

L25-Biogeography

ANNOUNCEMENTS

-1st draft of paper due TODAY

--Two (2) printed copies turned into your TA (or his proxy) with cover page (first/last initials+last 4 ID)

PEER REVIEW

-You will receive 2 papers on Friday

--use online rubric (Carmen > Content > WPR >ERPR) to help you evaluate

--You will fill out a score sheet in recitation next week

--Papers with 2 peer reviews will be returned on Nov 7th

ANNOUNCEMENTS

Phylogenetics homework DUE in class on Nov 10th

3rd Exam on Nov 12th

Revised paper DUE Nov 14th

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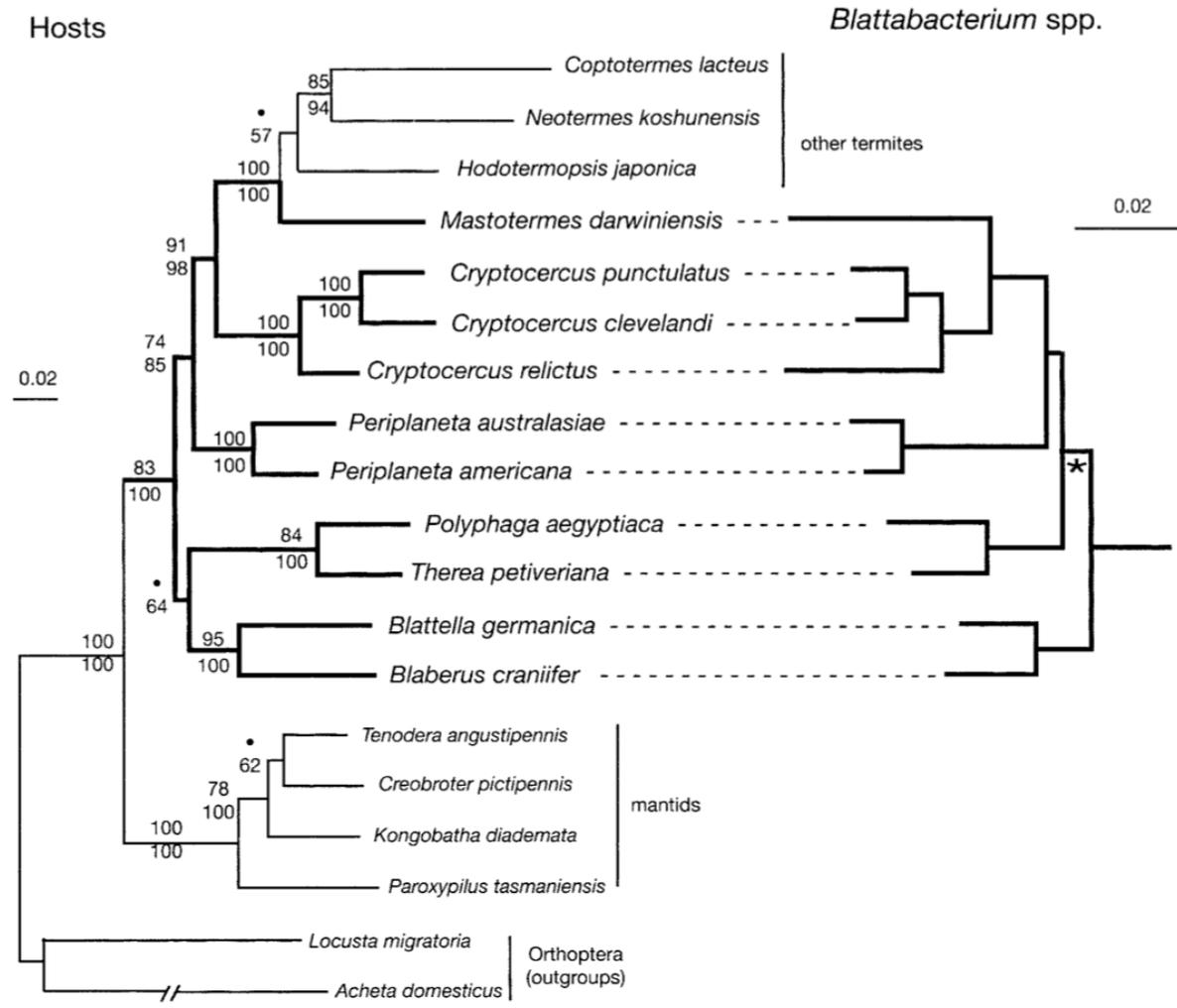
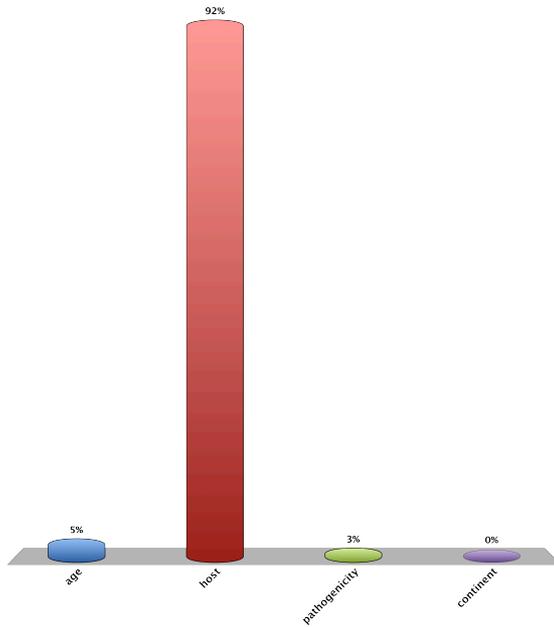
Based on the branching pattern *Blattabacterium* speciate by...

A. age

B. host

C. pathogenicity

D. continent



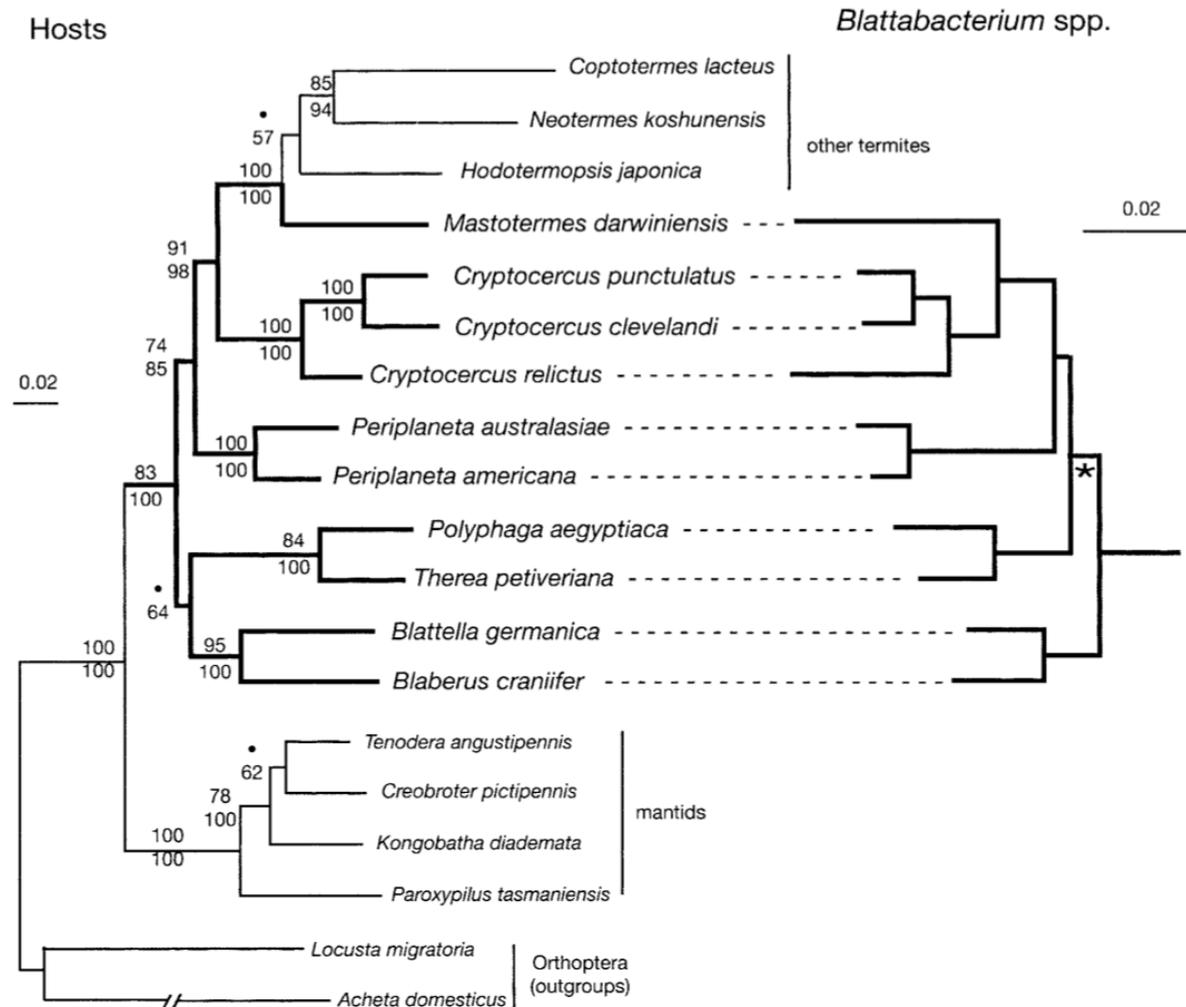
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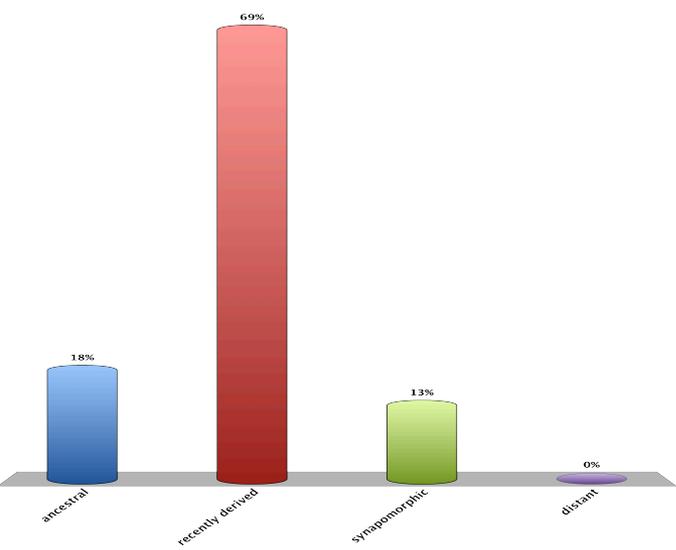
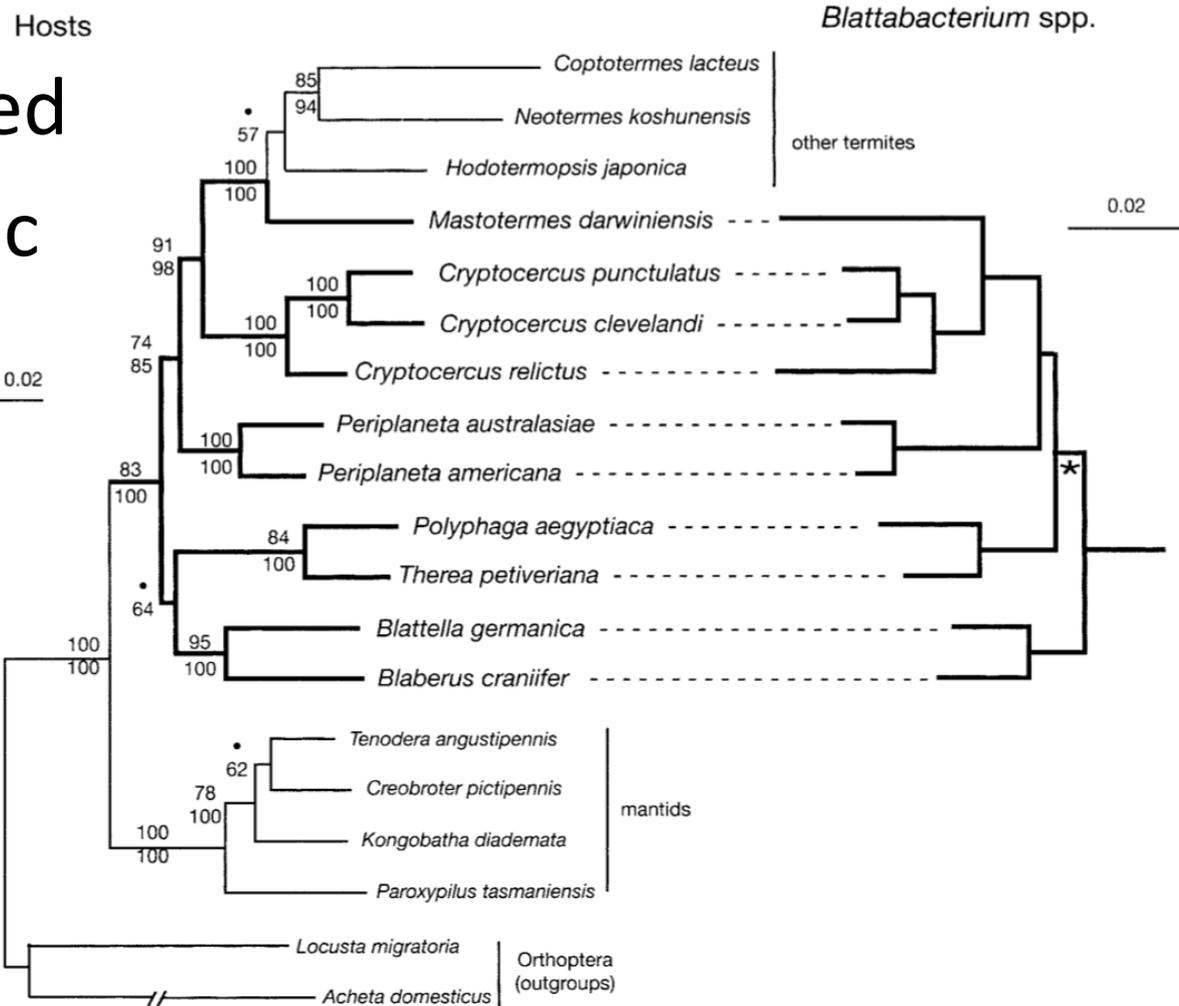
C. pathogenicity

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The presence of *Blattabacterium* in the termite clade would be considered _____.

- A. ancestral
- B. recently derived
- C. synapomorphic
- D. distant



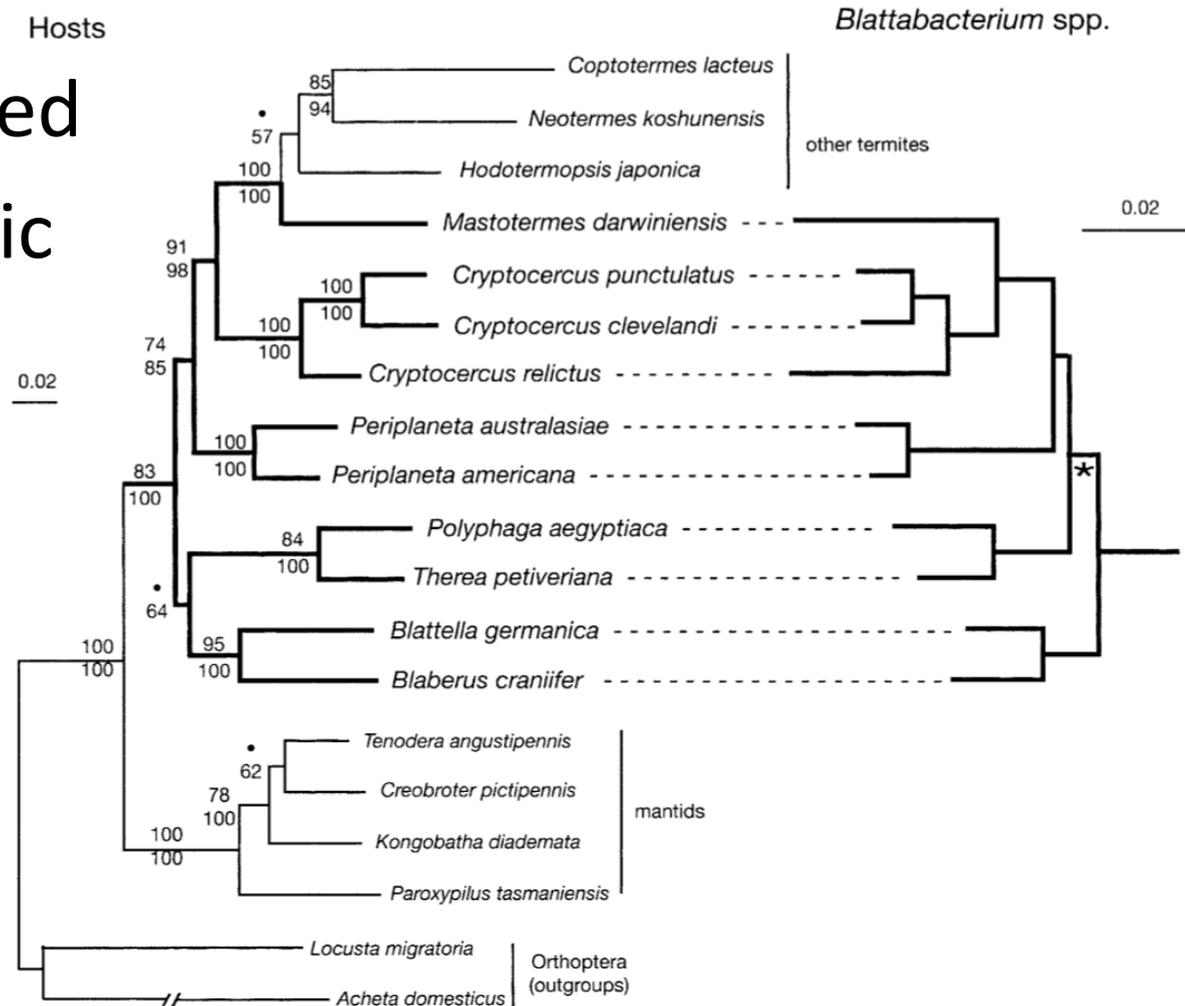
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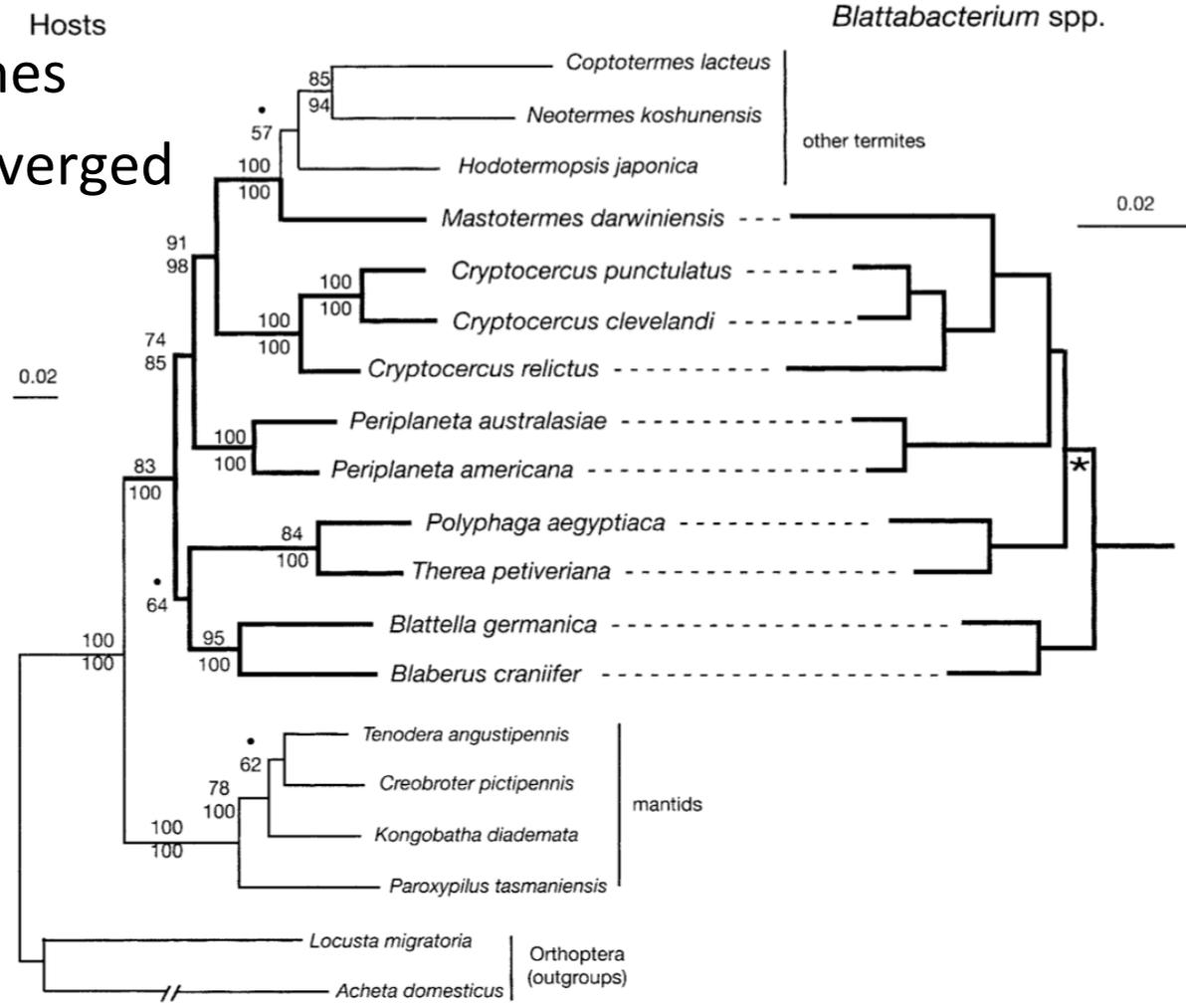
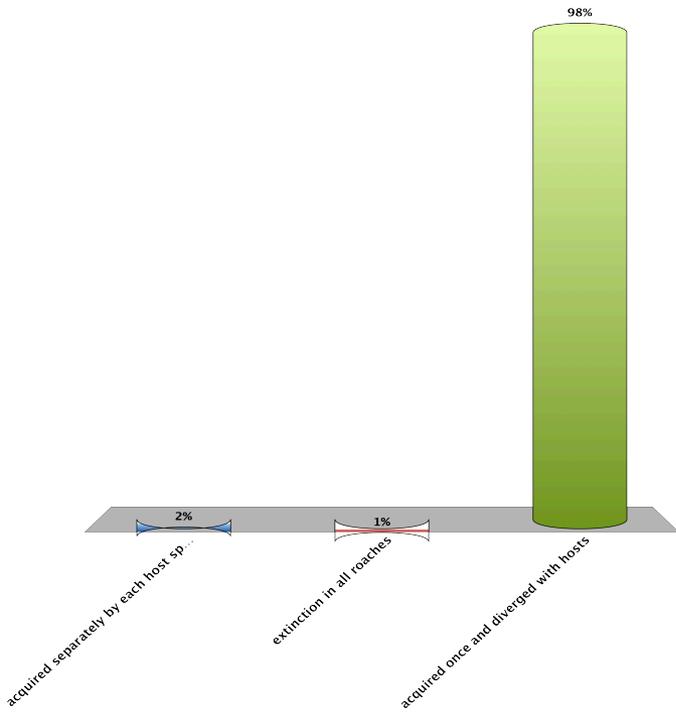
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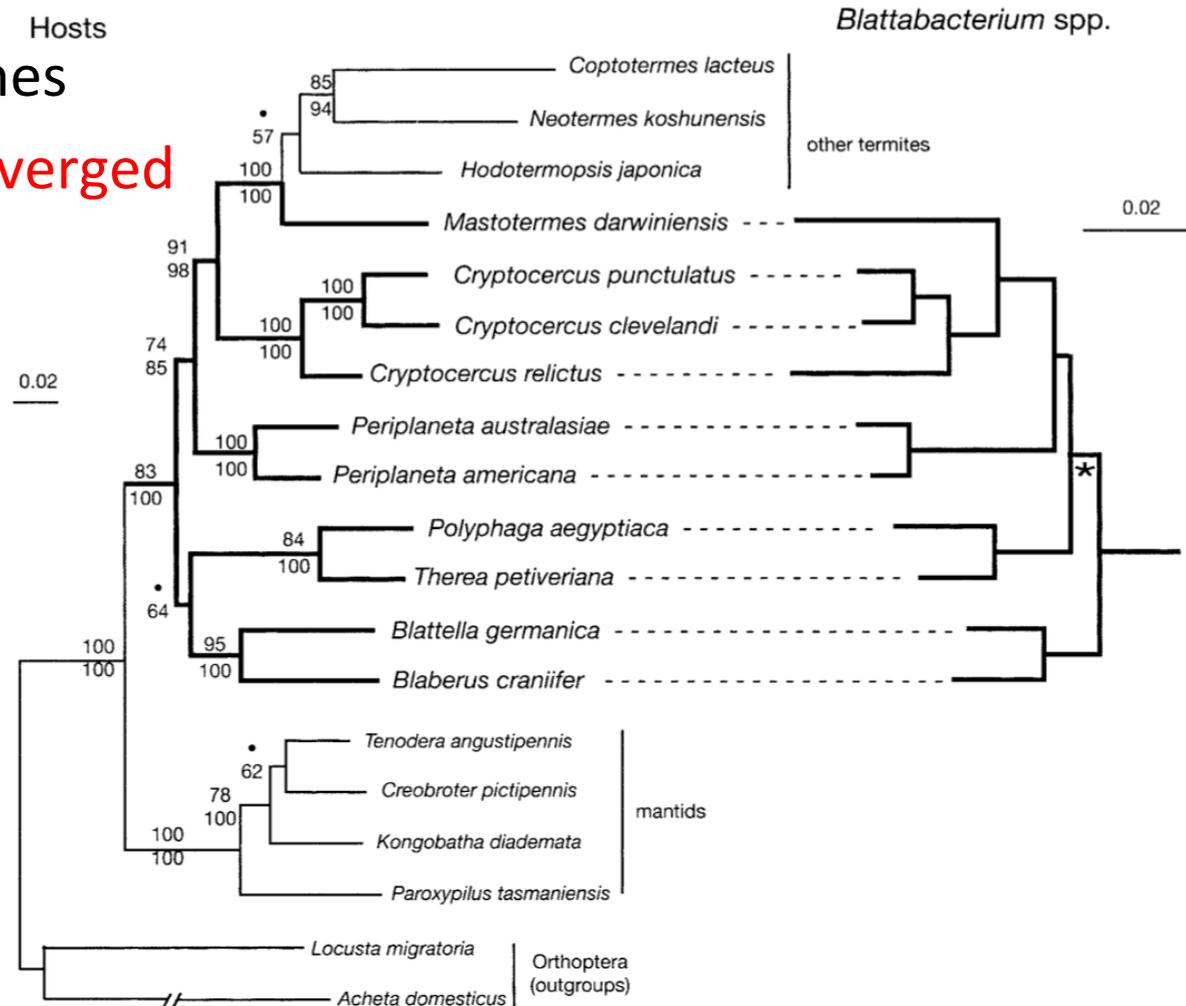
What hypothesis best explains the given distribution of the endosymbiont?

- A. acquired separately by each host species
- B. extinction in all roaches
- C. acquired once and diverged with hosts



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Phylogenetics can be used to test hypotheses of divergence and speciation

Examining related organisms **spatially** offers an opportunity to explore how geological and anthropogenic events, as well as ecological forces, have impacted the formation of species.

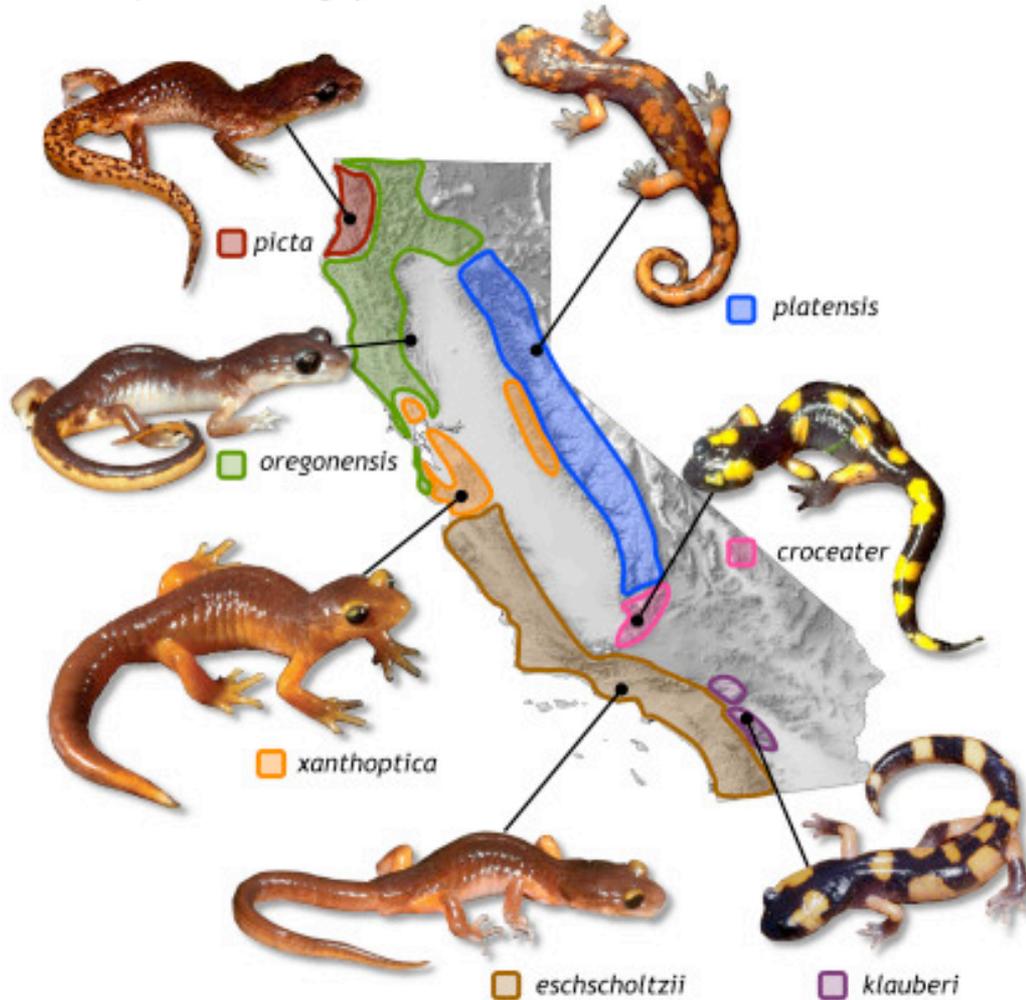
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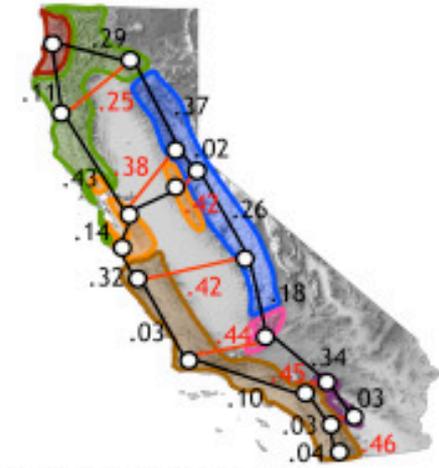
Biogeography is the study of spatial distributions of organisms

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a) *Ensatina* ring species



b) Genetic divergence



c) Ecological divergence



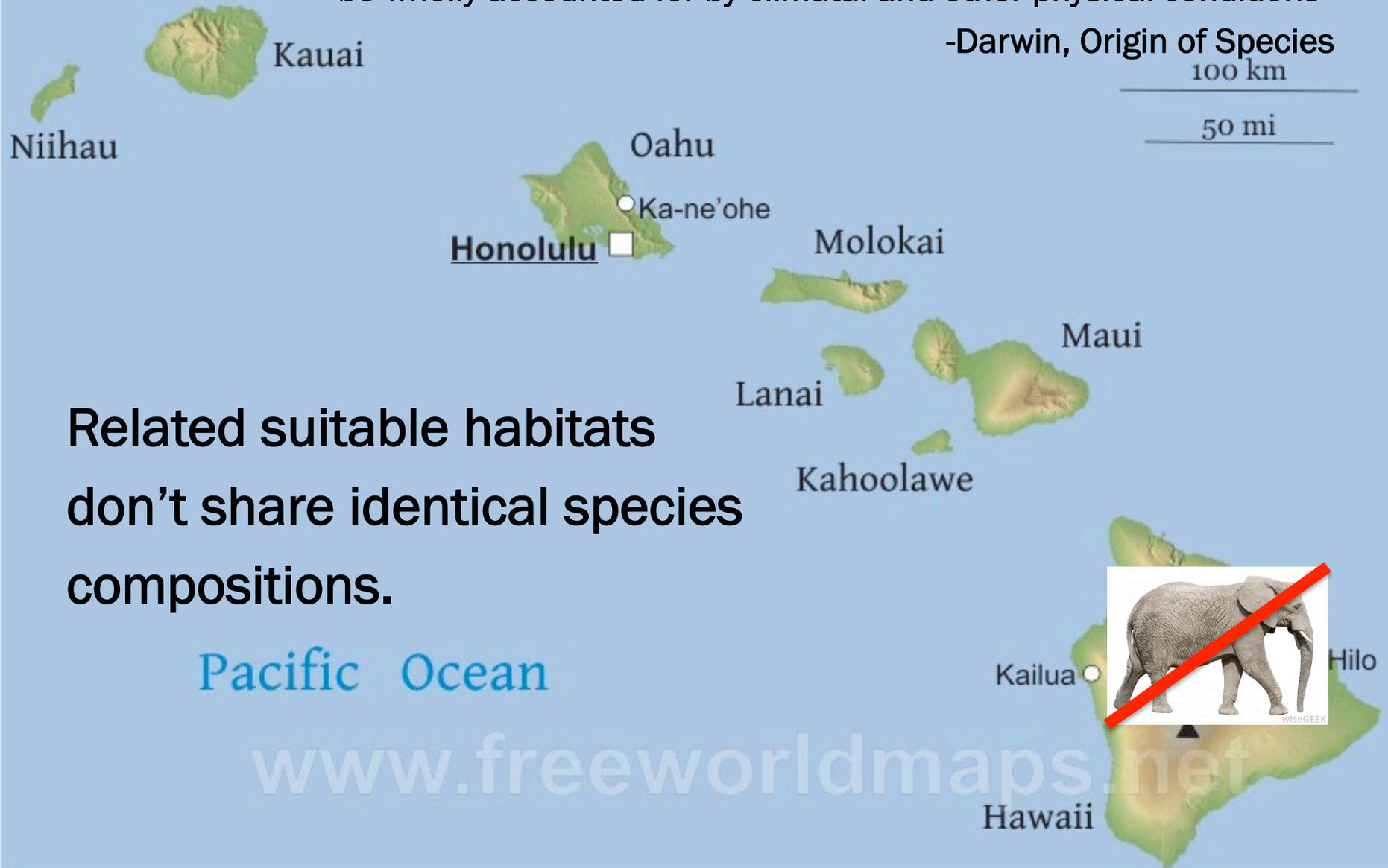
Biogeographic Evidence for Evolution

“neither the similarity nor the dissimilarity of the inhabitants of various regions can be wholly accounted for by climatal and other physical conditions”

-Darwin, Origin of Species

100 km

50 mi



Related suitable habitats
don't share identical species
compositions.

Pacific Ocean

www.freeworldmaps.net

Hawaii

Biogeographic Evidence for Evolution

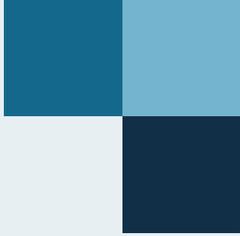
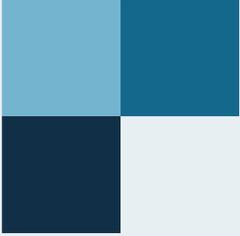
Relatedness of continental island species to those on the main land masses supports a dispersal hypothesis for spatial structuring of species



Additional hypotheses Darwin drew from island-based research...

Remote islands are largely populated by species capable of long-distance dispersal





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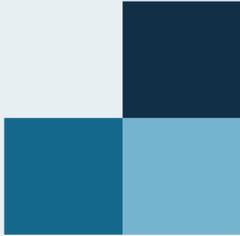
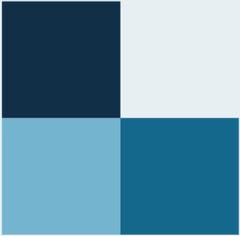
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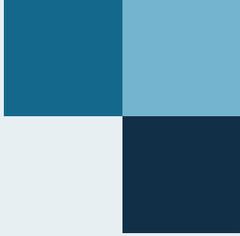
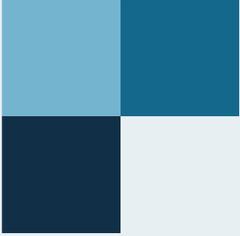


Additional hypotheses Darwin drew from island-based research...

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How do we explain the Galapagos tortoises?



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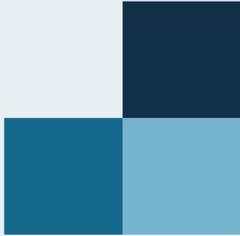
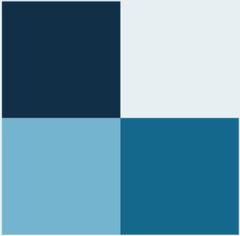
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Additional hypotheses Darwin drew from island-based research...

Remote islands are largely populated by species capable of long-distance dispersal

Galapagos tortoises are **endemic** to the Galapagos and **migrated** from South America >6 Mya



Additional hypotheses Darwin drew from island-based research...

Remote islands are largely populated by species capable of long-distance dispersal

Continental species transported to islands of similar ecologies often flourish

Native species dominate on islands where dispersal to the island is low



Major patterns of distribution

Geographic distribution for most species are limited or restricted to a particular geographic region (**endemic**), although some can had worldwide distributions (**cosmopolitan**)

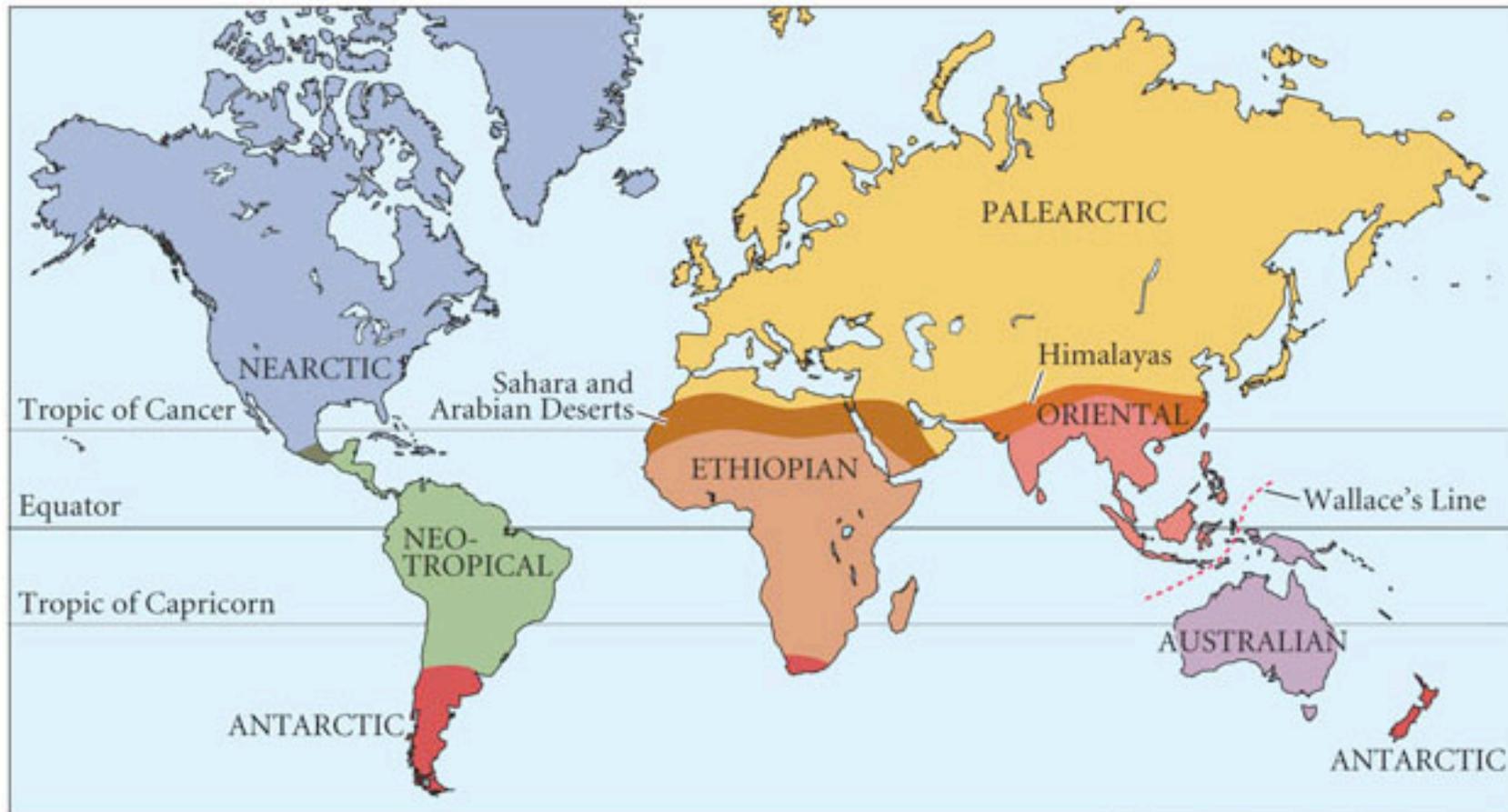


Biogeographic realms

-designated by Wallace

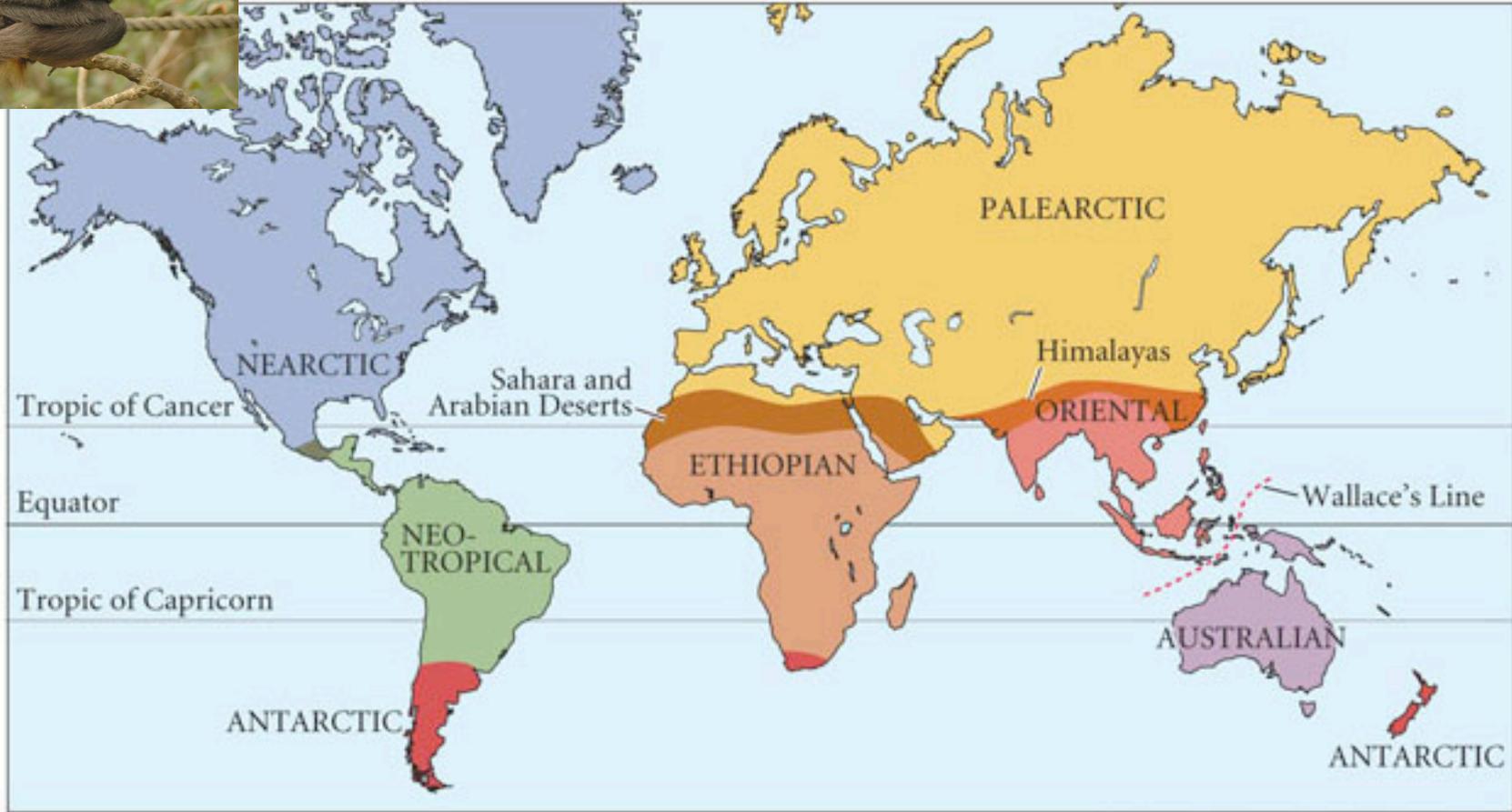
-The result of geological history

-taxonomic composition is more uniform within regions rather than between them.



Biogeographic realms

- peak (or even restricted) species diversity for taxa present
- some trans-realm infiltration can occur



Fragmentation of populations (disjunct distributions)

-noncontinuous spatial distribution of species

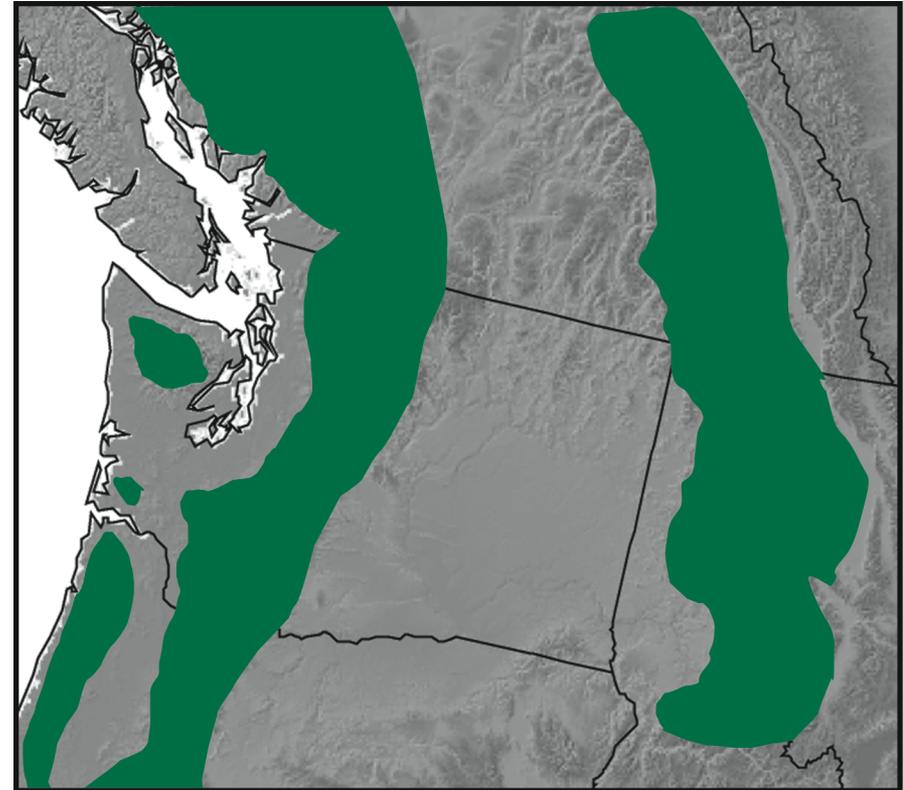
ecosystem dominants

- western hemlock
- western redcedar

climate

- mild & wet winters
- cool & dry summers

> 150 lineages have a disjunct distribution



Fragmentation of populations (disjunct distributions)

-noncontinuous spatial distribution of species

Extinction of intervening species due to biotic (predation) or abiotic (glaciation) events



Vicariance: population separation due to physical, climatic or habitat barriers arising.



Fragmentation of populations (disjunct distributions)

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Extinction of intervening species due to biotic (predation) or abiotic (glaciation) events

Vicariance: population separation due to physical, climatic or habitat barriers arising.

Dispersal: movement of individuals to receptive habitats autonomously, anthropogenically, etc.



Fragmentation of populations (disjunct distributions)

-noncontinuous spatial distribution of species

Vicariance and ***dispersal*** can be hypotheses for spatial distributions of species

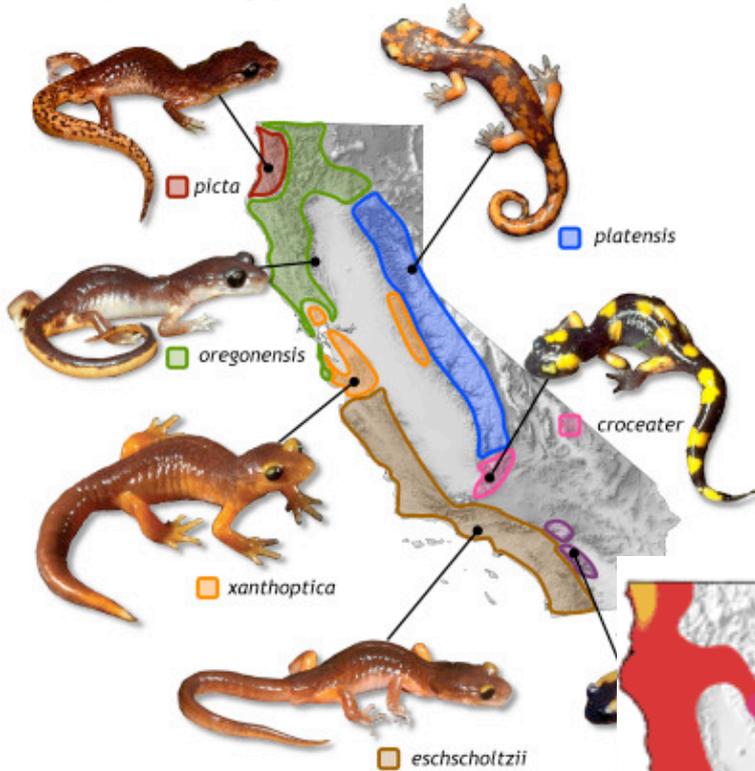
-fossil evidence: could suggest relatively long-term inhabitation (but absence of f.e. doesn't exclude this)

-is local species diversity (dis)similar to that of others in proximal areas?

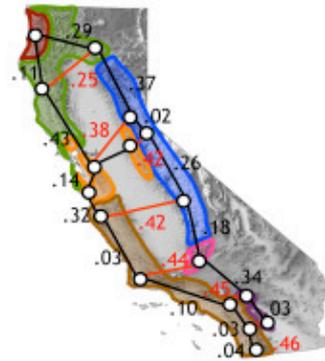


Phylogeography is concerned with the *processes* governing the spatial distribution of genealogical lineages.

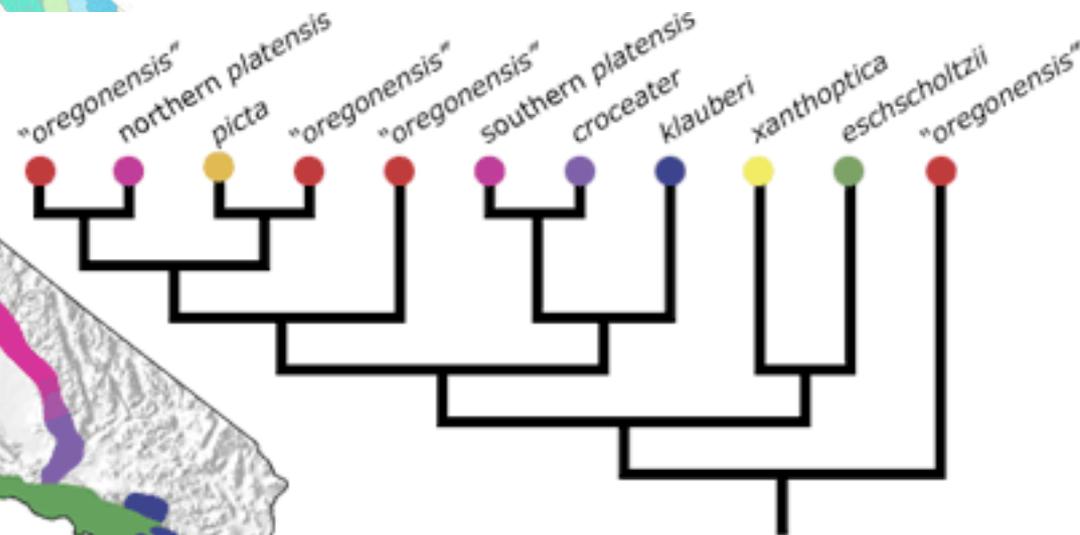
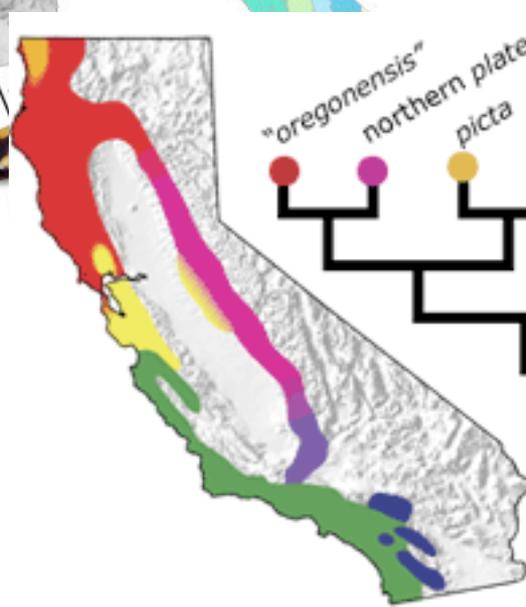
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b) Genetic divergence



c) Ecological divergence



Phylogeography

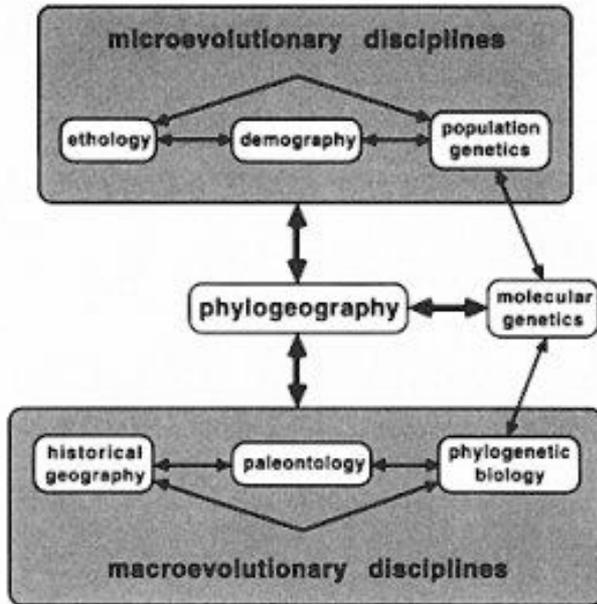


FIGURE 1.2 Phylogeography lies at a critical juncture among several well-established fields.

“The analysis and interpretation of lineage distributions usually requires extensive input from molecular genetics, population genetics, ethology, demography, phylogenetic biology, paleontology, geology, and historical geography. Thus, **phylogeography is an integrative endeavor** that lies at an important crossroads of diverse microevolutionary and macroevolutionary disciplines.”

(Avice, 2000)

Phylogeography is concerned with the *processes* governing the spatial distribution of genealogical lineages.

“Time and space are the jointly considered axes of phylogeography onto which (ideally) are mapped particular gene genealogies of interest.”

(Avice, 2000)

b) Genetic divergence

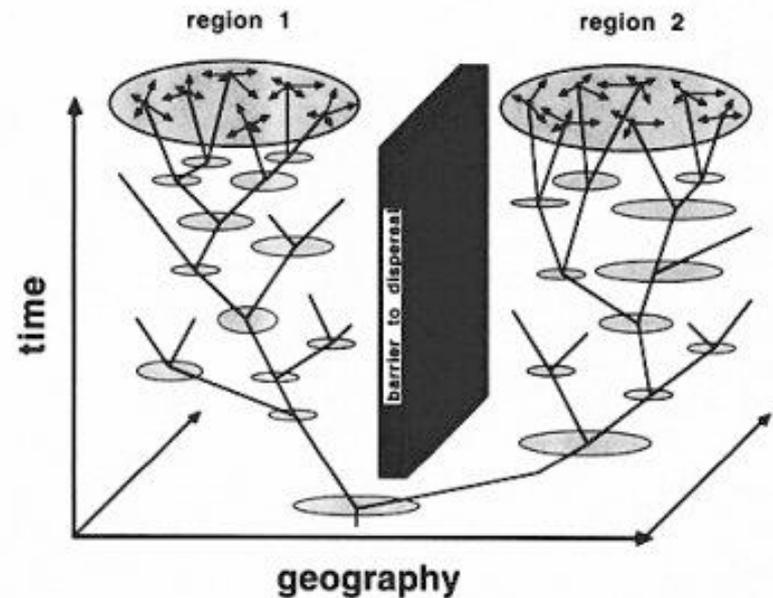
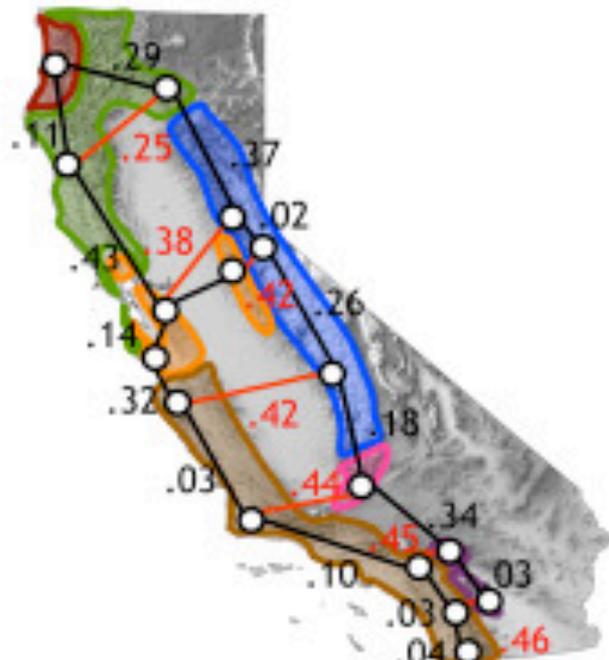


FIGURE 1.1 Hypothetical gene genealogy for a species displaying restricted gene flow within each of two physically separated regional populations (after Avice, 1996a). Shaded ovals represent geographic ranges of particular lineages, and arrow vectors in the extant populations (top) denote spatial magnitudes of contemporary dispersal of individuals from their natal sites.

Phylogeography is concerned with the *processes* governing the spatial distribution of genealogical lineages.

Initially mitochondrial DNA was used because of its slow rate of evolution

Additional genes, and even whole genomes (phylogenomics), are also used

b) Genetic divergence

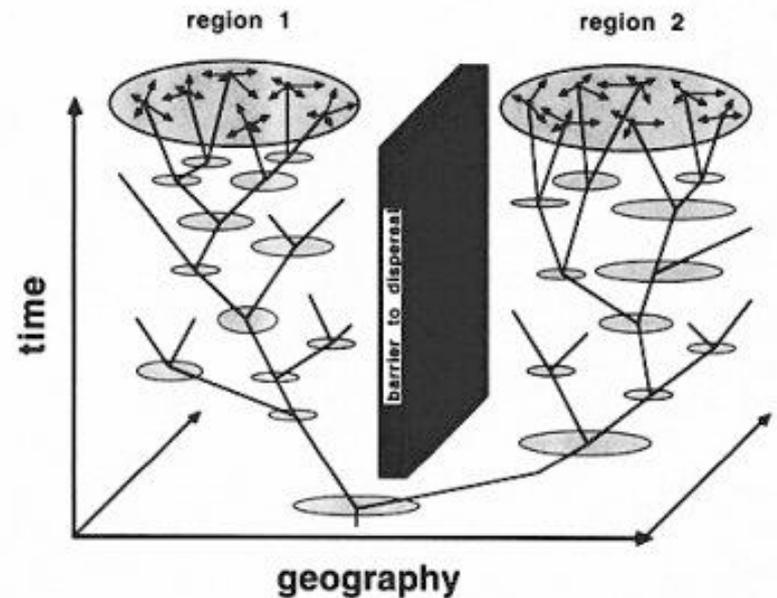
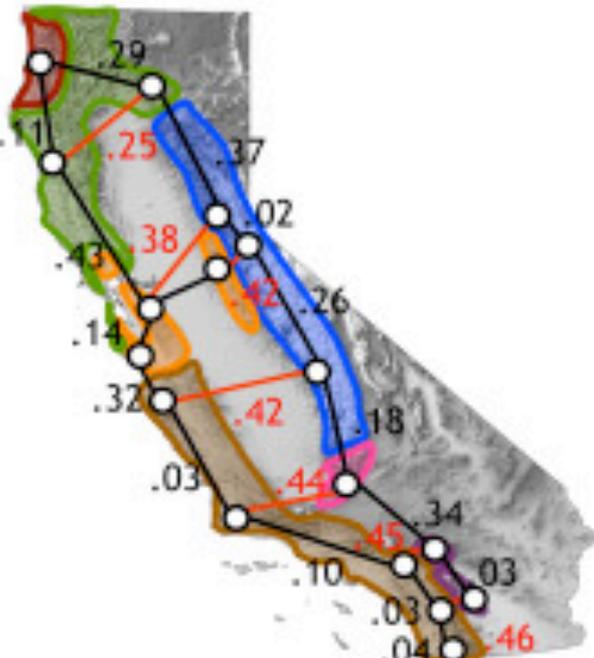


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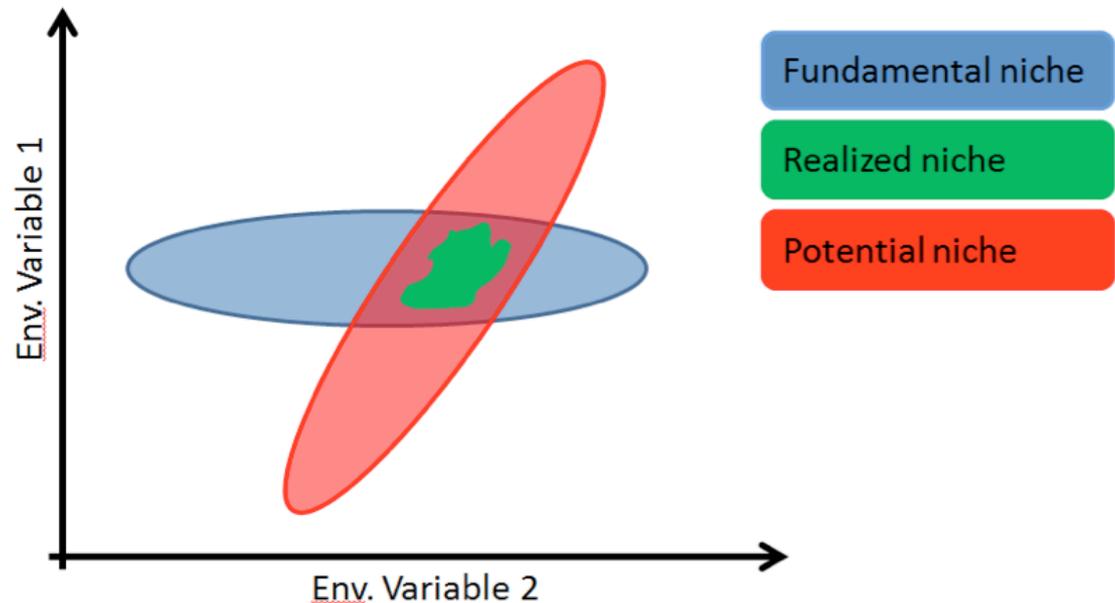
Generating Phylogeographic Hypotheses

- georeferenced locality data
- a set of climatic and environmental layers
- algorithm to estimate the niche envelope on the basis of species presence/absence and the distribution of environmental variables

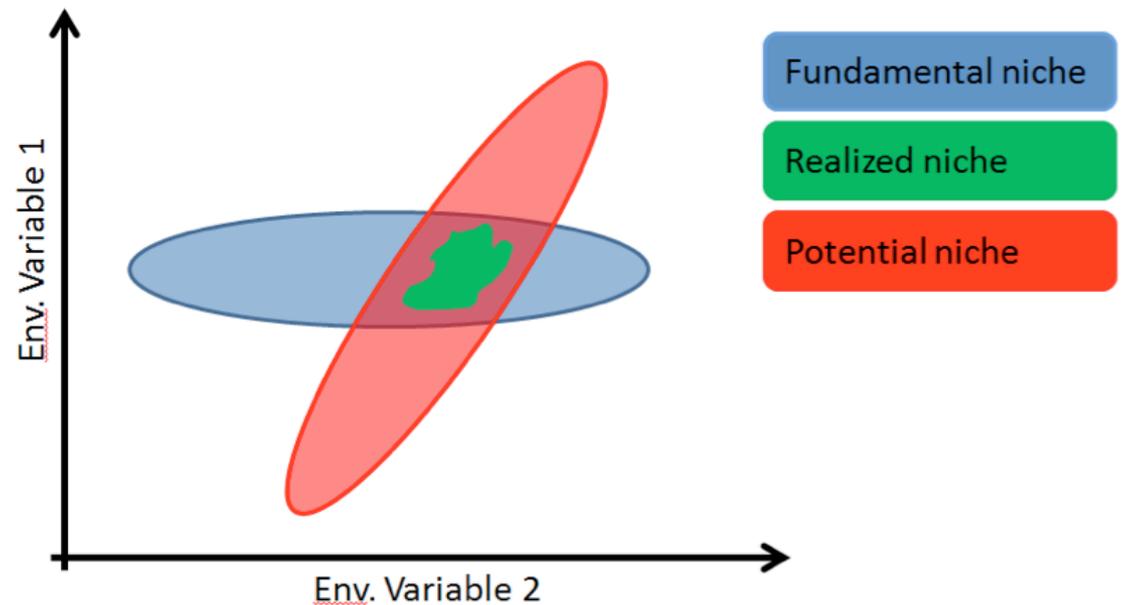
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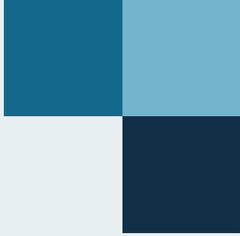
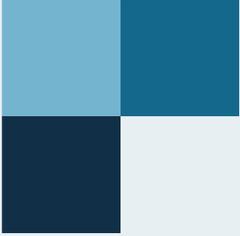
Estimate the environmental requirements and therefore the potential geographic distribution of a species.

- Fundamental niche (Grinnell): the set of resources and environmental conditions necessary for an organism to maintain a viable population
- Realized niche (Hutchinson): the portion of the fundamental niche that the species actually occupies.



What are some events that can expand realized niches?





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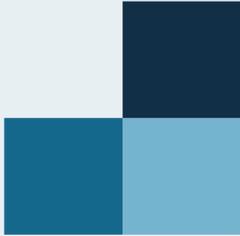
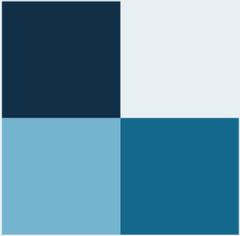
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Habitat disruption due to meteorological event



Habitat disruption due to meteorological events

....anthropogenic events

