Lecture 13

Biodiversity

I. What is Biological Diversity?
II. Latitudinal and Altitudinal Gradients
III. Geographic Controls on Diversity
   A. Historical Theories
   B. Equilibrium Theories
IV. Island Biogeography
   A. Historical Perspective
   B. Current Perspective
V. Mapping Distributions
VI. Common Patterns of Distributions

I. What is Biological Diversity?

- Biodiversity
- Species Richness
Lecture 13
I. What is Biological Diversity?

Species Area Curve:

\[ S = cA^2 \]

\[ \log S = \log c + z \log A. \]

How many species are there on the Earth?

Jon Feldsa (1991)
Udzungwa Partridge
(Xenoperdix udzungwensis)
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II. Latitudinal and Altitudinal Gradients

Latitudinal gradient of diversity

![Map showing latitudinal gradient of diversity](image1)

**Figure 14.1**: Number of species of butterflies by biogeographical realm. The 6,300 total is for the Oriental and Australian realms combined. Ackery et al. (1991) listed 1,607 Malayan species. Ribbands (1982) gave estimates for the other realms. There are an estimated 17,500 species of butterflies worldwide.

Altitudinal gradient of diversity

![Graph showing altitudinal gradient of diversity](image2)

**Figure 14.4**: Declining species richness of birds and mammals at higher elevations in the Himalayan Mountains (after Bogom et al. 1990, Hunter and Yvon 1982, Whitaker 1975).
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III. Geographic Controls on Diversity

Historical Theories of Biodiversity:

Stability-Time Hypothesis

- Tropical regions have experienced less disruption
- Environmental stability = increased species richness

Equilibrium Theories of Biodiversity:

- Large gradients for resources offer a wide range of habitat for different species to occur.
- Species typically have highly specialized niches.
- Key resources may be more abundant.
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III. Geographic Controls on Diversity

Equilibrium Theories of Biodiversity:

• Habitat Diversity
• Large Land Areas of the Tropics
• Environmental Stability
• Competition
• Predation
• Productivity
• Disturbance

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III. Geographic Controls on Diversity

Equilibrium Theories of Biodiversity:

• Intermediate Disturbance Hypothesis

The intermediate disturbance hypothesis. The hypothesis predicts that species diversity will be highest at intermediate levels of disturbance.

The intermediate disturbance hypothesis predicts that species diversity will be highest at intermediate levels of disturbance. Low levels of disturbance allow competition to reduce diversity, while high levels of disturbance reduce diversity. In the curve, diversity is highest at intermediate disturbance levels.
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III. Geographic Controls on Diversity

Equilibrium Theories of Biodiversity:

• Intermediate Disturbance Hypothesis

(South America)
(California)

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IV. Island Biogeography

The equilibrium theory of Island Biogeography

• Introduced by R H MacArthur & E O Wilson in 1963.
• The theory attempts to explain the 3 basic characteristics of island life:
  – the species-area curve
  – the effect of isolation
  – species turnover

Map: The Colonised Archipelago (M. S. Dayton et al., 1964)
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IV. Island Biogeography

Why does the rate of extinction increase?

- As species arrive, competition for resources increases.
- The result is that some populations become very small.
- Small populations are vulnerable to random extinction events.

S = Equilibrium species
SF = Small far islands
LF = Large far islands
SN = Small near islands
LN = Large near islands
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IV. Island Biogeography

Effect of Island Size on Turnover rates

after Pianka et al. (1995)

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IV. Island Biogeography

FIGURE 14.13 A revised view of the theory of island biogeography by the author that takes into account the rescue effect on small islands, the larger effect of large islands, and the fact that the addition of species to island biota occurs both through immigration and evoluti.
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II. Mapping Distributions

(fish survey)
(bird survey)
(mammal surveys)
(plant survey)
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II. Mapping Distributions

Common Biogeographical Distributional Patterns

- Endemic
- Cosmopolitan
- Pandemic
- Paleoendemic
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Common Biogeographical Distributional Patterns

Biogeographic relicts

Only 5% of old growth redwood forest remains.