A Lesson of Ecology

Natural systems are maintained and constrained by processing energy.

Energy Converter

Energy Input

Useful Energy
(can perform work)

Energy Diverted
as Heat
(can’t perform useful work)

Note: The first law of thermodynamics is met.

\[ E_{\text{input}} = E_{\text{diverted}} + E_{\text{useful}} \]

Species in an ecosystem are divided into trophic levels

- Trophic levels are determined by the main source of nutrition for a species.
- Trophic levels are given names:
Lecture 11

Trophic levels

Flow of energy through a food chain

R = metabolic heat (respiration)
NU = not used (E in dead organic matter)
NA = not assimilated (E in feces)
I = ingested E
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10% rule of thumb

Ranges from:
ca. 5% in carnivores
to
ca. 20% in herbivores

There are limits to the length of food chains!

One thing seems certain, however: one cannot take literally the well-known jingle by Jonathan Swift, or the whimsical diagram of Hegner:

Big fleas have little fleas
Upon their backs to bite 'em
And little fleas have lesser fleas
And so, ad infinitum.

From Robert Hegner as found in Odum 1971
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Energy Flow Diagram
Locate NPP & GPP on the diagram

Some materials accumulate in food chains

Biological Magnification Can Have Serious Biological Effects
Communities vary in species diversity

- Species

- Species Diversity
  - Species richness
  - Equitability

Patterns -
  - Latitudinal gradients –
  - Size effect –
  - Distance effect –
The # of species in an area is related to its size.

\[ S = cA^z \]

Where \( z \) is typically between 0.15 & 0.35

Rule-of-Thumb

↓ of 90% in area results in 50% ↓ in species

The # of species ↓ with ↑ distance from a source of species

Implications of the theory

1831 1882 1902 1950
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Good and Bad Places Exist for Every Species

Organisms have their own role in a community

Ecological Niche - defined many ways.

In its broadest sense …

Niche =
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The competitive exclusion principle

Gause’s Experiment

Reduced niche overlap can allow coexistence

- Behavioral Acclimation
  Green anole lizard forced to move to branches by introduction of Brown lizard.

- Character Displacement
  Through evolution, 2 closely related species tend to be more distinct when they are sympatric than when they are allopatric.
Examples of Character Displacement

Two species of Asian nuthatches of the same genera.

Darwin’s Finches

Communities Can Recover From Disturbance

Succession -
Primary Succession

Secondary Succession

Communities Don’t Always Recover From Disturbance
Clear Cuts That Have Not Been Successfully Reforested