Communities

All species that live together in an ecosystem

Factors affecting Community Diversity:

- Dominant species
  - Decreases diversity
    - by competition

- Keystone species
  - Increases diversity
    - reduces numbers of competitive dominants

- Disturbance
  - Increases or decreases diversity, depending on:
    - Frequency
    - Intensity

-Biogeography
  - Latitude
  - Area

Keystone Species

A highly important species in community

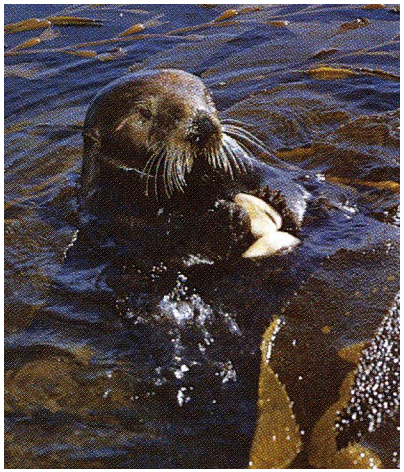
- Other species depend on it
- High biodiversity when present
- Low biodiversity when absent
- Not very abundant, but strong influences on others

Sea stars

Sea otters

Fig Trees

Keystone predators



Present -> high species richness (biodiversity)

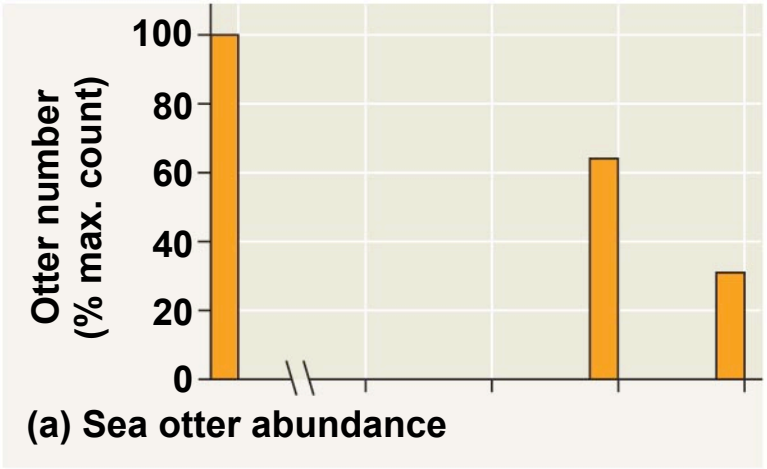
Absent -> low richness

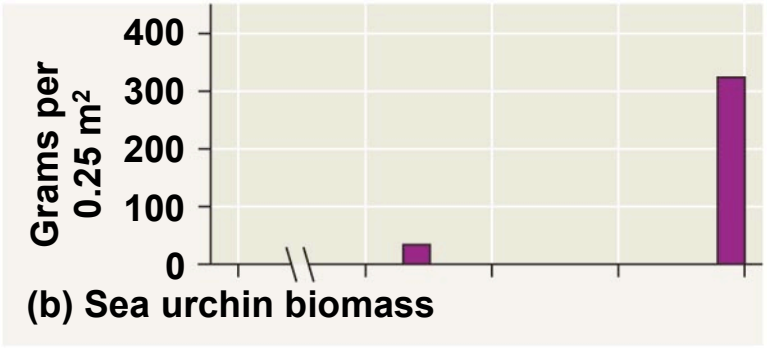
Why?

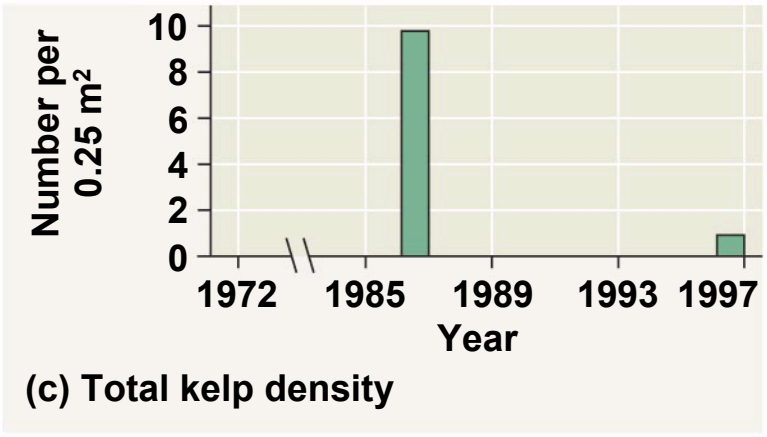
They feed on ecologically dominant species (competitors or herbivores) who reduce biodiversity

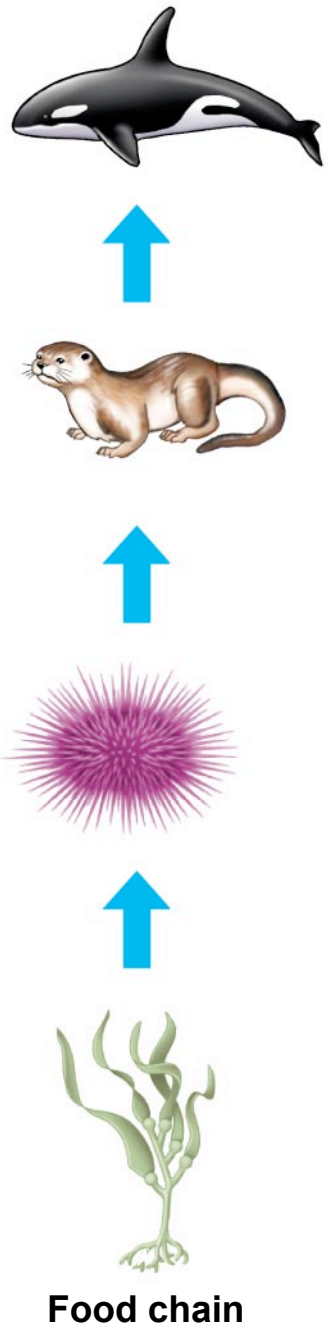
A keystone species can be a Mutualist

- **Fig trees**
  - **get seed dispersal as animals eat fruit**
- **Frugivores (fruit eaters)**
  - **get food**









Food chain

Sea otters are keystone predators

- Sea urchins eat kelp
- Otters feed on urchins

- Low urchin #s

High species diversity

Otters absent

- High urchin #s

- Eat too much kelp
- Loss of food & habitat

Low species diversity

Succession

- A process of community change over time
  - **Change in species composition**

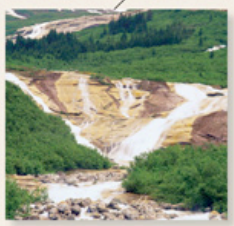
- One group of species replaces another as abiotic environment changes

  Herbs & grasses -> Shrubs -> Trees

Seral stage	Pioneer	*Dryas*	Alder	Spruce
Time (years) since glacial retreat	5	40	60	200
Soil depth (cm)	5.2	7.0	8.8	15.1
Soil N (g/m^2)	3.8	5.3	21.8	53.3
Soil pH	7.2	7.3	6.8	3.6
Litterfall ($g/m^2/yr$)	1.5	2.8	277	261

Cyanobacteria
Moss
Lichens

Mountain avens
(*Dryas drummondii*)



Alder
(*Alnus sinuata*)

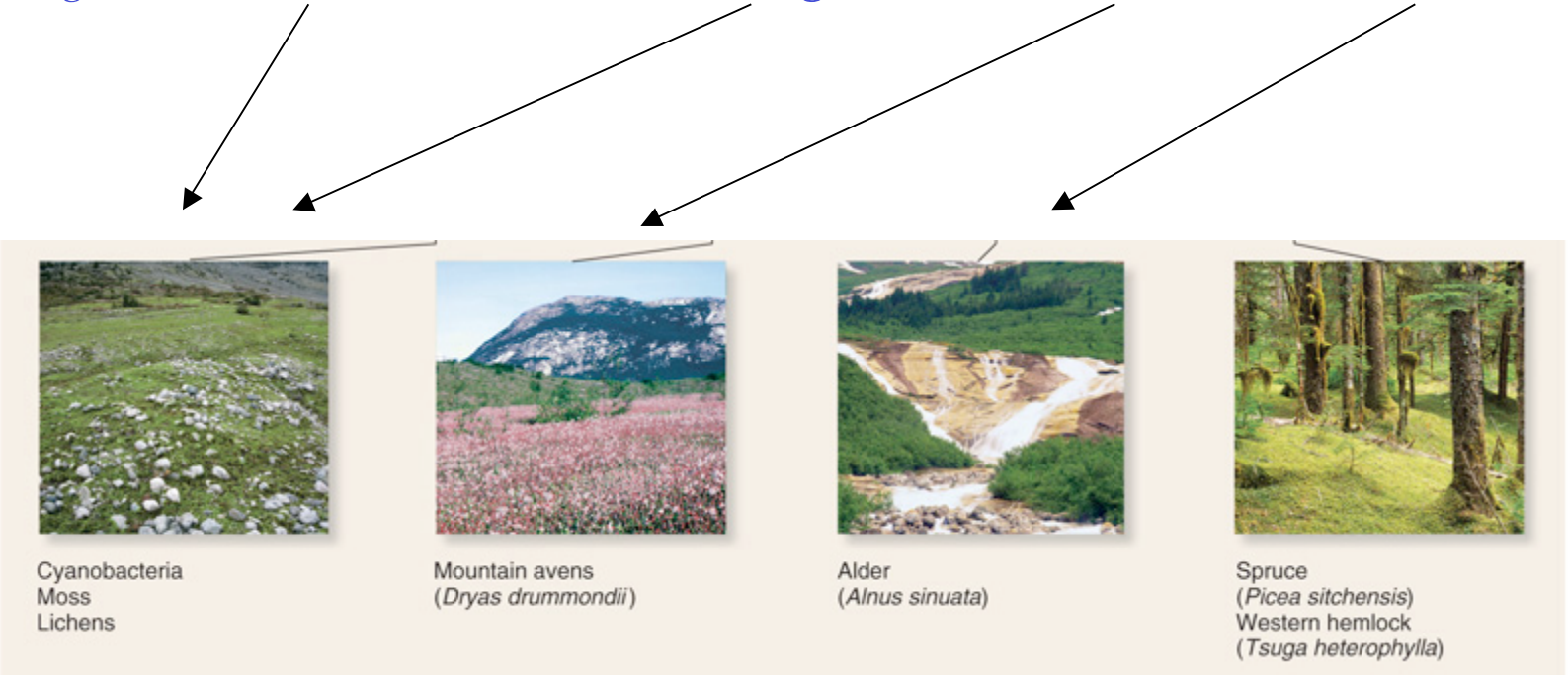
Spruce
(*Picea sitchensis*)
Western hemlock
(*Tsuga heterophylla*)

Succession

Seral stages - each phase of succession

- **A seral stage is one group of species that occupies the habitat**
- **Each group of colonizing species changes the environment**
- ***"Pioneers" - first group of species to arrive***
- ***One seral stage replaces another***
- **New group of species have similar abiotic requirements**

- *eg: Mosses & Lichens -> Herbs & grasses -> Shrubs -> Small Trees*



Succession

Climax community

- Distinct end point of succession

- **Stable community w/ no changes in species**
  - *eg:* **Trees**

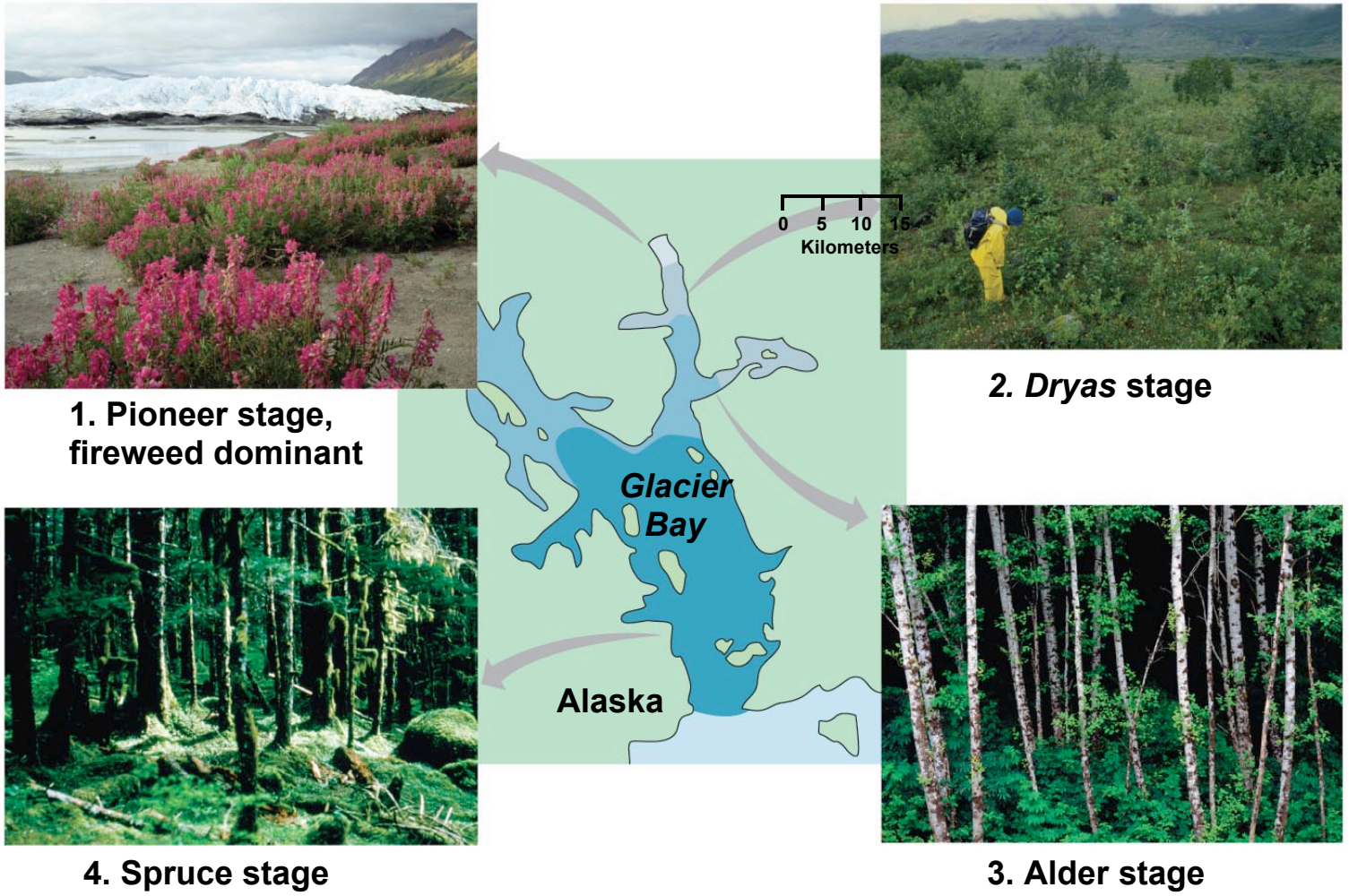
- **Community persists until there is disturbance**

Primary succession

– Colonization of a newly exposed site (e.g. glacier, volcano)

• Slow: No soil or vegetation initially *(soil formation needed)*

• Seral stages replace each other, followed by climax forest



1. Pioneer stage, fireweed dominant

2. *Dryas* stage

4. Spruce stage

3. Alder stage

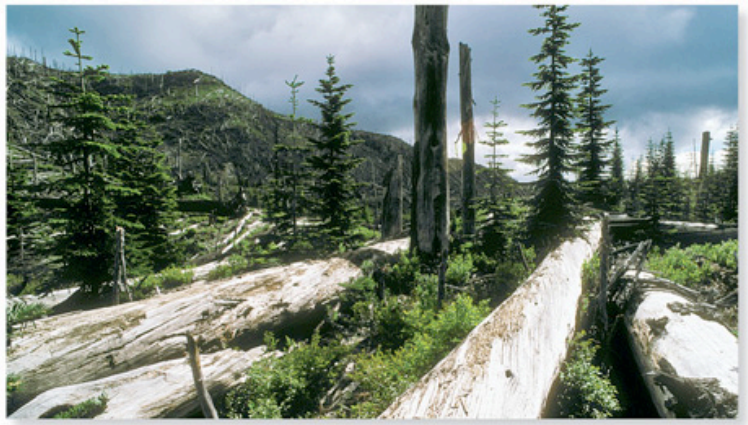
Secondary succession

– Community establishment after disturbance

i.e.: fire, tornado, hurricane, flood, logging

- Original vegetation destroyed
- Area already has soil
- Faster process due to soil presence
- Seral stages replace one another
- Climax forest is stable community

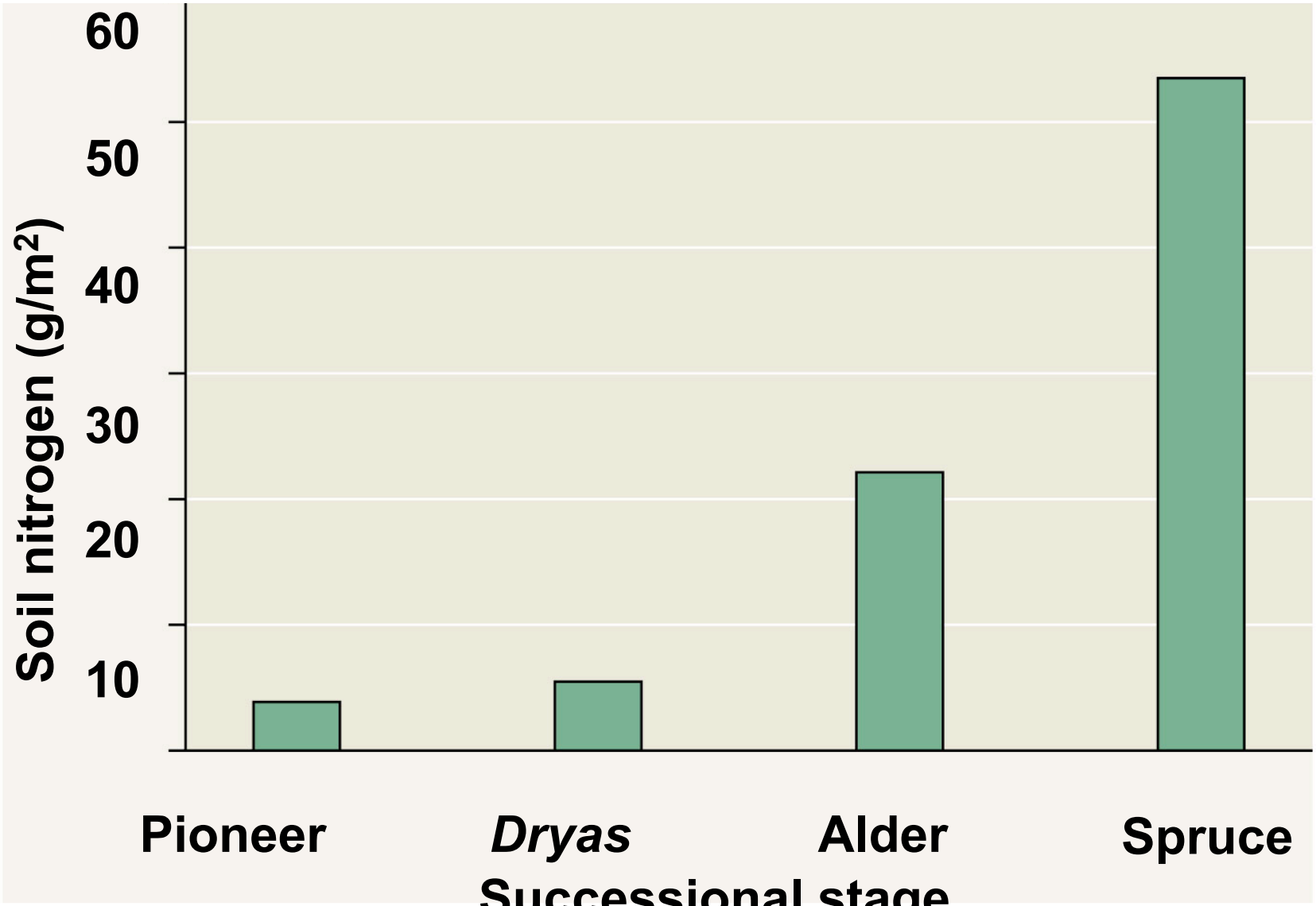
(a) 1980



(b) 1997

- ***Forest trees cannot be replanted immediately after a forest fire***
- ***Abiotic conditions are not good for tree seedlings & must change over time for climax forest trees to thrive***

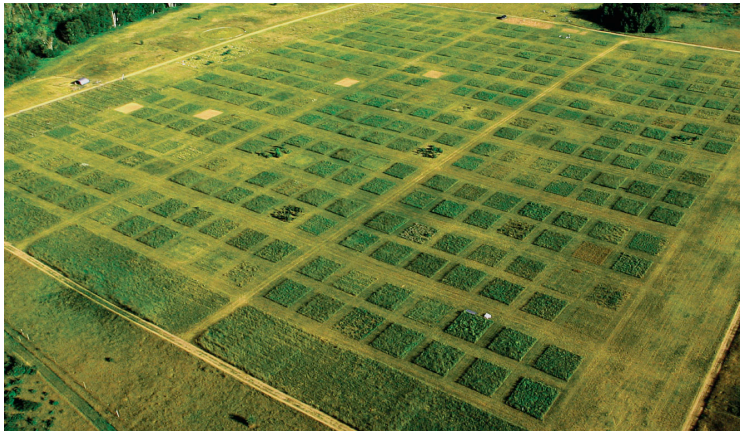
Species composition changes as abiotic factors change



Diversity and Community Stability

Diversity was manipulated in experimental communities to study the potential benefits

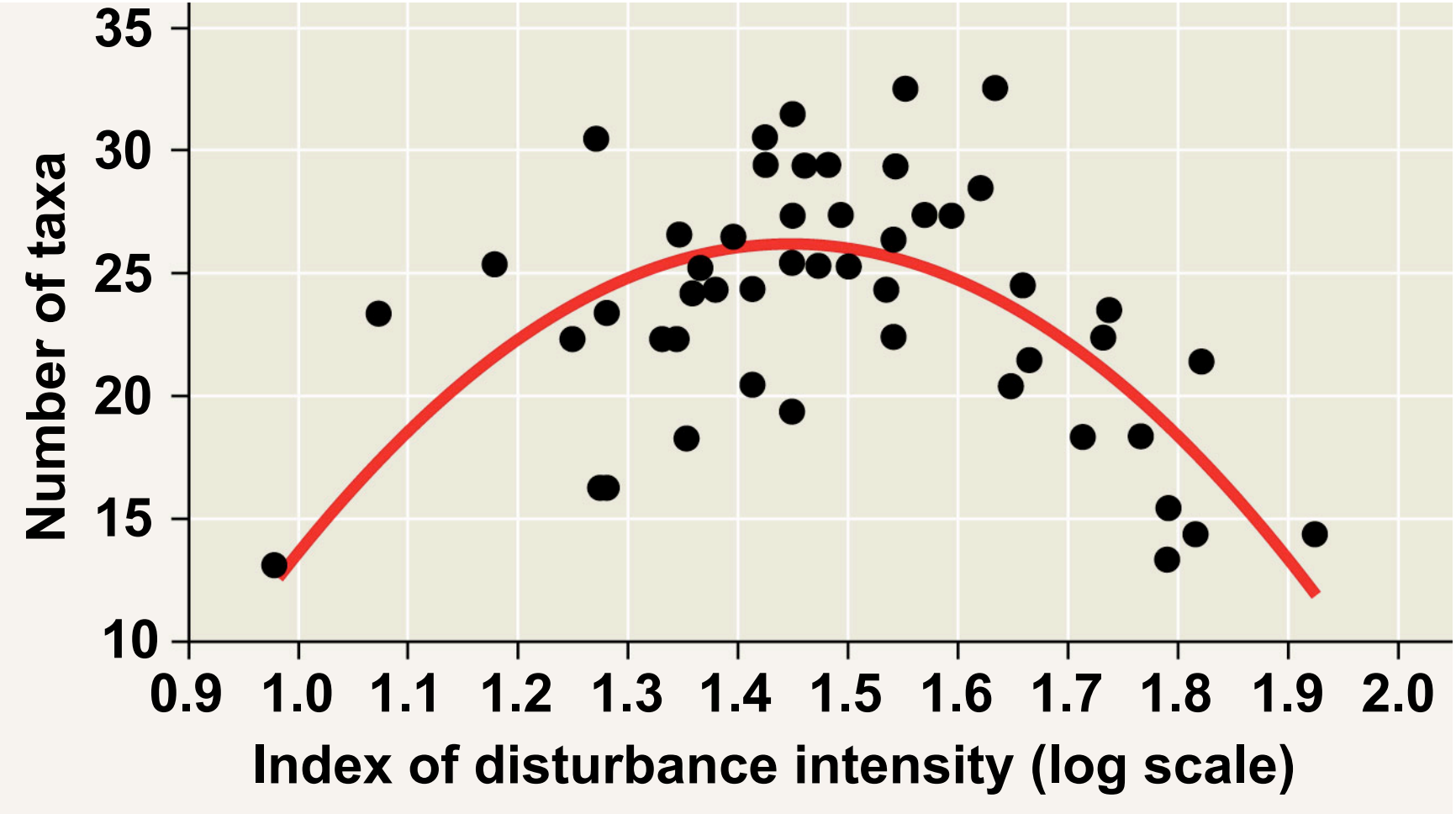
- **Communities with higher diversity are:**
  - –More stable & more productive
  - –Better able to withstand & recover from environmental stresses
  - –More resistant to invasive species



Intermediate Disturbance Hypothesis

Moderate levels of disturbance results in greater diversity

- **High levels: exclude many slow-growing species**
- **Low levels: dominant species exclude other species**



Nonequilibrium Communities

Most communities are constantly changing due to disturbances

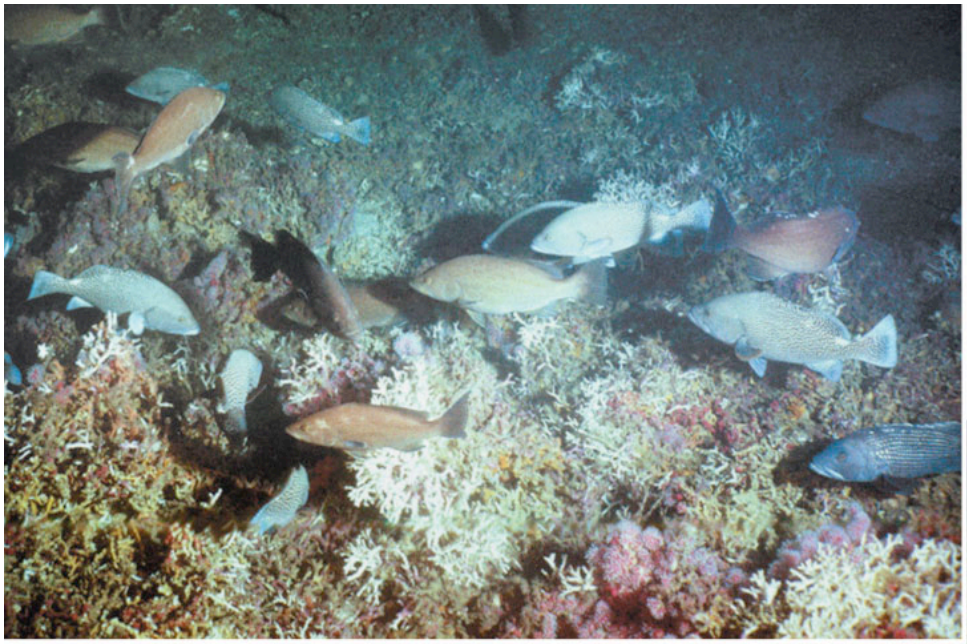
Frequent large scale disturbances (such as fire) prevent a climax community from developing

(a) Soon after fire

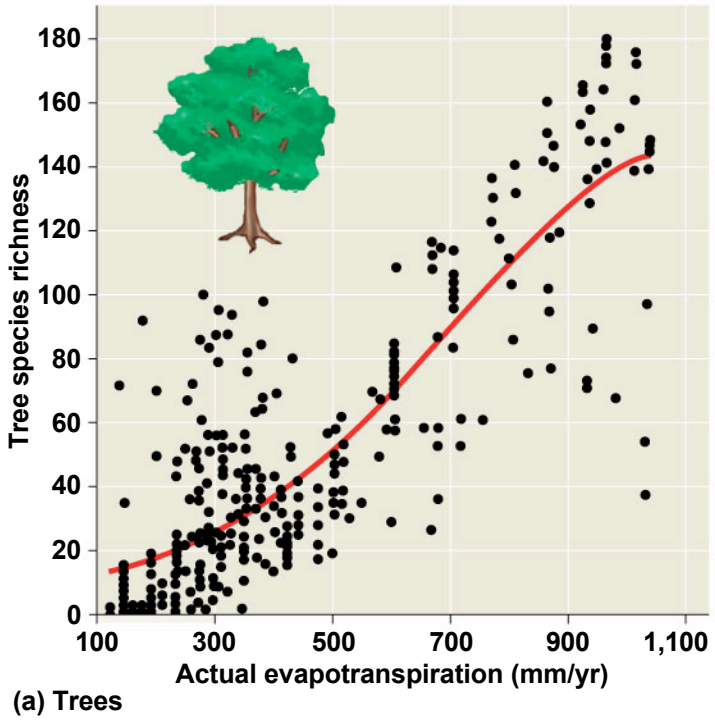
(b) One year after fire

The Yellowstone forest:
an example of a nonequilibrium community

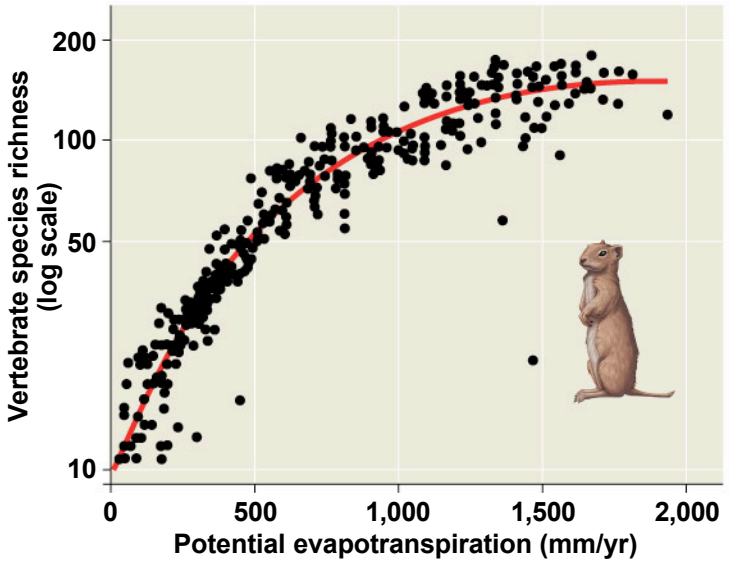
Severe large-scale, frequent disturbances by humans reduce diversity



Bottom trawling in benthic habitats destroys marine communities



(a) Trees



(b) Vertebrates

Effects of Biogeography on Species Richness

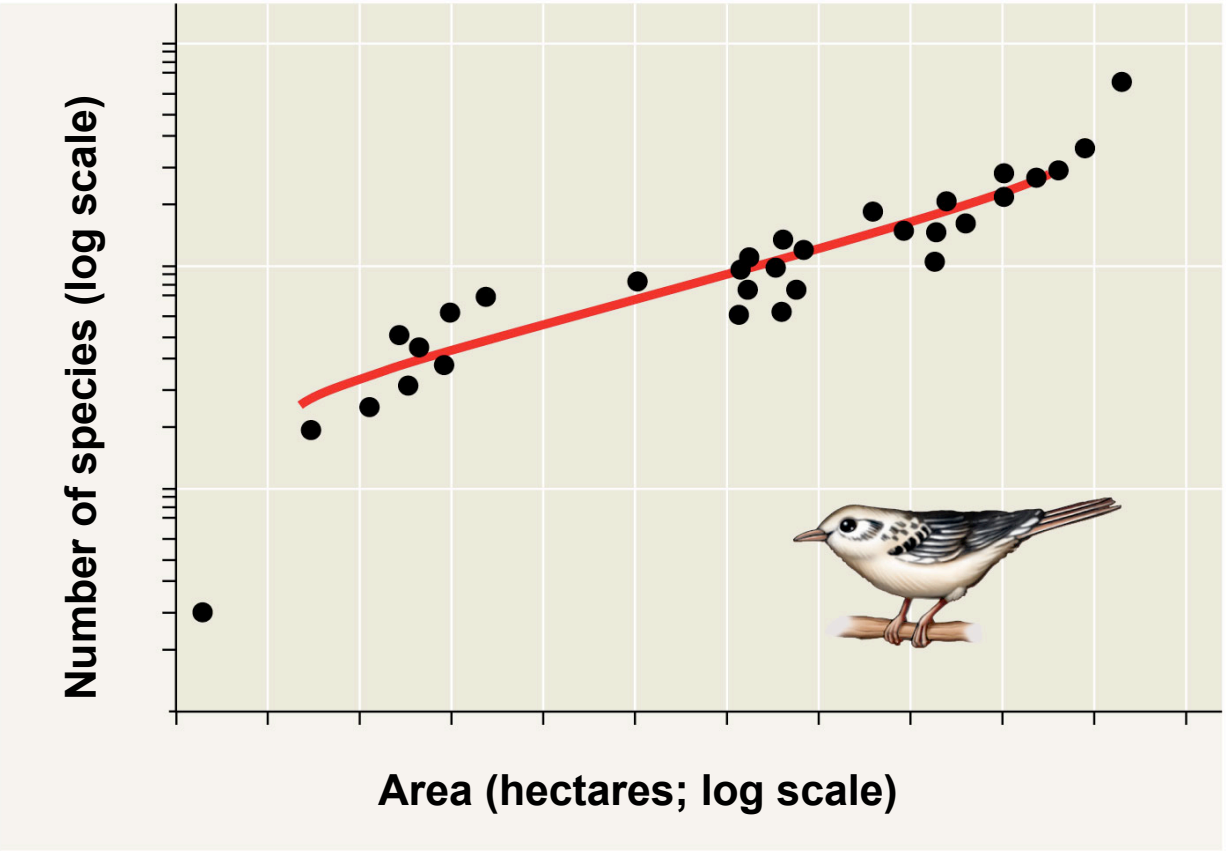
Latitudal gradients

-More species closer to equator

-Fewer species near poles

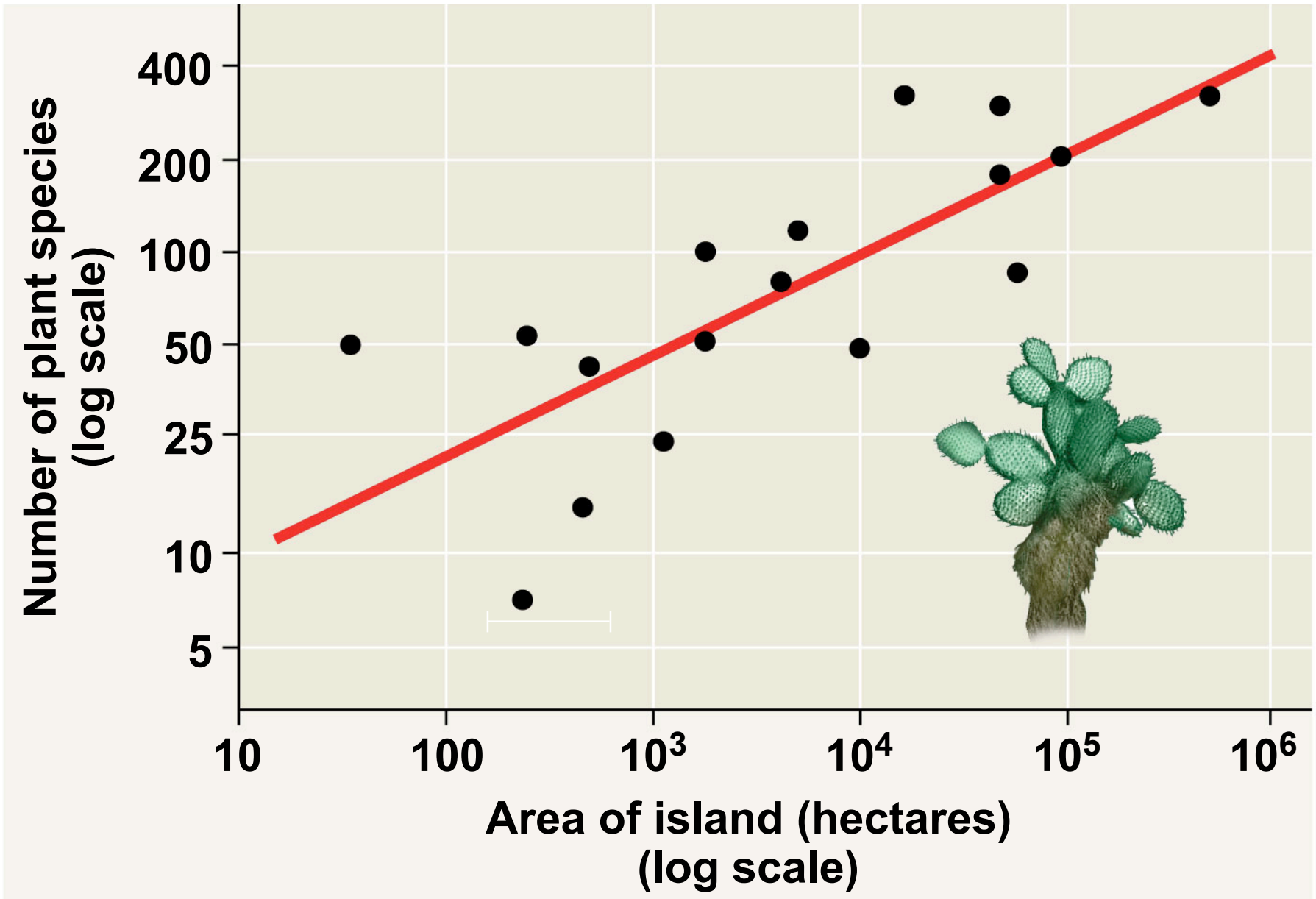
Effects of Area Size on Species Richness

- Species richness increases with size of habitat



North American Birds

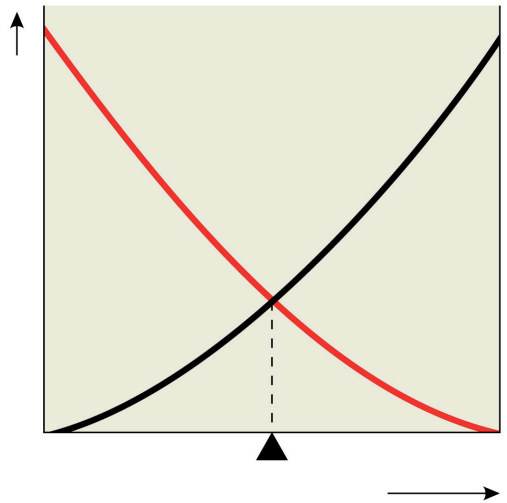
Island Size influences Species Richness

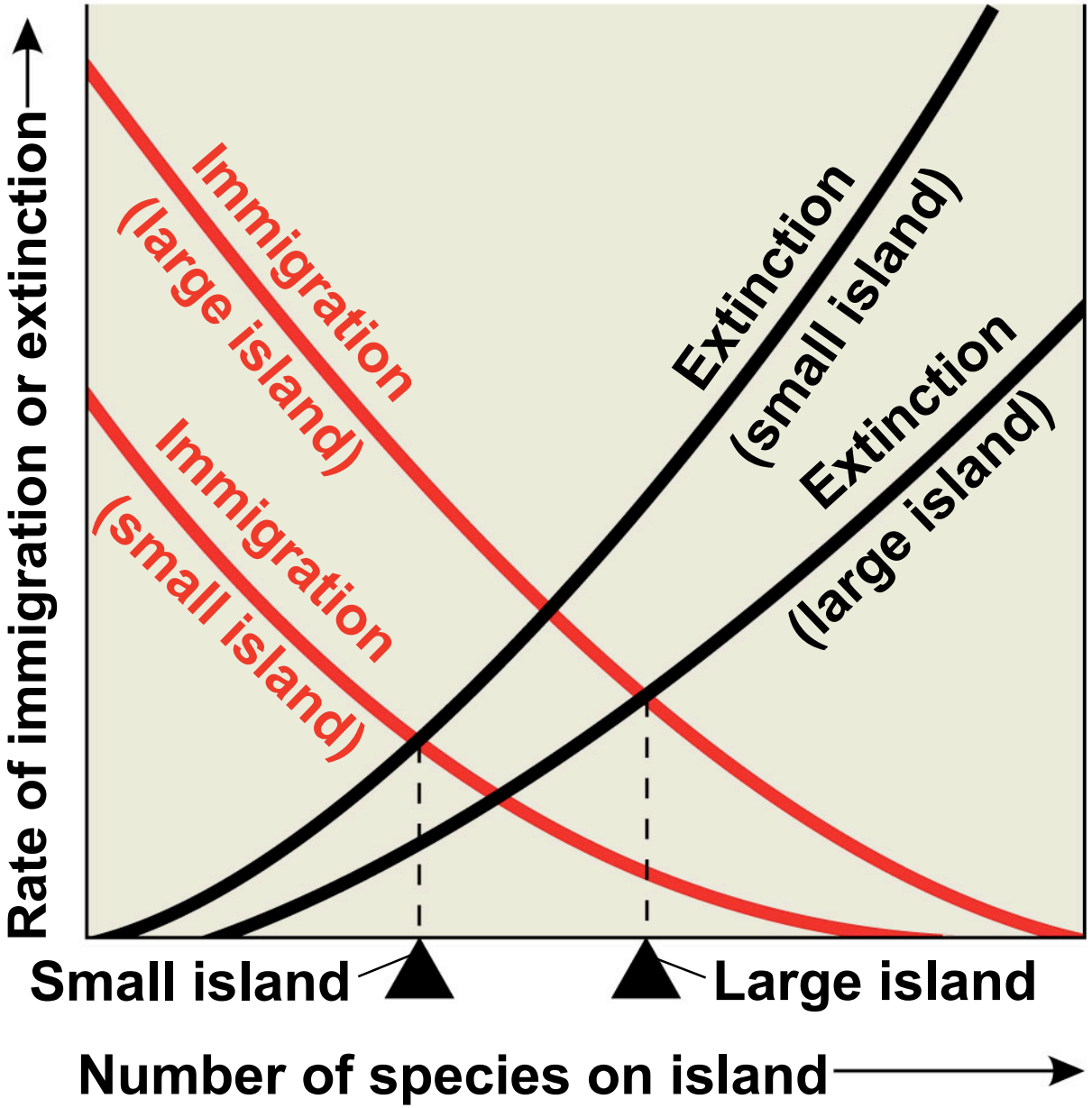


Equilibrium model of Island Biogeography

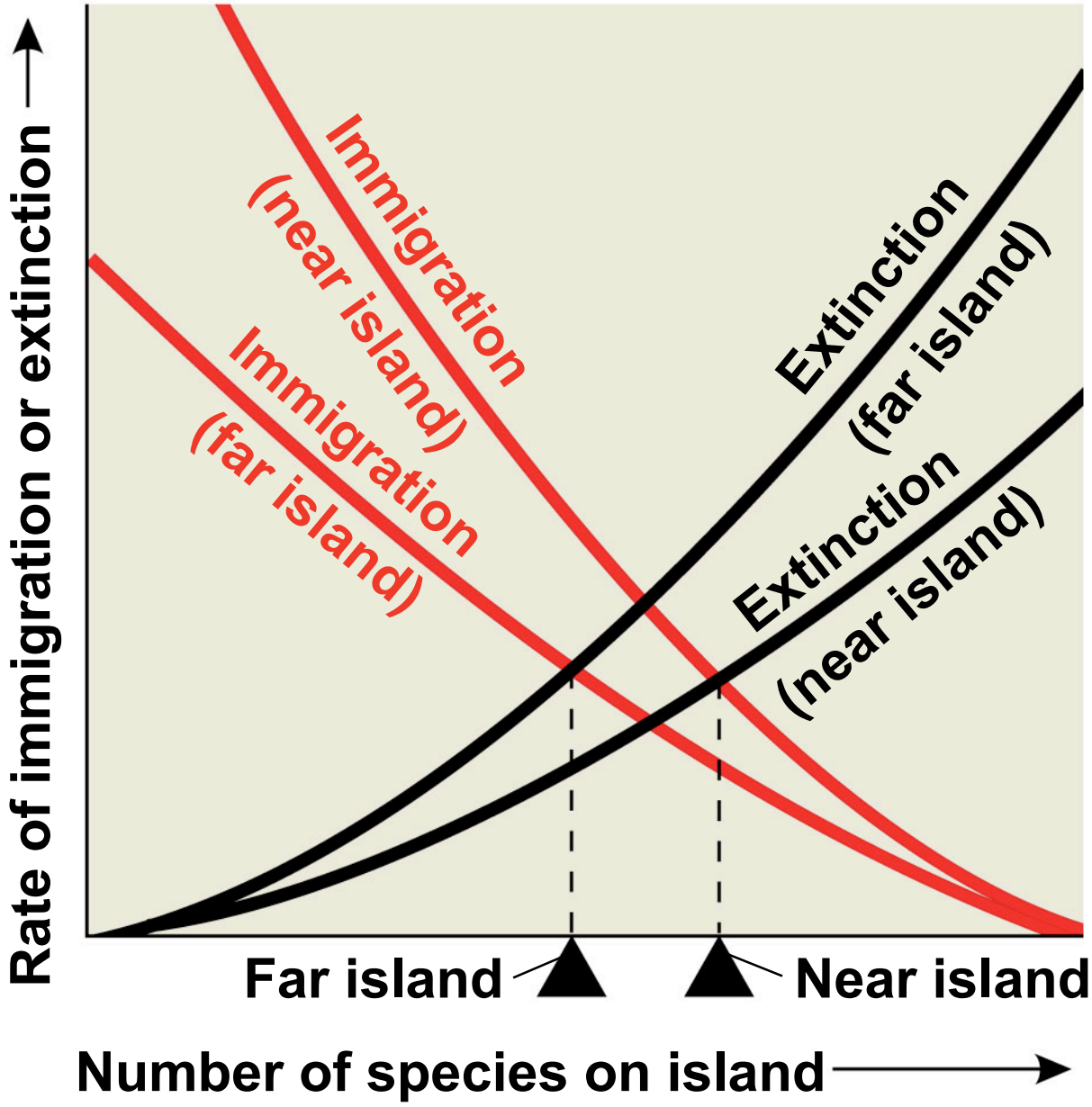
Species richness on islands depends on:

- **Immigration & Extinction rates**
  - **# coming in vs. # dying out**
- **Island size**
  - **Larger islands have more species**
- **Distance from the mainland**
  - **Closer islands have more species**





(b) Effect of island size



(c) Effect of distance from mainland

Island Biogeography Theory is applied to Conservation Biology

- *Natural habitats today are islands in a "sea" of humanity*
- *Large barriers to dispersal*
- *Park size vs. Species loss*
  - *Small parks lose more species than large ones*
  - *Parks farther from wildlands have lower colonization rates*
  - *Conclusion: almost all our national parks are too small & too isolated to save species from local extinction*