

## What is Conservation Biology?

- "Conservation biology is a synthetic discipline that focuses on the application of biological principles to the preservation of biodiversity; it represents a fusion of relevant ideas from ecology, genetics, biogeography, behavior, reproductive biology, and a number of applied disciplines such as wildlife management and forestry." (Brussard 1991)

## Measures of Diversity

- Species richness- the number of species
- Evenness- how well represented each species is
- ? - within habitat, and ? - between habitat diversity
- Shannon-Weiner diversity measure includes both richness and evenness.

$$H' = -\sum_{j=1}^s p_j \ln p_j$$

### Measuring diversity

Table 21.2 Comparison of diversity indices  $H'$  and  $e^H$  for hypothetical communities of five species having different relative abundances

Proportion of sample represented by species					Diversity index		
A	B	C	D	E	$H'$	$e^H$	$e^H$
0.20	0.20	0.20	0.20	0.20	5.00	1.609	5.00
0.25	0.25	0.25	0.25	0.00	4.00	1.386	4.00
0.24	0.24	0.24	0.24	0.04	4.30	1.499	4.48
0.25	0.25	0.25	0.25	0.008	4.62	1.391	4.01
0.10	0.10	0.10	0.07	0.01	2.80	1.229	1.42

Diversity indices weight species richness by abundance.

## Biodiversity

what is it?

- Character diversity
- Functional diversity
- Community/Ecosystem diversity
- Genetic diversity
- Population diversity
- Family/Order/Phylum
- Species diversity
  - alpha diversity
  - beta diversity



## Temporal and Spatial Factors Influencing Evolution of Freshwater Organisms

- Time- ancient lakes and watersheds have many unique species and high diversity
  - Lake Biakal has 377 endemic crustacea, 86 turbellaria, 98 mollusks, 29 fish, and a freshwater seal
- Geographic isolation
  - unique groundwater fauna related to isolation
  - dispersal ability linked to degree of isolation
  - temporary pools can have many endemic species

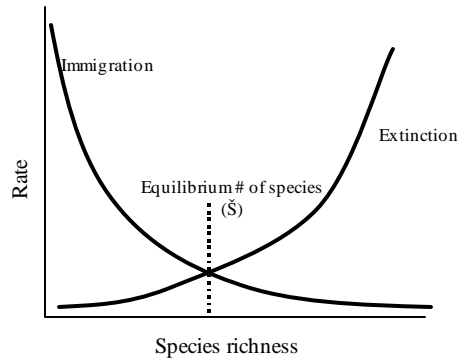
## Short-Term Factors Influencing Local Distribution of Species

- Colonization
- Habitat type
- Disturbance
- Productivity
- Species interactions
- Species introductions

## Island Biogeography

- Two major parameters characterize an island:
  - Distance From the Mainland or Species Source
  - Size
- How do size and distance from mainland affect the species richness of island communities ?
- Theory of Island Biogeography was proposed by Robert MacArthur and Edward Wilson in 1967 using a quantitative mathematical modeling approach to explain the number of species found on an island as a balance between immigration and extinction.

## Island Biogeography



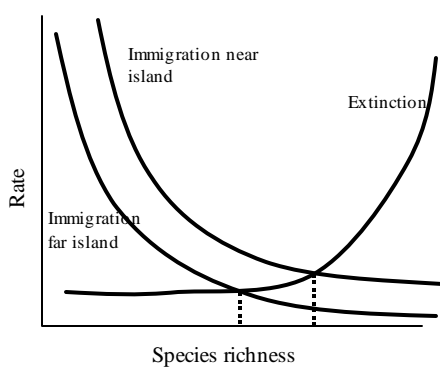
## Immigration Rates to Islands

- The rate of colonization will be high initially because most species are new and because the island can be reached by those adept at dispersal.
- As more species occupy the island, fewer open niches will be available to new arrivals.
- As time passes, immigrants will increasingly belong to species that have already reached the island, so that the rate of new species drops off.
- Furthermore, the rate of immigration will be affected by the location of the island, as islands close to the source region will have higher rates of immigration, while islands far from the source region will have lower rates of immigration.

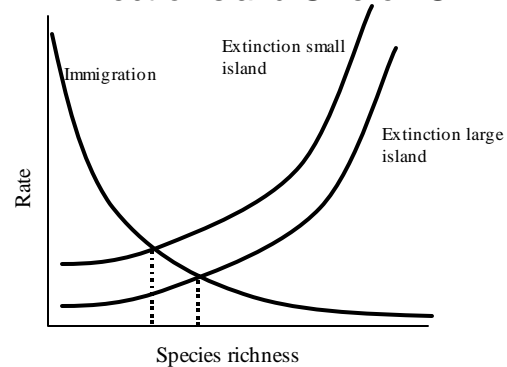
## Extinction Rates on Islands

- The rate of extinction, will start at a low level but gradually rise because the more species, the greater the risk of extinction as populations of individuals become smaller due to competition.
- At first, the few species present can occupy a greater variety of ecological niches than would be possible on the mainland, with little competition from other species on the new island.
- As new species arrive, the rate of extinction rises, as smaller populations must be supported due to a constant food resource. Smaller populations have a greater chance for extinction.
- Extinction rates will tend to be higher on small islands, as small islands support small populations

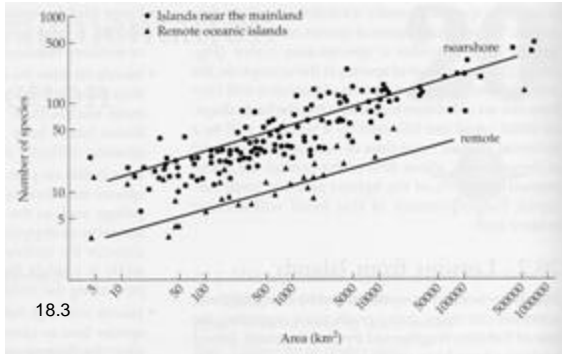
## Effect of Island Distance on $\check{S}$



## Effect of Island Size on $\check{S}$



## Effect of Island Distance on $\checkmark$



## Invasions of Nonnative Species

- Most permanent form of pollution
- Summary of why species invade successfully
  - most invaders fail to establish
  - most successful invaders have no significant effects
  - all aquatic systems can be invaded
  - major community effects occur most often in low-diversity systems
  - top predators are more likely to have strong effects
  - species must have appropriate physiological and morphological adaptations to invade successfully
  - invaders are more likely to become established in disturbed systems
  - even stable systems can be vulnerable to invasion
  - the greater the number of invaders and the number of invasions, the greater the probability of successful invasions
  - species that have a history of prior invasions are likely to invade successfully again

## Ecosystem Costs

- second most detrimental factor on biodiversity, after habitat loss; 400 of 958 of US threatened or endangered spp.
  - Species extinctions via predation
    - Brown tree snake wiped out 10 of 13 native birds on Guam, 6 of 12 native lizards, and 2 of 3 native bats
    - Nile perch in Lake Victoria has extirpated half of the endemic cichlid species
    - Pet cats/feral cats
    - Sea lamprey - destroyed 97% of lake trout in 21 years
  - Effects via competition:
    - English sparrow
    - Cascading effects - opossum shrimp

## Snakehead fish found in Lake Michigan

- Biologists fear colony, large environmental toll
- By DAN EGAN

- **Posted: Oct. 19, 2004**
- When biologists found a dreaded snakehead fish lurking in a Maryland pond two years ago, the solution was simple: Poison the whole pond.



## Extinction

- Extinction rates are about 1 million times greater than rates of speciation
- Aquatic systems are very vulnerable
- Lake Victoria- 300 species evolved in last 12,000 years, 200 extinct in last decade from introduction of Nile Perch and pollution
- In U.S. there are 73 fish, 69 bivalves, 28 snails, 17 amphibians, and 20 crustaceans listed as threatened or endangered
- Over half of the freshwater unionid mussel species are endangered
- Extinction is forever

