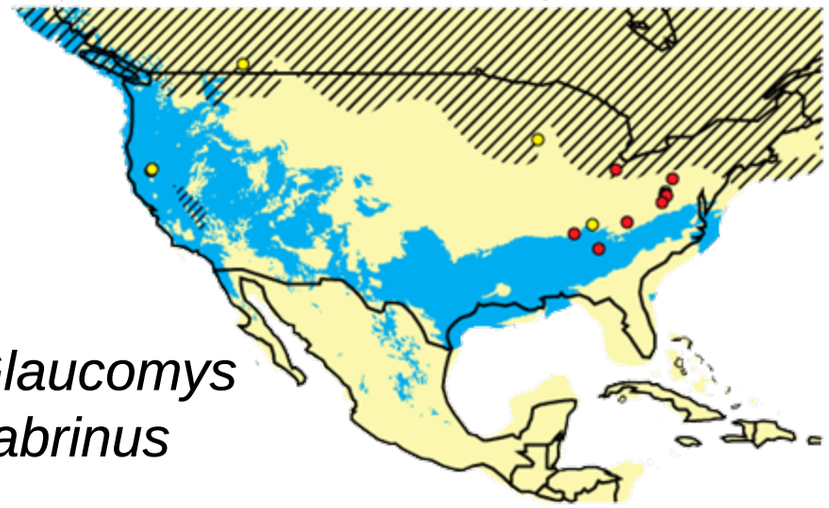
Landmass extent

Glacial extent

Blarina brevicauda

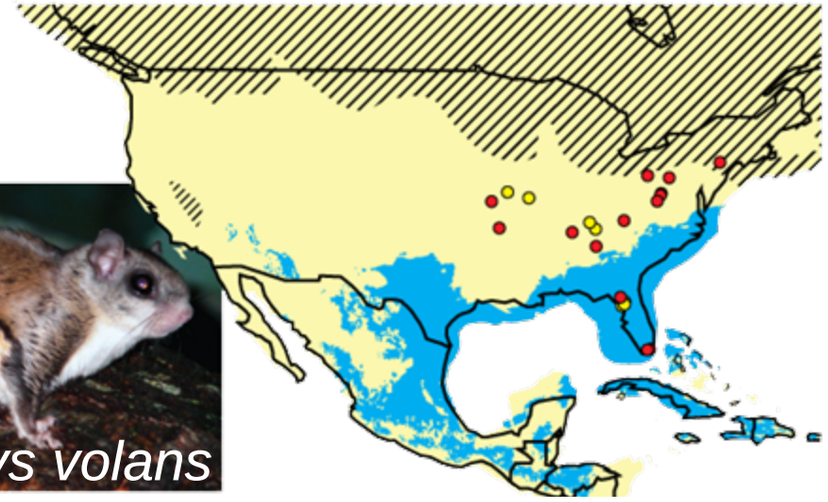


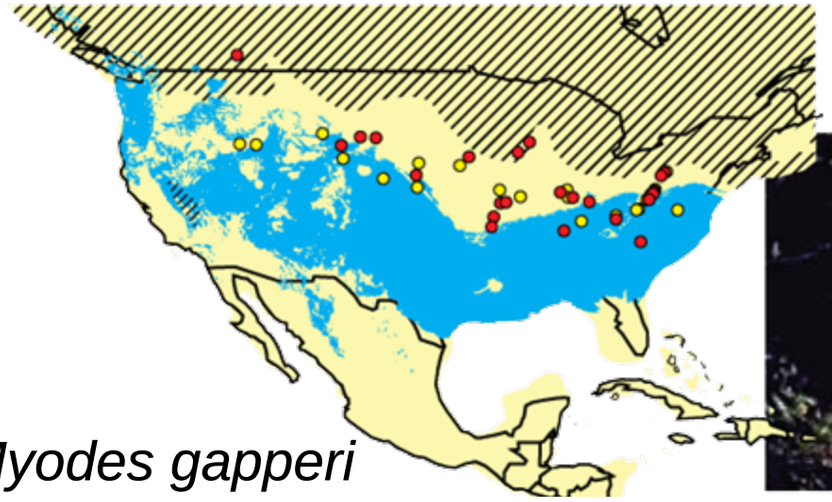
Martes americana



Glaucomys sabrinus

Glaucomys volans





Myodes gapperi

Davis, **McGuire**, & Orcutt, 2014. *Ecography*

Challenges encountered

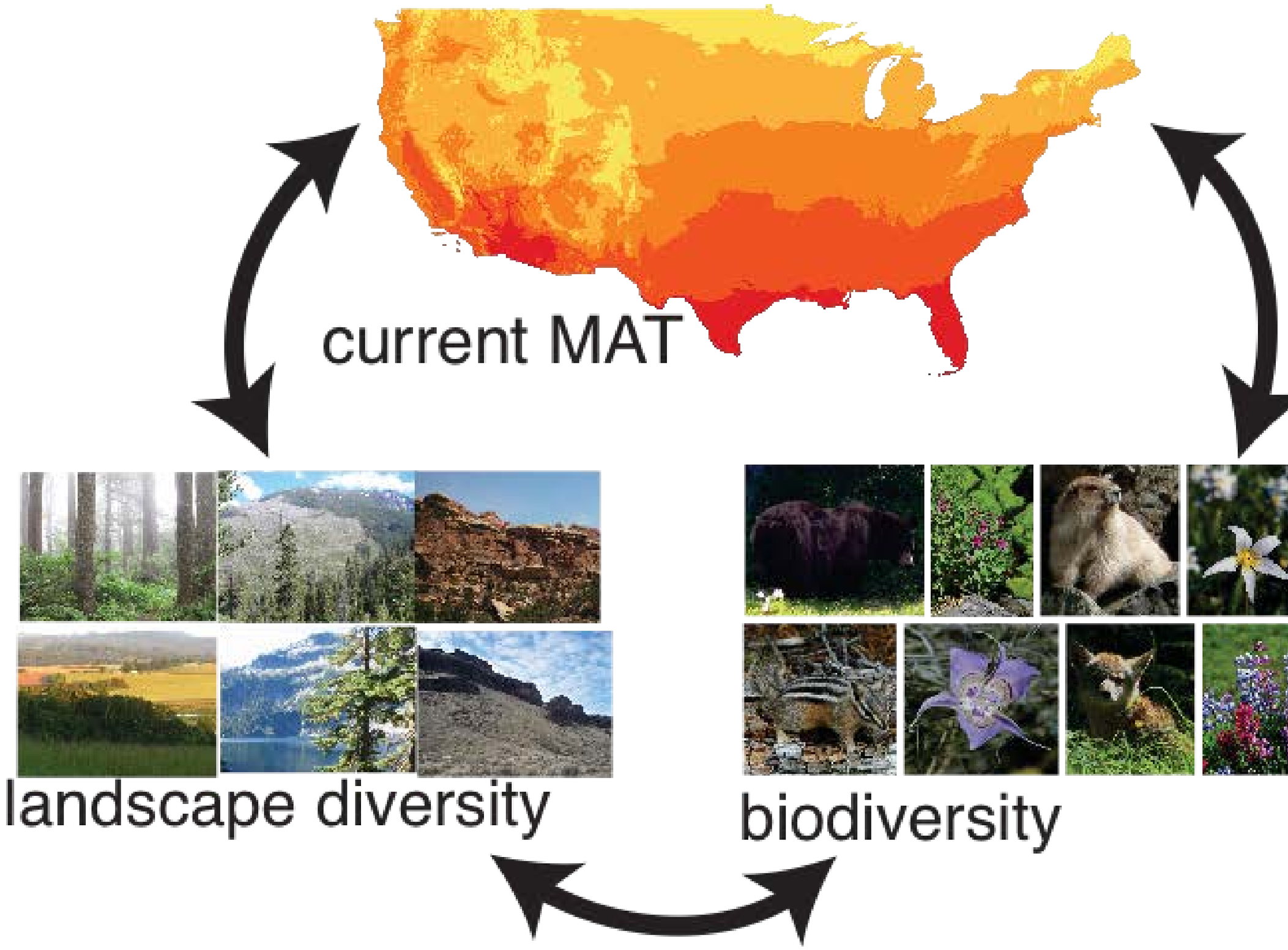
data needed to improve models are hard to access

- physiological limitations
- interspecific interactions
- habitats and landscapes

museum data could fill some gaps

- weather data
- species co-occurrence notes
- standardized habitat data
- location-specific physiography
- absence data

Ecological/historical experiments



Integrating Collections & Ecological Research

1. How to reach more ecologists?

Convince them that an historical approach is critical to their understanding of ecological drivers. Create simple protocols for collecting & submitting voucher specimens and covariate data.

2. Which ecological groups specifically are well-suited to using collections data, in your experience?

Any ecologist with an historical perspective/background.

3. What data is missing from collections data that, if collected in the future, would make collections data better for ecologists?

- Specimen & locality images
- Specimen-specific covariate data: interspecific interactions, habitats, landscapes, physiology, weather
- Detailed field notes
- Absence data
- References to tissue samples, and DNA or isotopic data produced

Spatial Ecology & Paleontology Lab (SEPL)

PI: Jenny L. McGuire

jmcguire@gatech.edu

website: mcguire.gatech.edu

Georgia Tech Earth and Atmospheric Sciences

Georgia Tech School of Biological Sciences