UNIVERSITY OF MINNESOTA EXTENSION

MAKING A DIFFERENCE IN MINNESOTA: ENVIRONMENT + FOOD & AGRICULTURE + COMMUNITIES + FAMILIES + YOUTH

Big Woods, Big Rivers

MINNESOTA MASTER NATURALIST PROGRAM

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LESSON FOUR: ECOLOGY AND THE BIG WOODS, BIG RIVERS

What is where and why?

By Danielle J Quist, U of MN Extension AFNR FWCE

Objective: *Understand the principles of ecology.*

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Levels of Study
Species Interactions
+ Energy Flow
Biogeochemical Cycles
Biological Diversity

Ecological Principles

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WHAT IS ECOLOGY?

The study of the distribution and abundance of organisms.

-- Andrewartha and Birch 1954

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ECOLOGY

Ecology is the study of the processes influencing the distribution and abundance of organisms, interactions among organisms, and interactions between organisms and the transformation and flux of energy and matter.

-- Institute of Ecosystem Studies 2006

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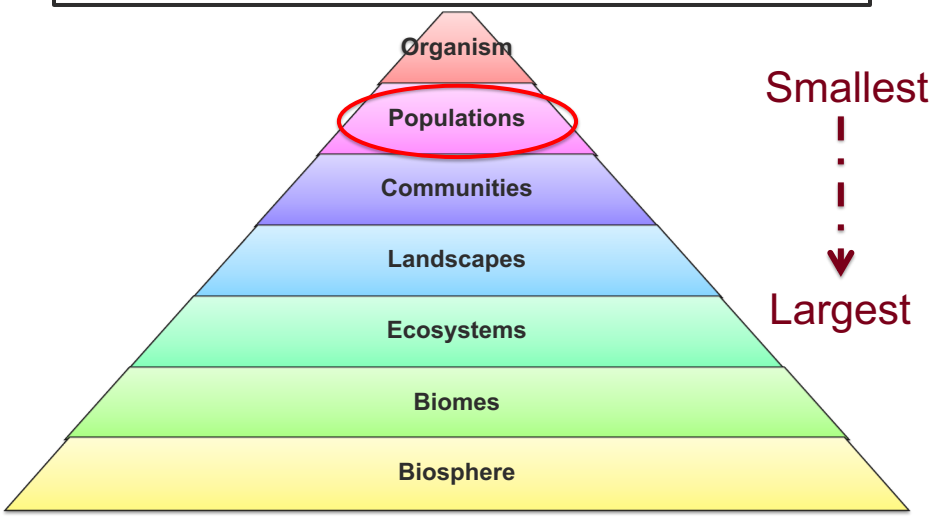
LEVELS OF ECOLOGICAL STUDY



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POPULATIONS

- A population is a group of organisms of the same species living in a particular place at a particular time.
- These organisms can exist in this place and time because the resources they need are available.
- Some ways to describe a population include…
  - Population Size
  - Population Growth
  - Population Density

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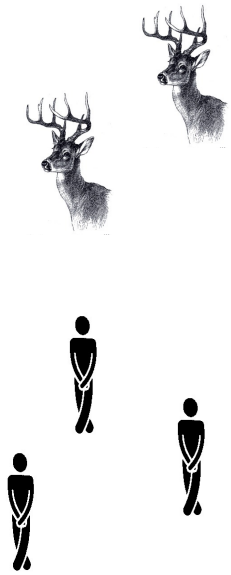
POPULATION SIZE

- 1936 521,000 deer
  2,600,000 people



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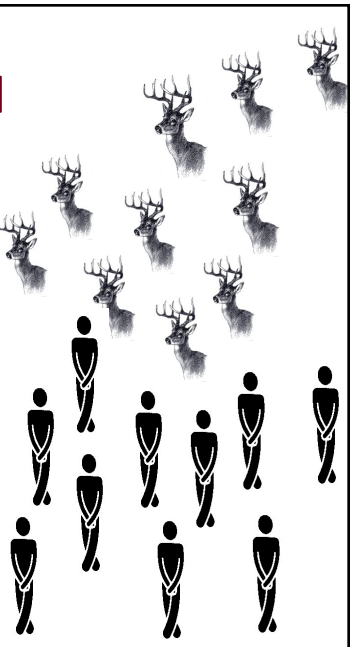
POPULATION GROWTH



- 1936 521,000 deer
  2,600,000 people
- 2005 1,200,000 deer
  5,000,000 people

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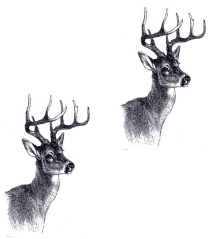
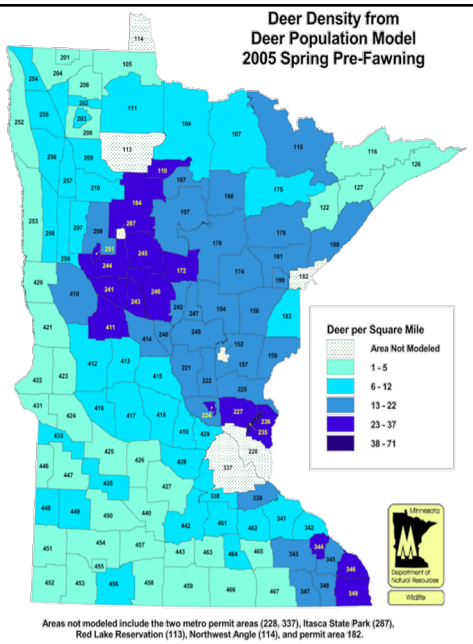
POPULATION DENSITY





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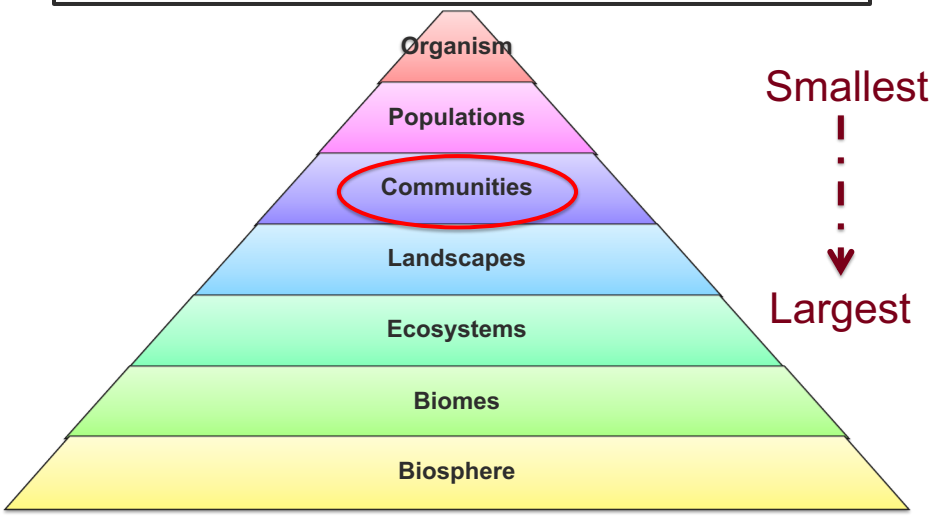
LEVELS OF ECOLOGICAL STUDY



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COMMUNITY

- Communities include all of the populations of organisms living in the same area and how they interact or depend on each other for existence.
- Sometimes ecologists will refer to only one subset of populations, such as the bird community or the soil invertebrate community.

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HOW DO YOU DESCRIBE A COMMUNITY?

- Structure
- Composition
- Productivity
- Species Interactions

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TYPES OF SPECIES (INTERSPECIFIC) INTERACTIONS

- Classify interactions by the effect each organism has on the other:
  - ✓Positive (+)
  - ✓Negative (–)
  - ✓No effect (o)

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NAME THE INTERSPECIFIC INTERACTIONS

- + / + mutualism
- + / – predation, herbivory, parasitism
- – / – competition
- + / o commensalism
- – / o ammensalism
- o / o no interaction!

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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WHAT TYPE OF INTERACTION DO THESE PICTURES SHOW?

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

BY B&T Leventhal

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

Image by B&T Leventhal

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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WHAT TYPE OF INTERACTION DOES THIS PICTURE SHOW?

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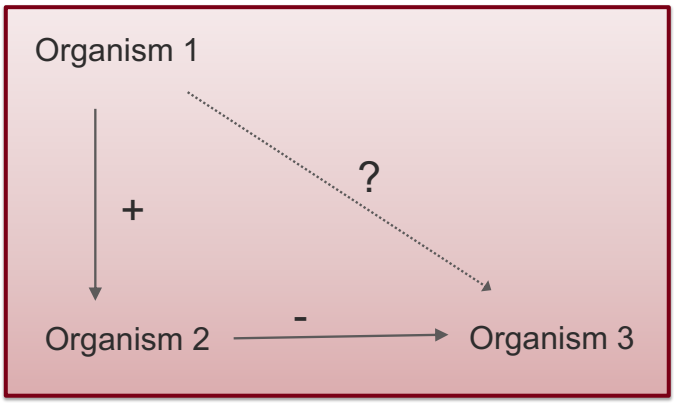
INDIRECT INTERACTIONS



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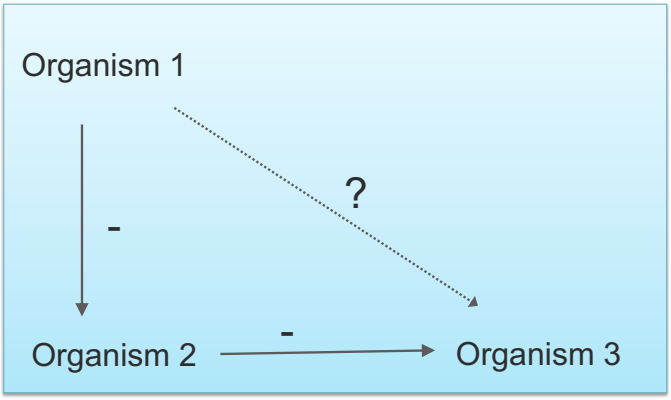
INDIRECT INTERACTIONS



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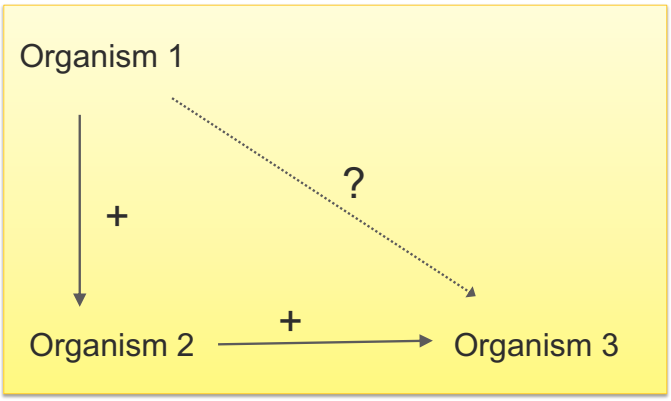
INDIRECT INTERACTIONS



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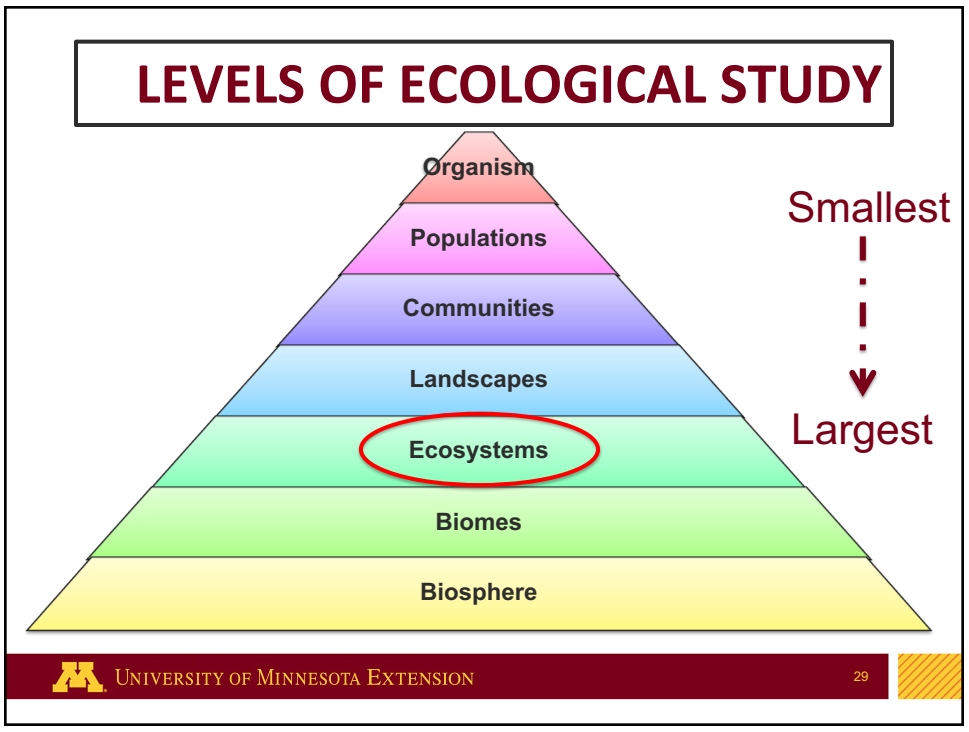

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ECOSYSTEM

A natural community (or natural communities) together with the surrounding environment, functioning together as a unit.

- *The Nature Conservancy*

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HOW DO YOU DESCRIBE AN ECOSYSTEM?

- Energy Flow
- Nutrient Cycling
- Biogeochemical Cycles
- Vegetation Types and Diversity

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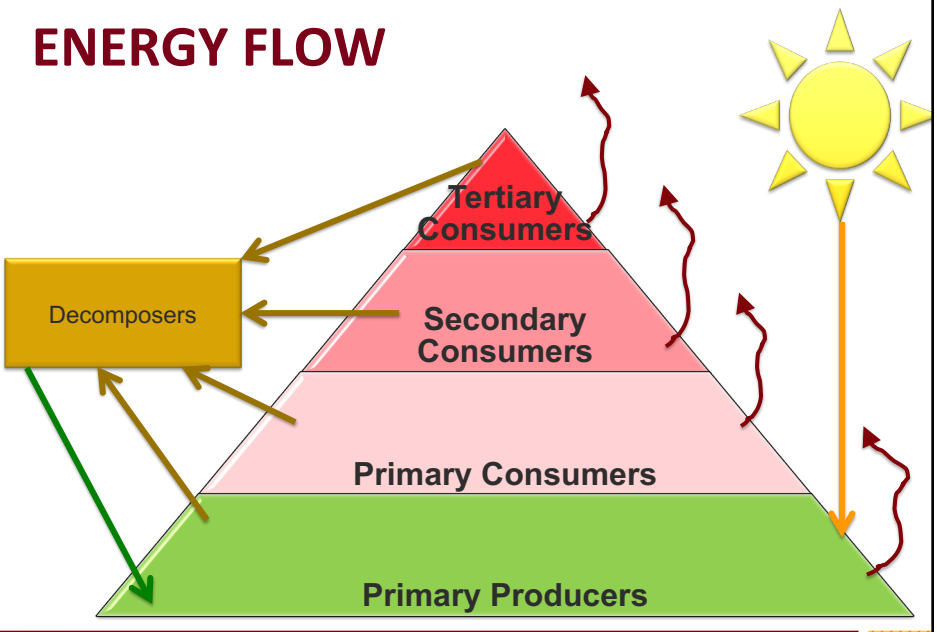
ENERGY FLOW



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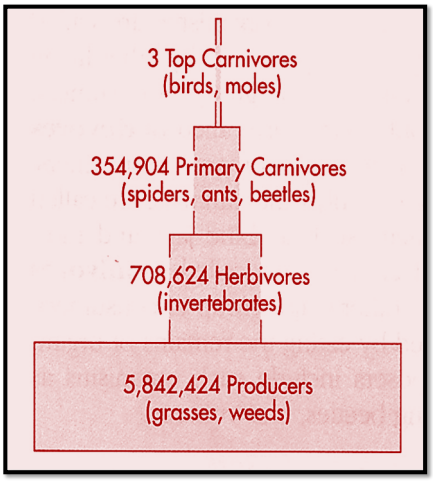
ENERGY FLOW: ECOLOGICAL PYRAMID



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ENERGY FLOW: FOOD CHAIN

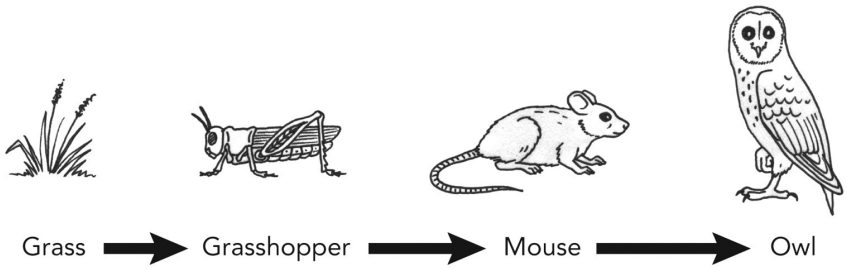

Image Courtesy of Siyavula Education, www.thunderboltkids.co.za (CC BY-SA-ND)

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ENERGY FLOW: FOOD WEB

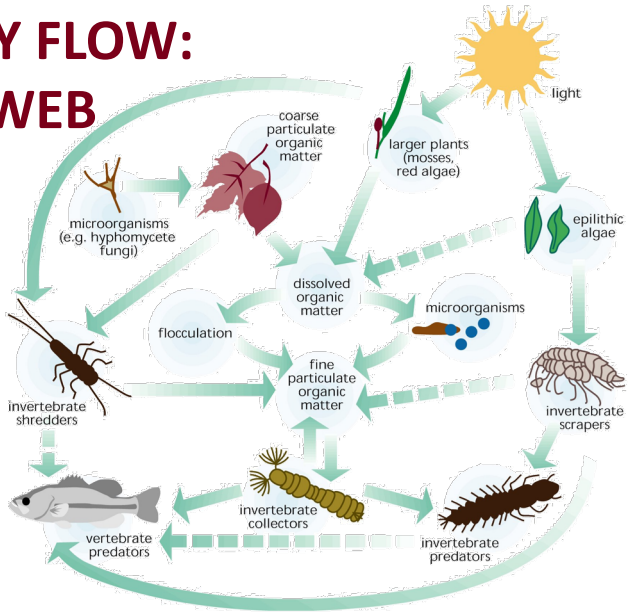

Image courtesy of Stream Corridor Restoration: Principles, Processes, and Practices, 10/98, by the Federal Interagency Stream Restoration Working Group (FIRWG)

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BIOGEOCHEMICAL CYCLES

The manner in which material critical to life (such as carbon, nitrogen, water and phosphorus) move from living organisms to the physical environment and back again.

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BIOGEOCHEMICAL CYCLES: WATER CYCLE

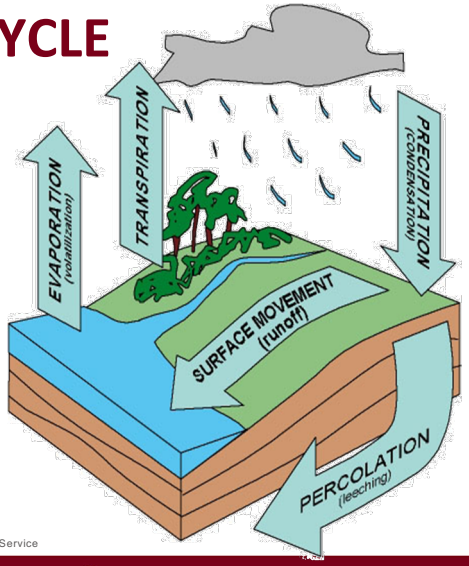

Image courtesy of the University of MN Extension Service

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BIOLOGICAL DIVERSITY

The full range of variability within and among living organisms and the ecological systems in which they occur. Biological diversity encompasses ecosystem or community diversity, species diversity, and genetic diversity.

-- Bureau of Land Management

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BIOLOGICAL DIVERSITY: WORLDWIDE

- Mammals – 5,500
- Amphibians – 4,184
- Reptiles – 8,700
- Birds – 10,100
- Fish – 31, 200
- Plants – 310,000
- Insects – > 1 million (most are still unnamed)

Image Courtesy of NASA

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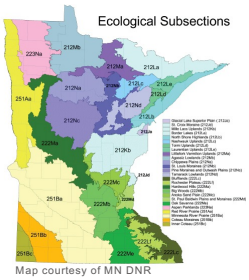
KINDS OF BIODIVERSITY

Ecosystem



Map courtesy of MN DNR

Species

Public Domain, https://pixabay.com/en/flying-bird-icon-flock-black-163704/

Genetic

Public Domain, https://commons.wikimedia.org/wiki/File:DNA_simple.svg

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A FEW PATTERNS OF BIOLOGICAL DIVERSITY…

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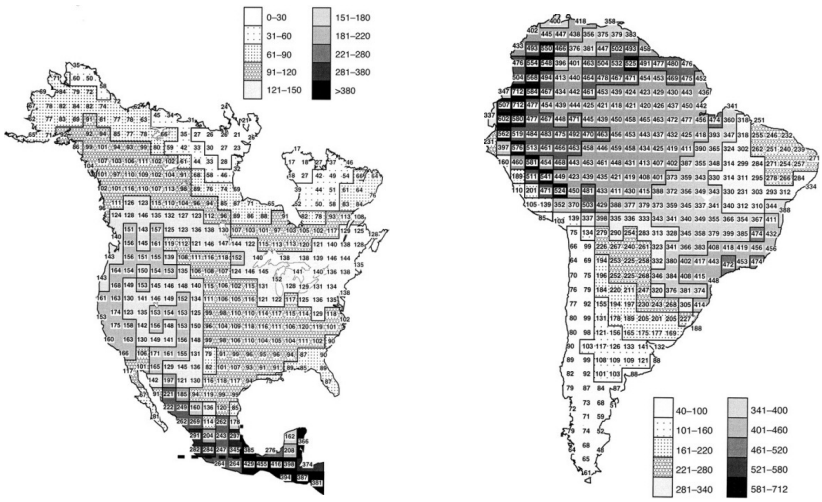
LATITUDINAL DIVERSITY GRADIENT



Figures from Hawkins, Bradford A., Eric E. Porter, and José Alexandre Felizola Diniz-Filho. 2003. PRODUCTIVITY AND HISTORY AS PREDICTORS OF THE LATITUDINAL DIVERSITY GRADIENT OF TERRESTRIAL BIRDS. Ecology 84:1608–1623.

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SPECIES VS AREA SIZE

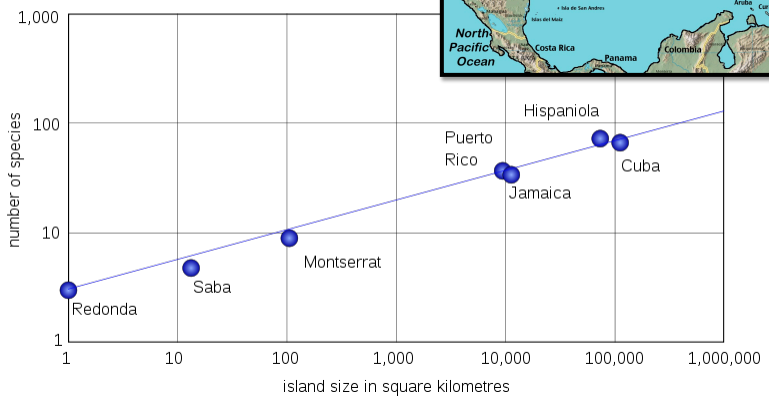

Image based on Figure 2 on page 8 of "The theory of island biogeography" by MacArthur and Wilson and research by Darlington 1957

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BIOLOGICAL DIVERSITY IN USA

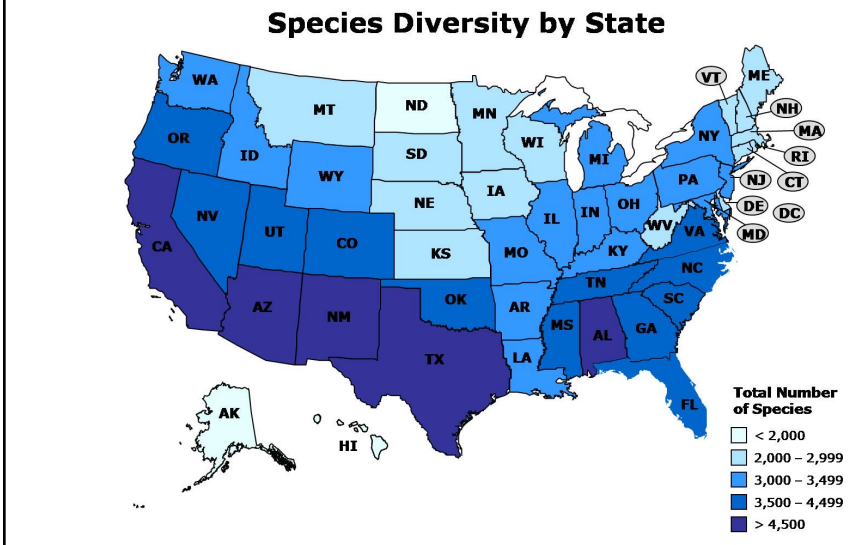

Image courtesy of NatureServe.org

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WHAT ARE PUBLIC VALUES OF BIOLOGICAL DIVERSITY?

- Ecosystem Services
- Economic Value
- Aesthetics
- Ethics

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"“When one tugs at a single thing in nature, he finds it attached to the rest of the world.”

John Muir

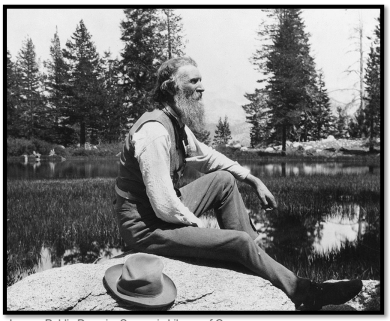

Image: Public Domain, Source is Library of Congress
https://commons.wikimedia.org/wiki/File:John_Muir_c1902.jpg

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"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community."

Aldo Leopold

Image Courtesy of USDA Forest Service

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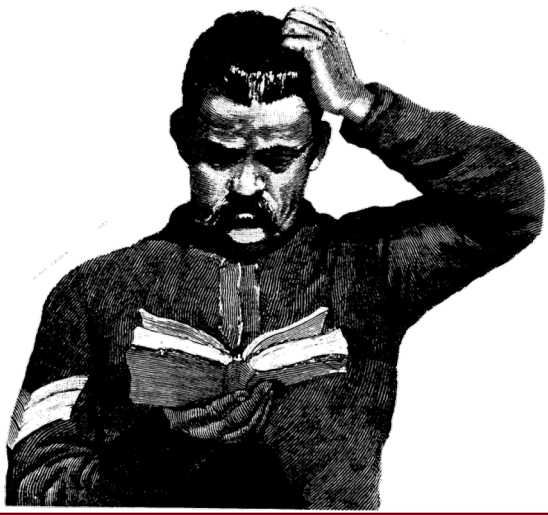

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Levels of Study
Species Interactions
+ Energy Flow
Biogeochemical Cycles
Biological Diversity

Ecological Principles

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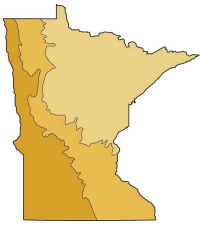
Barry Commoner encapsulated the ecological principles well in his four laws:

1) Everything is connected to everything else
2) Everything must go somewhere
3) Nature knows best
4) There is no such thing as a free lunch.



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ACKNOWLEDGMENTS

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