Community Structure II
Ch. 22

III. Processes affecting diversity – large scale
C. Equilibrium model of island biogeography
   1. Effects of island size and distance
   2. The balance between immigration and extinction
D. The latitudinal species gradient
   1. The patterns
   2. The hypotheses

C. Island biogeography

Patterns of species richness depend on
Island size
Island isolation

Number of species increases as island area increases

**Island Area & Species Number**

- **22.2**
  - Number of bird species on Caribbean islands is higher on larger islands.
  - Number of beetles species also increases with area on islands in a Swedish lake.

Mountains are islands too

**Montane Area & Species**

- **22.3**
  - Number of montane mammal species increases as the area of available habitat increases.

Lakes are islands?

**Lake Area & Fish Species**

- **22.4**
  - The lakes of northern Wisconsin form an archipelago of aquatic islands separated by land.
  - As on other islands, number of species increase with lake area.

Closer islands have more species than farther islands

**Area & Bird Species**

- **22.5**
  - For a given area, islands near New Guinea support more bird species than those farther away.
Effects of distance depend on taxa – why?

Isolation & Diversity

The distant Azore Islands support fewer bird species than the Channel Islands, which are near the coast of Europe.

In contrast, distance does not reduce the diversity of ferns and their allies on the Azore Islands.

Mountain distance matters for mammal diversity

Number of montane mammal species declines with increasing distance from source of potential colonists.

Distance & Species

Number of mammal species

Distance from source (km)

22.6

22.7

Large near islands have more species than small far islands

Equilibrium Model

According to the equilibrium model of island biogeography, the number of species on an island is determined by a balance between species immigration and extinction.

The rate of immigration of new species to an island decreases as the number of species on the island increases. Meanwhile, the rate of species extinction on the island increases as the number of species present increases.

The model predicts higher rates of immigration to islands nearer a source of colonists. The model predicts high rates of extinction on small islands.

Equilibrium Model Example

The model explains the low number of species on small, isolated islands. The model also accounts for high number of species on large, near islands.

22.8

22.9

Simberloff & Wilson tested EMIB on Florida mangrove islands

Ehrlich & Roughgarden 1985

Colonization Curves

The number of species on the near island soon equaled predefaunation levels, while the number of species on the far island was still below the original level.

Number of species present

Days

Predetrauion species number on near island

Predetrauion species number on far island

Near island

Far island

22.12
22.14

Mangrove island recolonization

Using species-area relationships to predict rates of extinction

Deforestation leads to habitat fragmentation: islands

Experimental reduction of fragment size

Effects of area and matrix

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Ehrlich & Roughgarden 1985


Calculating species extinctions from habitat area

\[ S = cA^z \]  

\[ \log(S) = \log(c) + z\log(A) \]

\( z \) = slope of regression line

Bottom line: overall rates of extinction are **10-100 fold** higher than background.

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**Range of \( z \)'s for Iowa grasslands**

<table>
<thead>
<tr>
<th>Species</th>
<th>( z )</th>
<th>( c )</th>
<th>Extinction</th>
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<td>Crone (701)</td>
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</tbody>
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D. Latitudinal gradient in species richness

pp. 517-520 (check page numbers)

1. What is the latitudinal species richness gradient?
2. Does it hold for all species?
3. What are the hypotheses about why this gradient exists?
4. Have any of them been proven to be the sole factor responsible for the observed patterns?