The species-area relationship

Arhenius (1920)

\[ S = cA^z \]

Re-writing the species-area relationship

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

• In this form, it is easy to see that \( c \) represents the intercept and \( z \) the slope of the species area relationship.

Why does the species-area relationship exist?

• The equilibrium model of island biogeography
  – MacArthur and Wilson in 1963
  – Explains the S-A relationship as a balance between immigration and extinction

• The passive sampling model
  – Coleman and colleagues in 1982
  – Explains the S-A relationship as a random process of landing on targets of different size

An island’s species richness depends on:

• island’s isolation
  isolation affects colonization rate

• island’s area
  area affects extinction rate

• colonization and extinction are dynamic
  colonization replaces extinct species \( \rightarrow \) species turnover

• species richness reflects an equilibrium between colonization and extinction

(MacArthur and Wilson, 1967)

Summary: predictions of the equilibrium model of island biogeography

• The species richness of an island represents a balance between extinction and colonization

• There is continual species turnover

• Larger islands have a greater species richness at equilibrium

• Islands closer to the mainland have a greater species richness at equilibrium
Limitations of the equilibrium theory of island biogeography

- Rate curves of extinction and immigration not known
- Islands may not be in equilibrium
- Probabilities of extinction and immigration vary among species
- Extinction and immigration not independent (residents repel colonists)
- Multiple mainlands = multiple immigration routes
- Assumes no speciation

Conclusions of the passive sampling model

- Predicts that larger islands should have greater species richness
- Predicts that rare species should be unlikely to occur on small islands
- Does NOT predict continual species turnover

Thus the passive sampling model is consistent with the species-area relationship but differs from the equilibrium model in two important ways

The Language of Fragmentation:

3 basic landscape elements

- Patch – recognizable area that contrasts with adjacent areas and has definable boundaries
- Corridor – connects two or more patches
- Matrix – the “background” or dominate cover type upon which patches and corridors occur

Pros and cons of corridors

**PROS**
- Reduce isolation
- Facilitate movement and gene flow
- Increase potential for recolonization of patches
- Provide habitat
- Recreational and aesthetic value

**CONS**
- Do not always affect movements
- Expose animals to danger (e.g., cars, humans, contaminants)
- Facilitate spread of disease, exotics, and disturbance
- Expensive

Design Principles of Fragments

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