

Biogeography (November 3, 2004)

1. But first: a few more words about nutrient cycling and salmon...
 2. Biogeography: explaining current distributions of organisms
 - a. Vicariance (Historical break-up of Pangaea, Gondwana)
 - b. Dispersal
 - c. Case study: Panama, & Bocas del Toro archipelago
 3. Why isn't species X in habitat Y?
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1. N in riparian forests: MDN & AFN
 - MDN: Marine derived Nitrogen. 24-26% of foliar nitrogen of terrestrial plants adjacent to spawning streams may be from salmon.
 - AFN: Alder-fixed Nitrogen

Transfer of MDN to riparian forests by:

Alder fixes nitrogen for its own use, but some AFN is transferred to surrounding soils by:

Use of MDN & AFN by white spruce

- At salmon spawning sites in which alder is absent, white spruce (*Picea glauca*) exhibits significant uptake of MDN.
- At bear middens, MDN uptake by white spruce is also high.
- At spawning sites in which alder is present, MDN uptake by white spruce is significantly decreased.
- Growth of white spruce is positively correlated with both MDN and AFN inputs. In riparian areas without alder or spawning salmon, white spruce are both slower growing and less dense. (from Helfield, J.M. and R.J. Naiman. 2002. Salmon and alder as nitrogen sources to riparian forests in a boreal Alaskan watershed. *Oecologia* 133: 573-582.)

2. Biogeography

- **Definition:** the study of how organisms ended up where they are today. Put another way: the study of the distribution of organisms in space and time.
- Ecologists typically work on scales ranging from populations-to-ecosystems. Biogeography looks at landscape-to-planetwide distribution (tectonic spatial scales).
- **Premise** (*raison d'être* for the field): Understanding the movements of landmasses can allow us to understand present distributions of animal (and their ecology), as well as give us insight into both earth history and evolutionary history.

Species distributions

- **Endemic species** are restricted to a certain region. Endemism is defined relative to a particular taxonomic group, and a particular region. For instance, the spotted owl is endemic to the Pacific Northwest
- **Disjunct distributions:** Related species (or even the same species) are found in

different areas. For instance, marsupials are found in Australia and South America; ratite birds (ostrich, emu and cassowary, rhea) are found in Africa, Australia, and South America, respectively.

- Biogeography seeks to explain observed species distributions.

2. How did organisms get to their present positions on Earth?

Broadly, there are two types of biogeographical explanation:

2a. Vicariance biogeography

To understand the role of vicariance in current species ranges, it is important to have accurate reconstructions of ancient landmass positions.

2b. Dispersal biogeography

- Current distributions of organisms are a result of them moving themselves relative to the landscape.
- Dispersal can be criticized as unscientific, because it is unfalsifiable. You can claim dispersal as an explanation whenever no other explanation for a distribution fits.
- “Barriers” to dispersal include physical, chemical, climatic, and ecological (e.g. competitive exclusion).

Modes of dispersal

- **Corridors** between two regions on the same land mass
E.g. Bering land bridge
- **Filter bridges** are selective connections between two areas.
E.g. rafting.
- **Sweepstakes** are rare chance events
E.g. muddyfooted duck, gravid females arriving on new islands.

2c. Case study: Panama and Bocas del Toro

Effect of Panamanian isthmus formation on mammals

Effect of archipelago formation on speciation

3. Why isn't species X in habitat Y?

Pick any X, and any Y, and the answer will basically come down to one (or more) of the following three things: