# Signature Features of Islands: Extinction

- **Why are species on islands more prone to extinction?**

- **Describe an example where principles from island biogeography apply to a species in the Greater Yellowstone Area?**

# Signature Features of Islands: Extinction

## Island species are more prone to extinction

- Natural Factors
  - Low population numbers
  - Environmental catastrophe (e.g. Krakatau)
  - Suitable habitat area
  - Low genetic diversity
  - Founder effects
  - Competition

# Natural Extinctions

- **Dinosaur extinction 65 million years ago**
  - **Meteorite, volcano, climate change, competition???**

- **Krakatau---Anak Krakatau**
  - **Series of eruptions in 1883 led to extinction of virtually all species on the island**

# Human Influenced Extinction

## Island species are more prone to extinction

- Human Factors
  - Habitat destruction and fragmentation
  - Introduced species-competition
  - Introduced species-predation
  - Over-exploitation
  - Human disturbance

***48% of all plant and animal species known to have gone extinct since 1600 AD were island species**

# Human Influenced Extinctions

- **Passenger Pigeon (*Ectopistes migratorius*)**

  - **One of the most abundant bird species on earth: 1810 ornithologist A. Wilson estimated > 2 million in one flock**
  - **Unprecedented hunting pressure likely began in late 1800's (with results similar to bison)**
  - **Last Passenger pigeon seen, March 24th, 1900 Sargents, Ohio**

# Human Influenced Extinctions

- **42% of New Zealand's Bird Species Extinct (57)**
  - **Characteristics of extinct birds:**
    - **Flightless**
    - **Ground nesters and feeders**
    - **Fearless**
    - **all 14 moas, 11 rails, 6 wrens and both eagles**
    - **38 following Polynesian arrival and 19 following European**
  - **Factors leading to extinctions:**
    - **Hunting**
    - **Introduction of the Pacific and European rat, possum, and stout----Predation**
    - **Habitat loss**

Huia

Laughing owl

Stephen's Island wren

Poipoi

Haast's eagle

Chatham rail

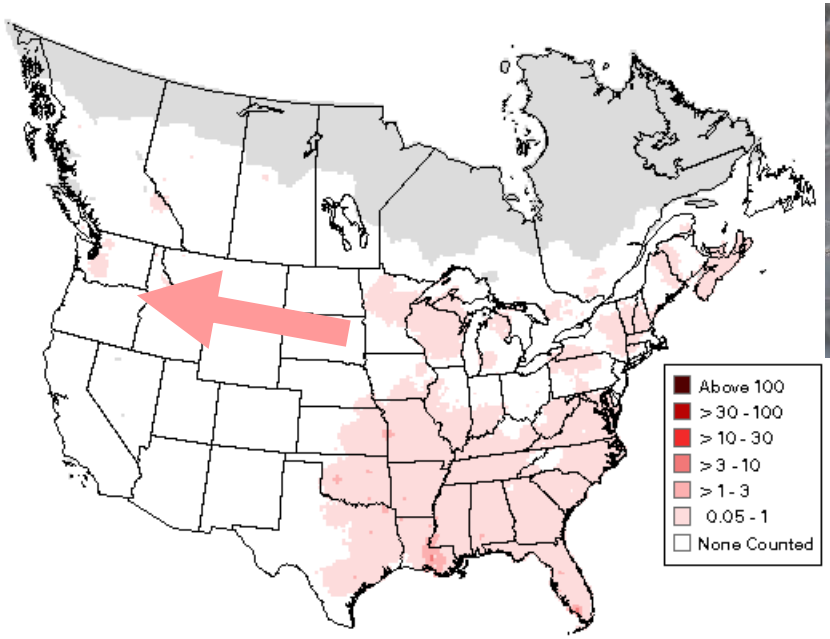
# Extinction: Species at the brink

- **Polar Bear (Ursus maritimus)**
  - Global population < 25,000
  - Scientists expect greater than 2/3 of the global population to decline by 2050
  - 95% of diet consists of ringed-bearded seals
    - Bears can need ice to hunt prey
  - Habitat disappearing due to climate change
  - Adapt to new terrestrial food source???

# Extinction: Species at the brink

- **Northern Spotted Owl (*Strix occidentalis caurina*)**
  - **Small population**
  - **Eats primarily woodrats and flying squirrels**
  - **Nests in old-growth forests of the Pacific Northwest**

Northern spotted owl




Barred owl

# Extinction: Species at the brink

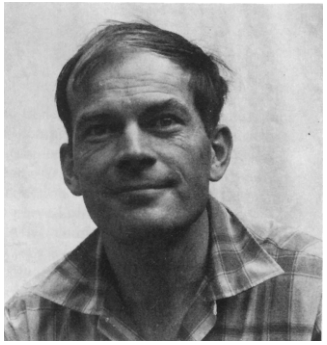
- **White-Nosed Syndrome**
  - **90% of bats in four hibernaculums in New York State have died from**
  - **Indiana bats (Myotis sodalis), small-footed bats (Myotis leibii)**
  - **Warming temperatures, West-Nile pesticides?**

# Signature Features of Islands: Summary

- Certain types of disperses have the best chance of colonizing islands
- Species that can cope with variable and limited resources are typically more successful on islands
- Random factors also play an important role in driving island systems
- Isolation + strong selective pressure = evolution-characteristics of island species
- Species on islands and "habitat islands" are prone to extinction
- Many of the patterns we see on islands apply to continental systems

# Equilibrium Theory of Island Biogeography

- **MacArthur and Wilson's (1967) Equilibrium theory of island biogeography**



- **Neutral or null models: make assumptions that simplify systems and make predictions based on a few variables**



MacArthur RH and Wilson EO. The theory of island biogeography. Princeton University Press, 1967.

# Island Biogeography

- **Purpose of model:**
  - **Develop a unifying theory predicting species diversity that is useful for all island systems or habitat islands**
  - **Predict species diversity (not abundance)**
  - **Include only the most important factors explaining species diversity on islands**
  - **Assume all other factors have small influence**
  - **Previous research lacking-unable to predict patterns**



MacArthur RH and Wilson EO. The theory of island biogeography. Princeton University Press, 1967.

# Equilibrium Theory of Island Biogeography

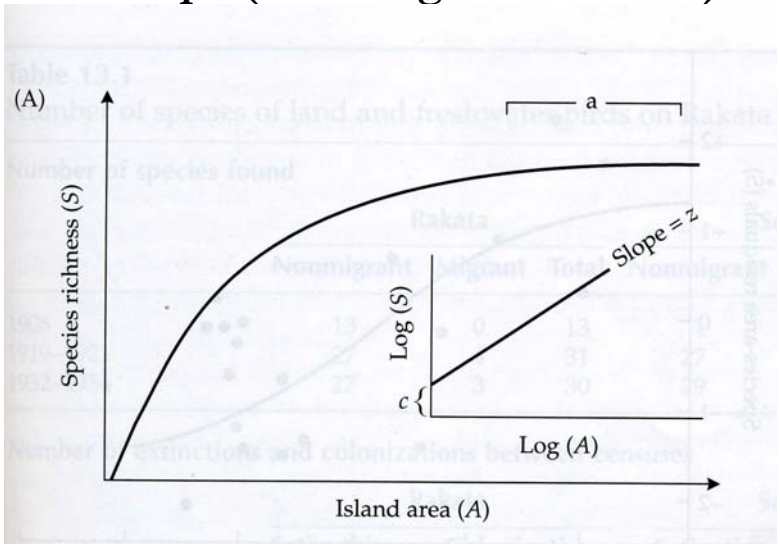
- **Central Idea to Model**
  - **Dynamic Equilibrium: opposing forces (immigration and extinction) maintain some constancy or equilibrium despite turnover**
    - **Example: thermoregulation in hummingbird**
  - **Basic characteristics of insular biotas that inform the model:**
    - **Species area-relationship**
    - **Species isolation-relationship**
    - **Species turnover**



Brown and Lomolino Biogeography 2nd edition. 1998. Sinauer Associates, Sunderland, MA.

# Equilibrium Theory: Species/Area Relationship

- **Species/Area Relationship**
  - **One of the best patterns recognized in nature**
  - **Power function: $S=cA^z$ or $\log S = \log c + z \log A$**
    - **S = species richness**
    - **c = fitted constant**
    - **A= island area**
    - **z = slope (when log transformed)**

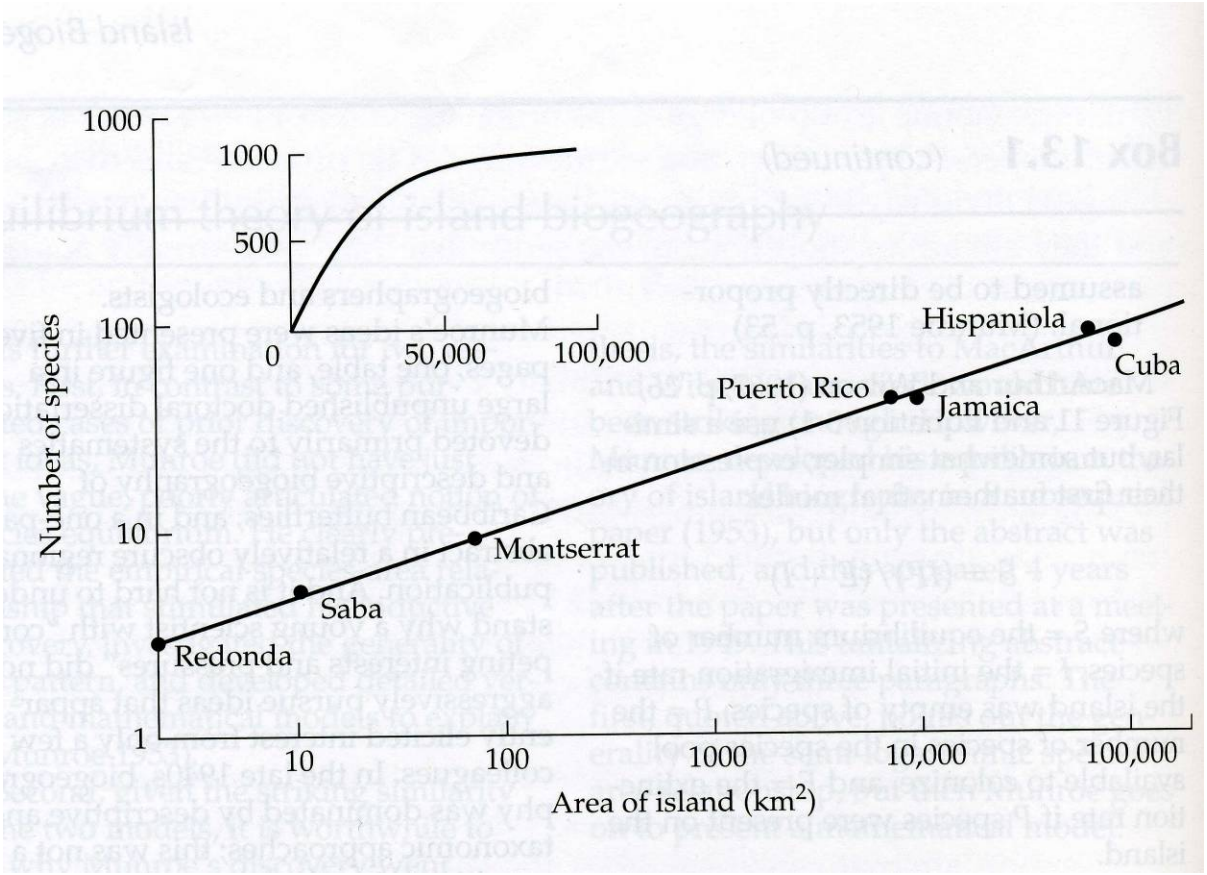





Brown and Lomolino Biogeography 2nd edition. 1998. Sinauer Associates, Sunderland, MA.

# Equilibrium Theory: Species/Area Relationship

- **Species/Area Relationship**

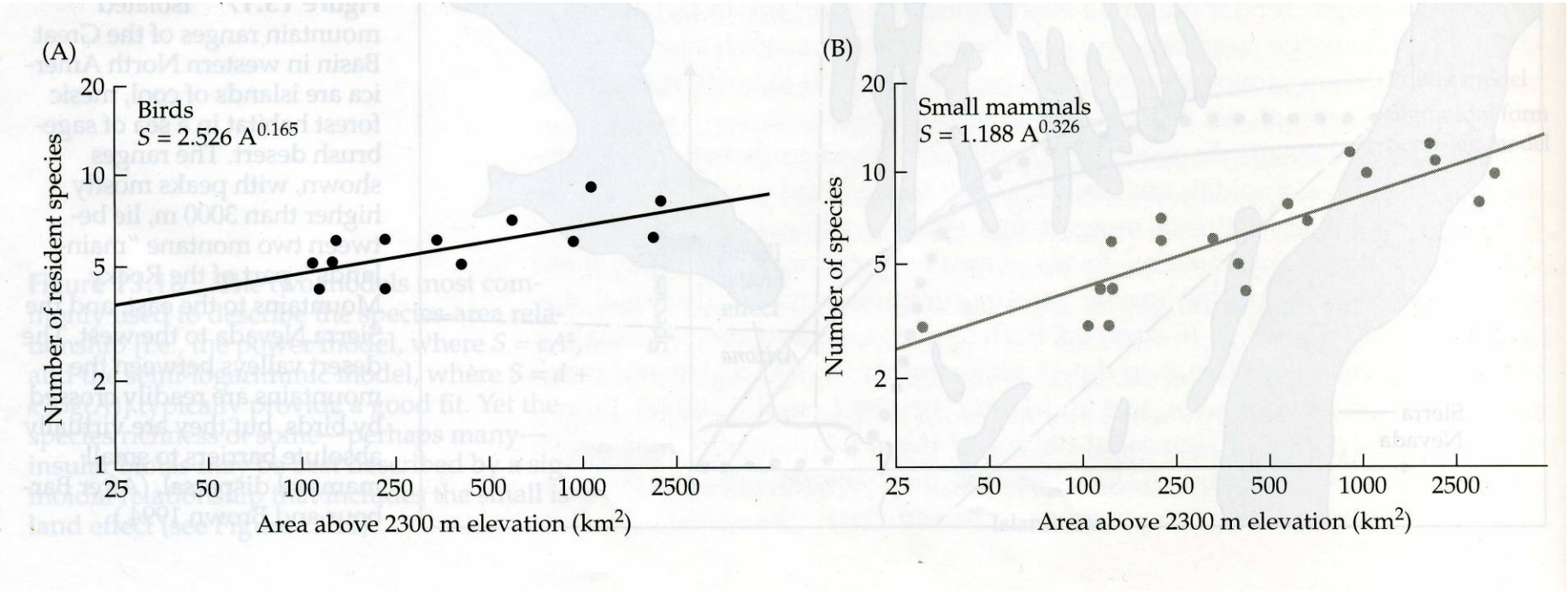





Brown and Lomolino Biogeography 2nd edition. 1998. Sinauer Associates, Sunderland, MA.

# Equilibrium Theory: Species/Area Relationship

- **Species/Area Relationship**
  - **Habitat Islands in the Southwest**

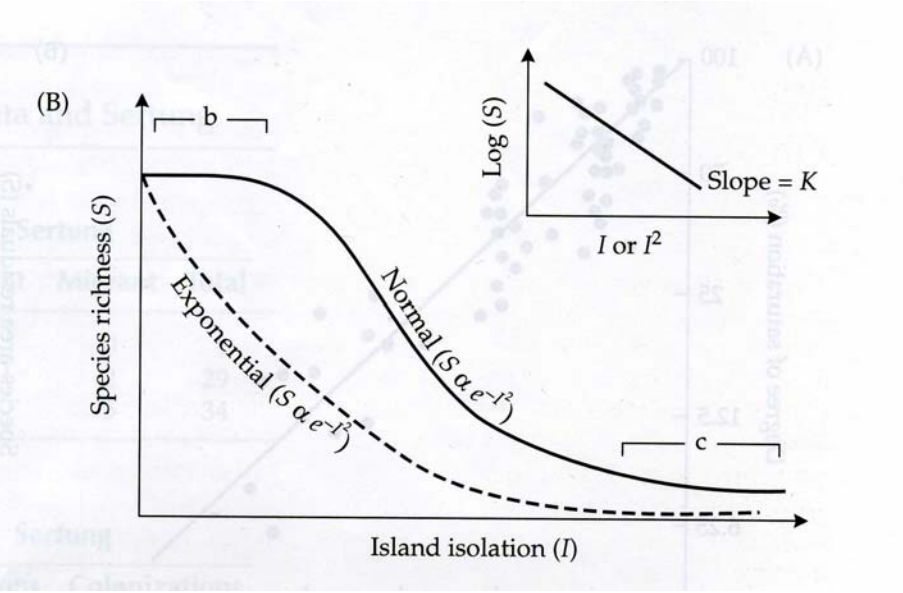





Brown and Lomolino Biogeography 2nd edition. 1998. Sinauer Associates, Sunderland, MA.

# Equilibrium Theory: Species/Isolation Relationship

- **Species/Isolation Relationship**
  - **Sigmoidal curve**
  - **In very near (b) or very far (a) islands relationship is less distinct**

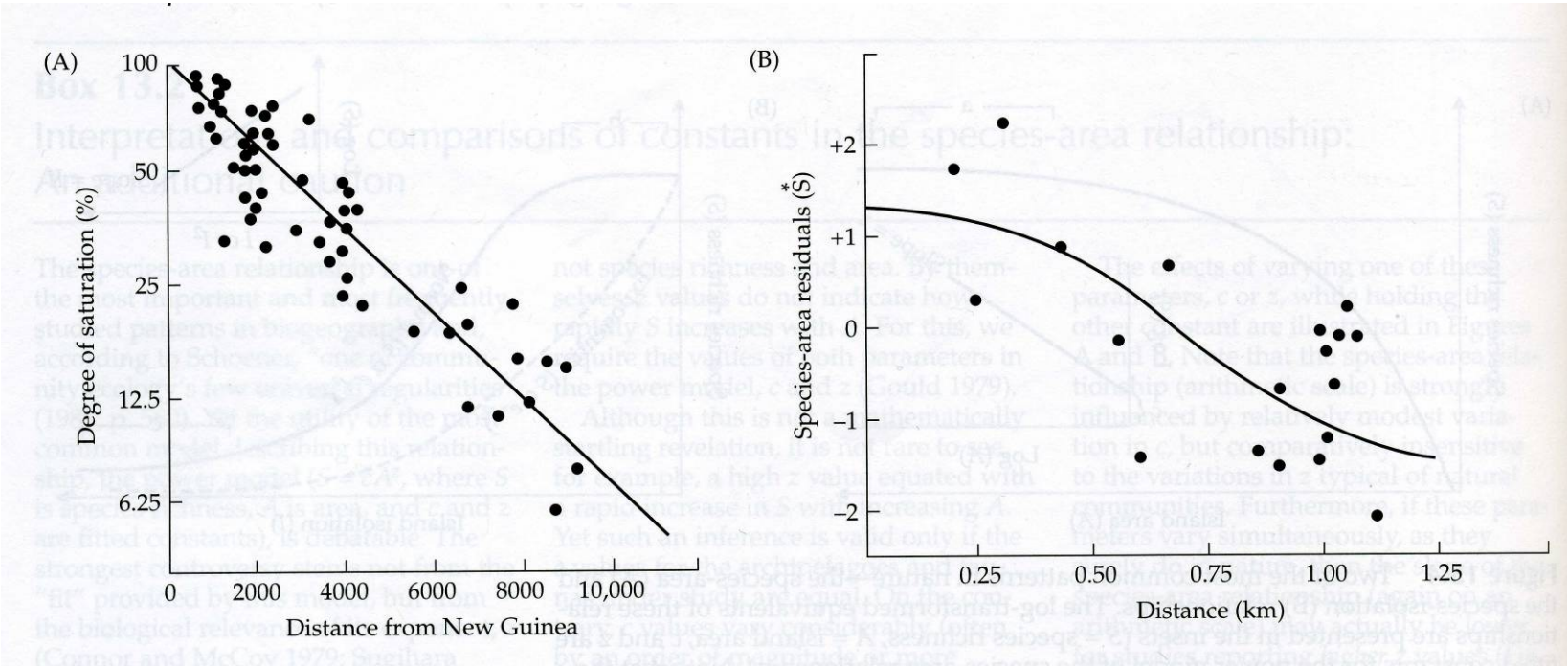





Brown and Lomolino Biogeography 2nd edition. 1998. Sinauer Associates, Sunderland, MA.

# Equilibrium Theory: Species/Isolation Relationship

- **Species/Isolation Relationship**






Brown and Lomolino Biogeography 2nd edition. 1998. Sinauer Associates, Sunderland, MA.