

# The Ecosystem Concept

August 29, 2019

What is ecosystem ecology?

# Ecology: definition

The study of the relationships between organisms and:

1. Each other
2. The environment

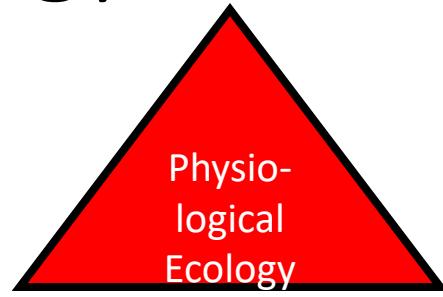
# Ecology: definition

The study of the relationships between organisms and:

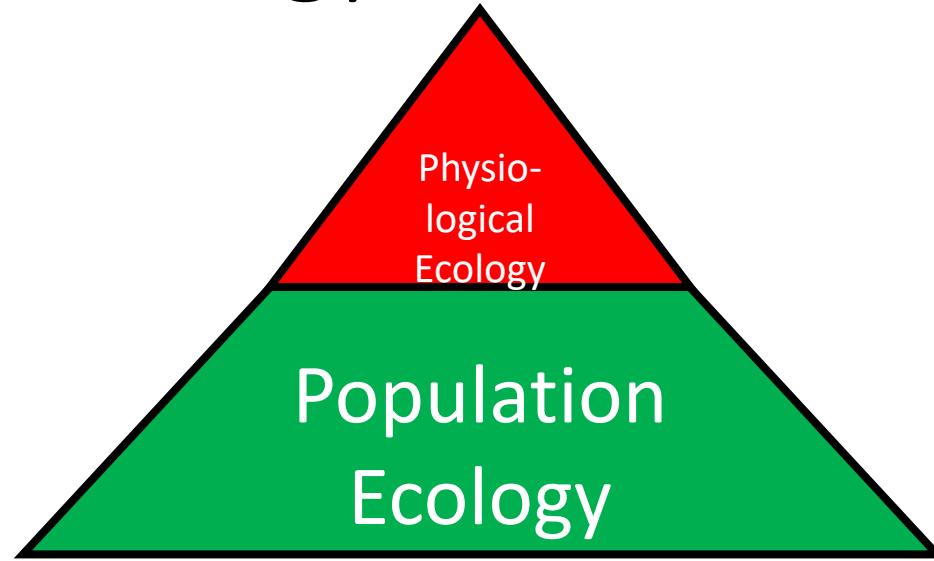
1. Abiotic environment
2. Biotic environment

What aspects of the abiotic and  
biotic environment influence  
organismal functioning?

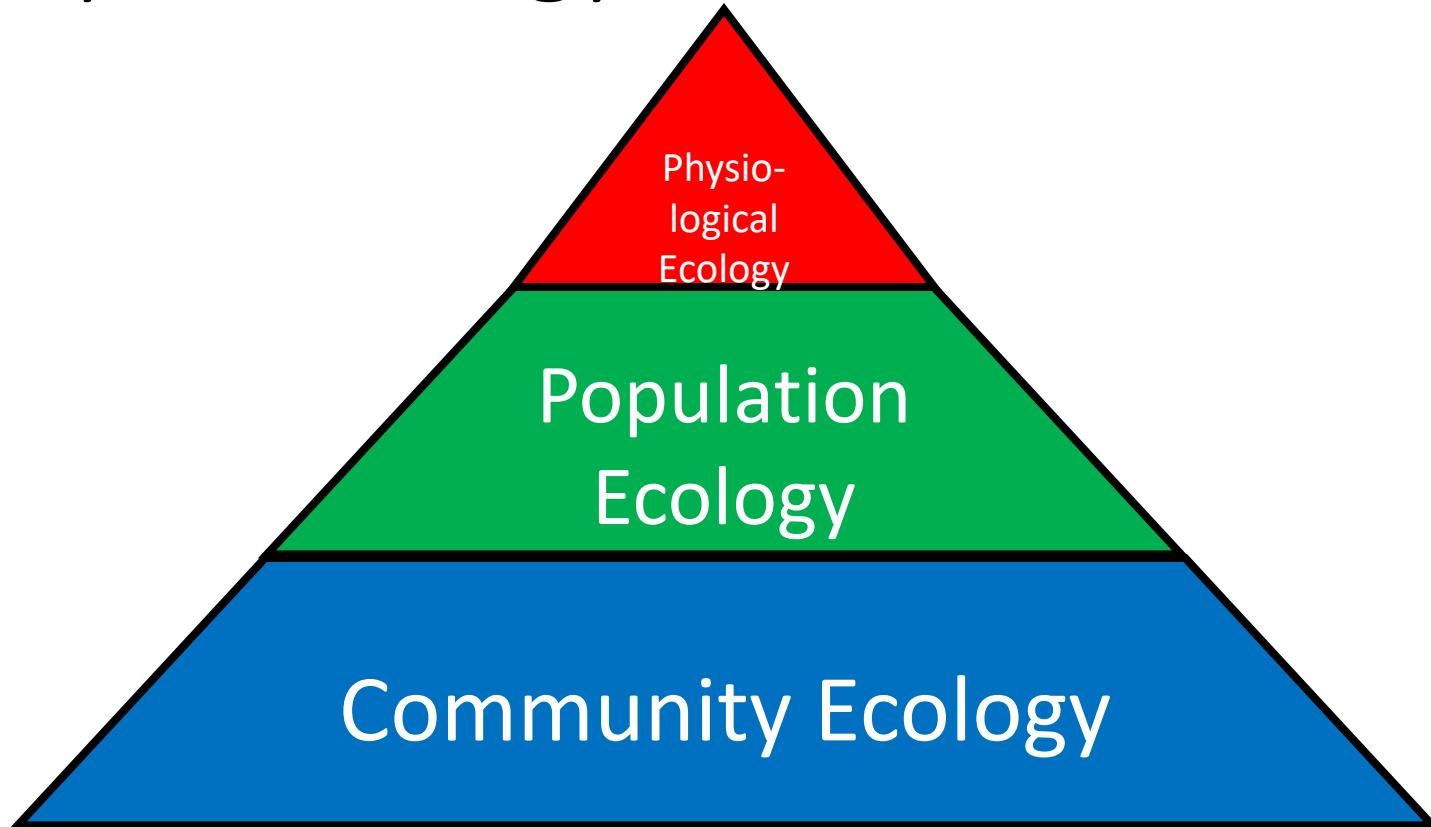
# Hierarchy of Ecology



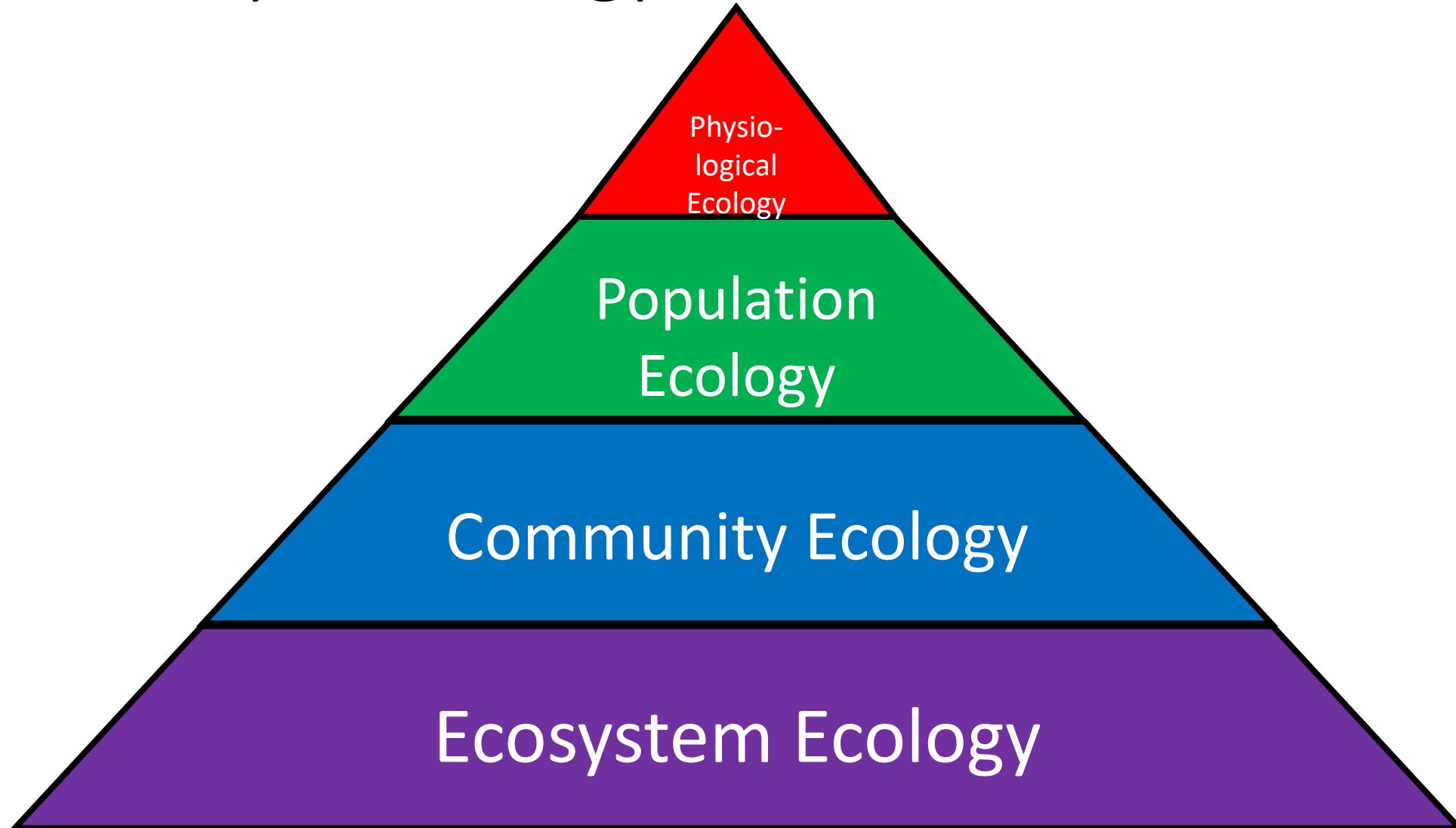
# Hierarchy of Ecology



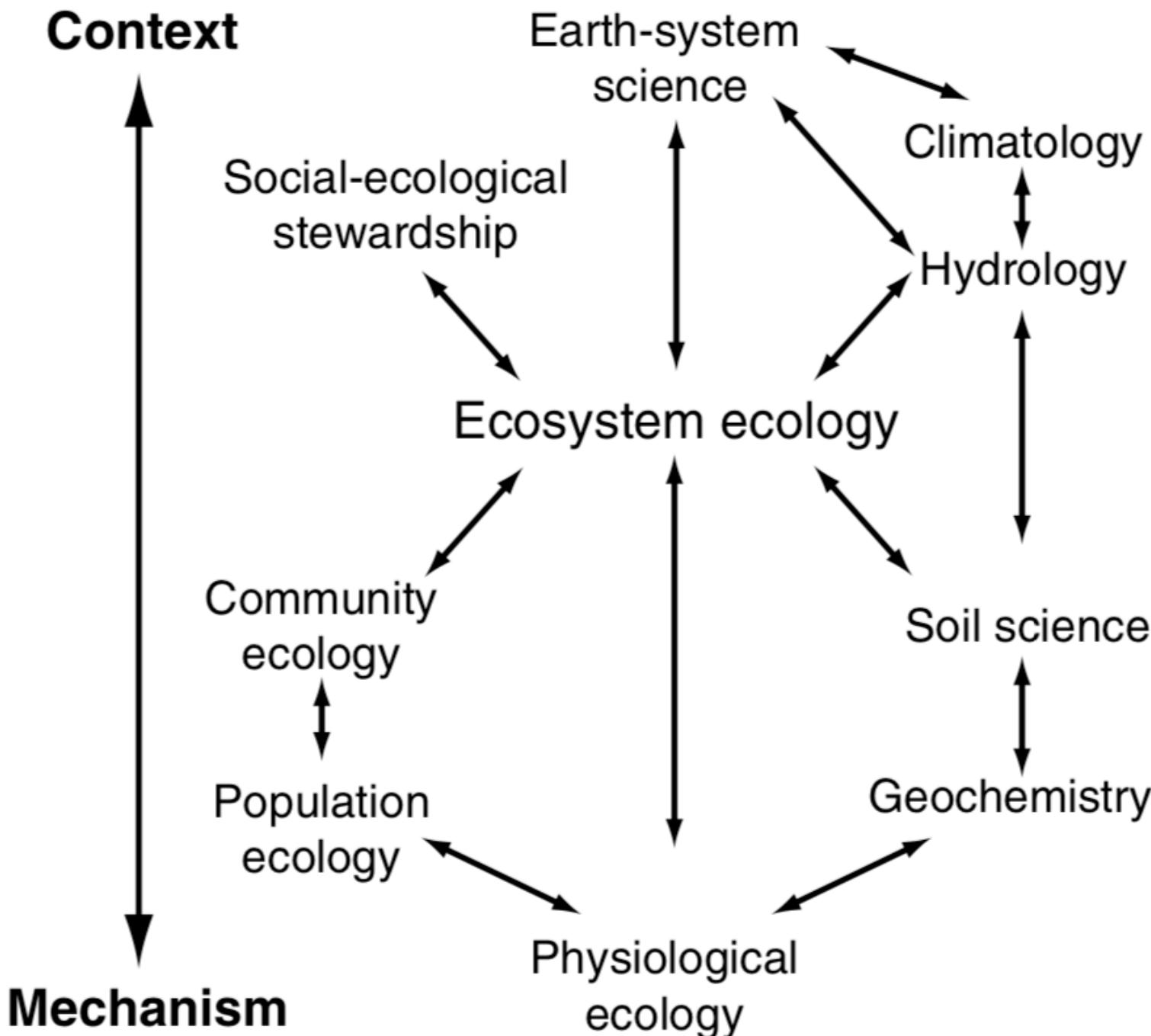
# Hierarchy of Ecology



# Hierarchy of Ecology



Ecosystem ecology is the study of the interactions between organisms and their environment as an integrated system



What is an ecosystem? Example?

How big is an ecosystem?

**a**  
Global ecosystem



**b**  
Drainage basin



**c**  
Forest ecosystem



**d**  
Endolithic ecosystem



Ecosystems can vary in size!

**a**  
Global ecosystem



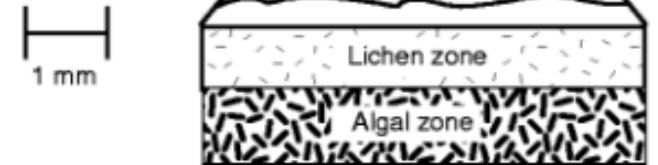
**b**  
Drainage basin



**c**  
Forest ecosystem



**d**  
Endolithic ecosystem



## Ecosystems can vary in size!

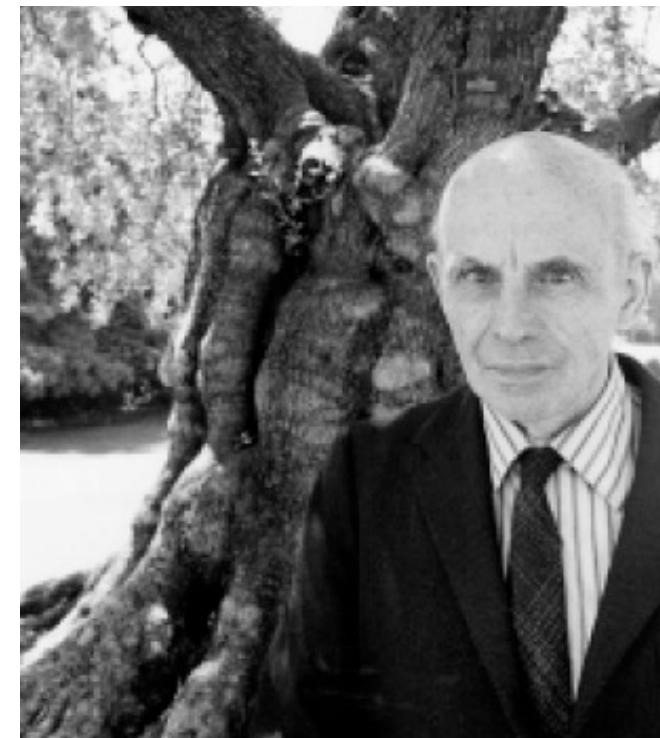
(but must include multiple organisms interacting with their abiotic and biotic environments)

Ecosystem Processes: “things an ecosystem does”

# Controls Over Ecosystem Processes

Hans Jenny (US soil scientist) in 1941 first to formalize a quantitative model of soil formation as well as the “state factors” that set the bounds for characteristics of an ecosystem:

**S = f (climate,  
organisms,  
relief/topography,  
parent material, time)**



Example: succession is the result  
of state factor changes

# CLIMATE

## Climate

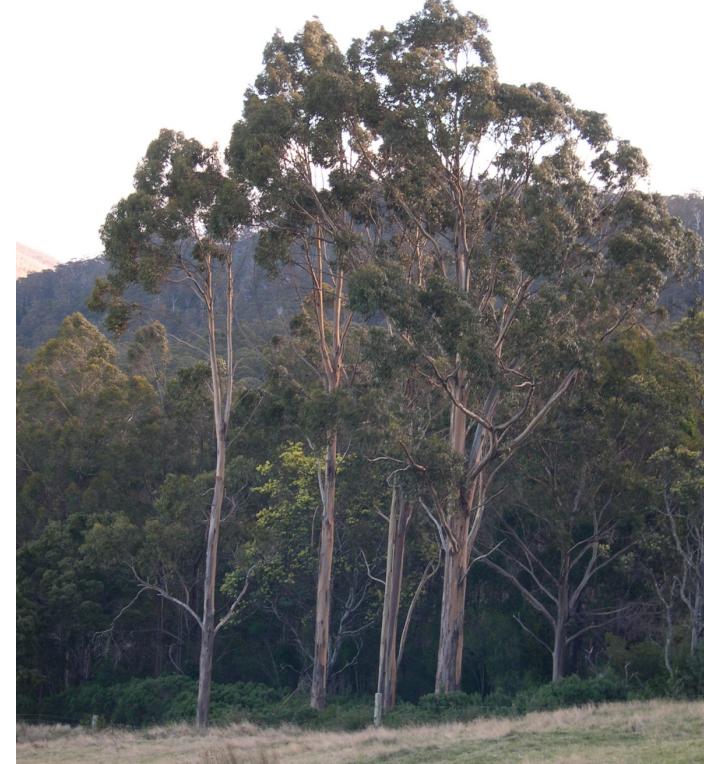


- \* Precipitation
- \* Temperature

C  
I  
O  
R  
P  
T



## Organisms



C

O

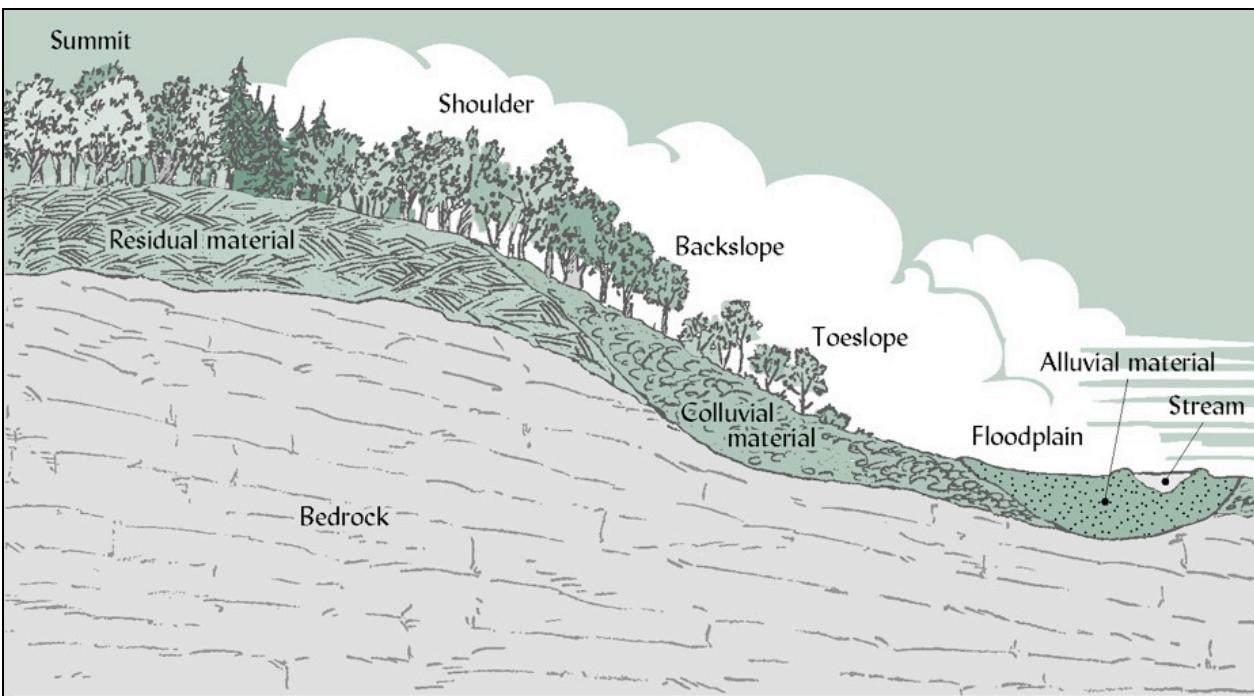
# R Relief/Topography

P

T



© Rick Scott



C  
O  
R



**Igneous** (basalt)



**Metamorphic** (schist)

## P Parent Material

T

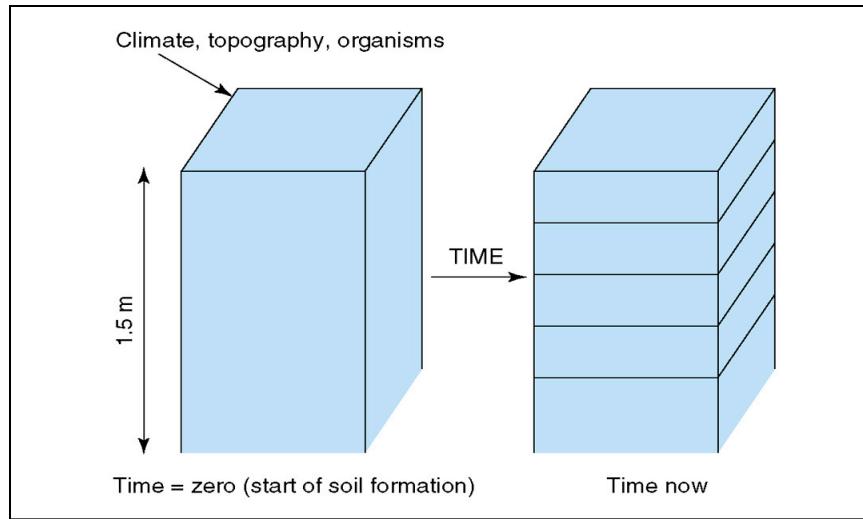
**Sedimentary**  
(sandstone)



C  
O  
R  
P  
T

Time

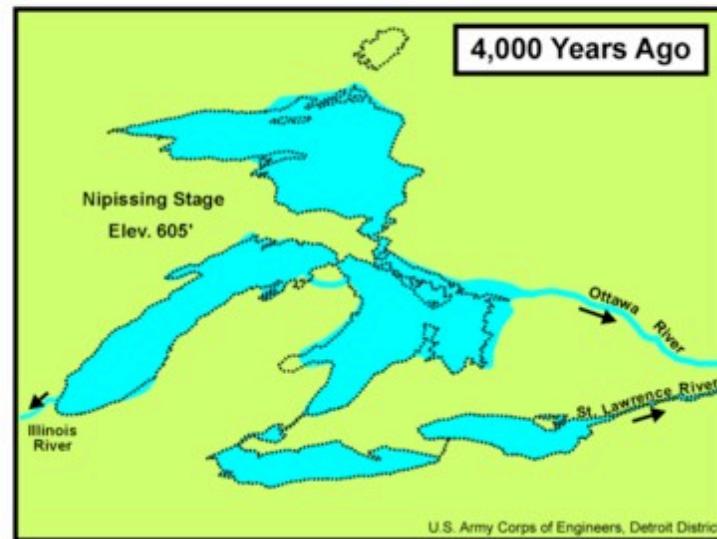
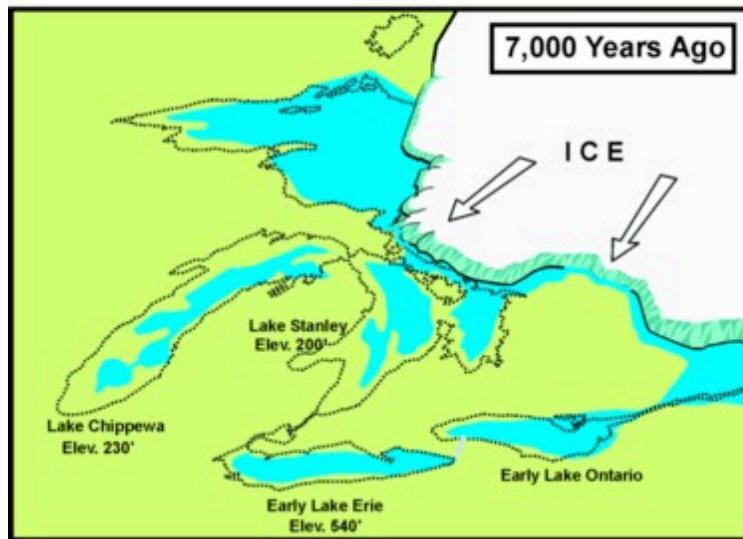
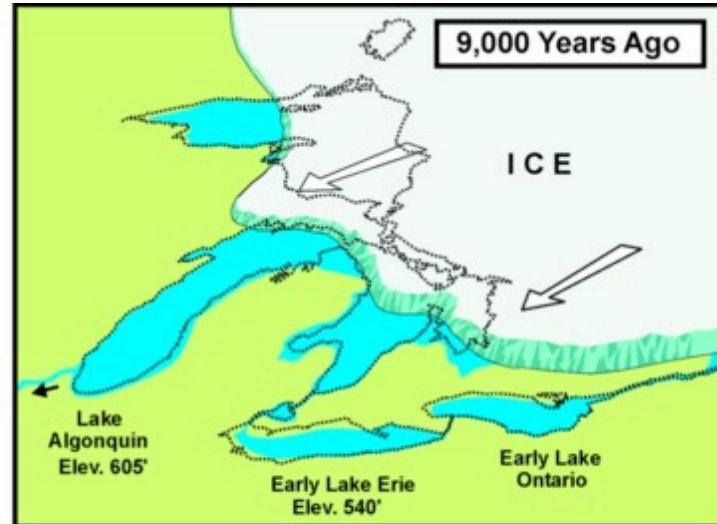
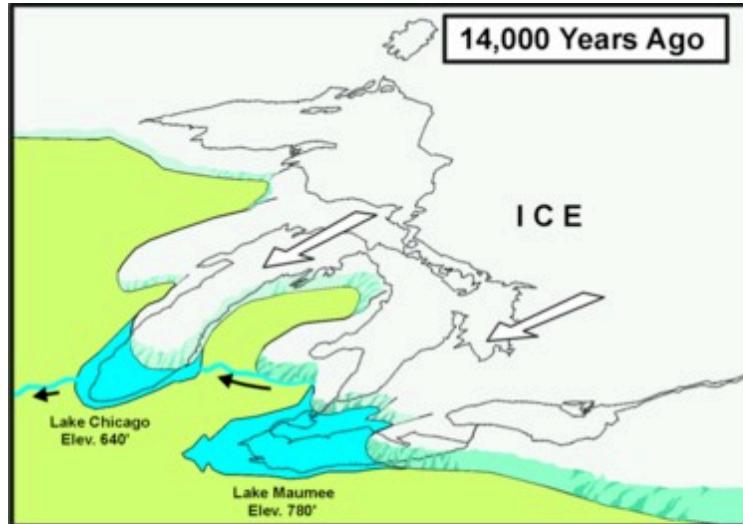
## Development of Soil



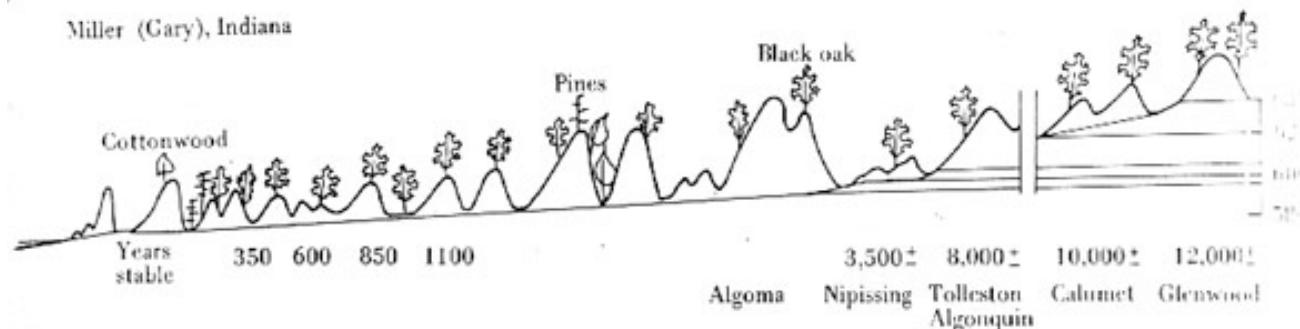
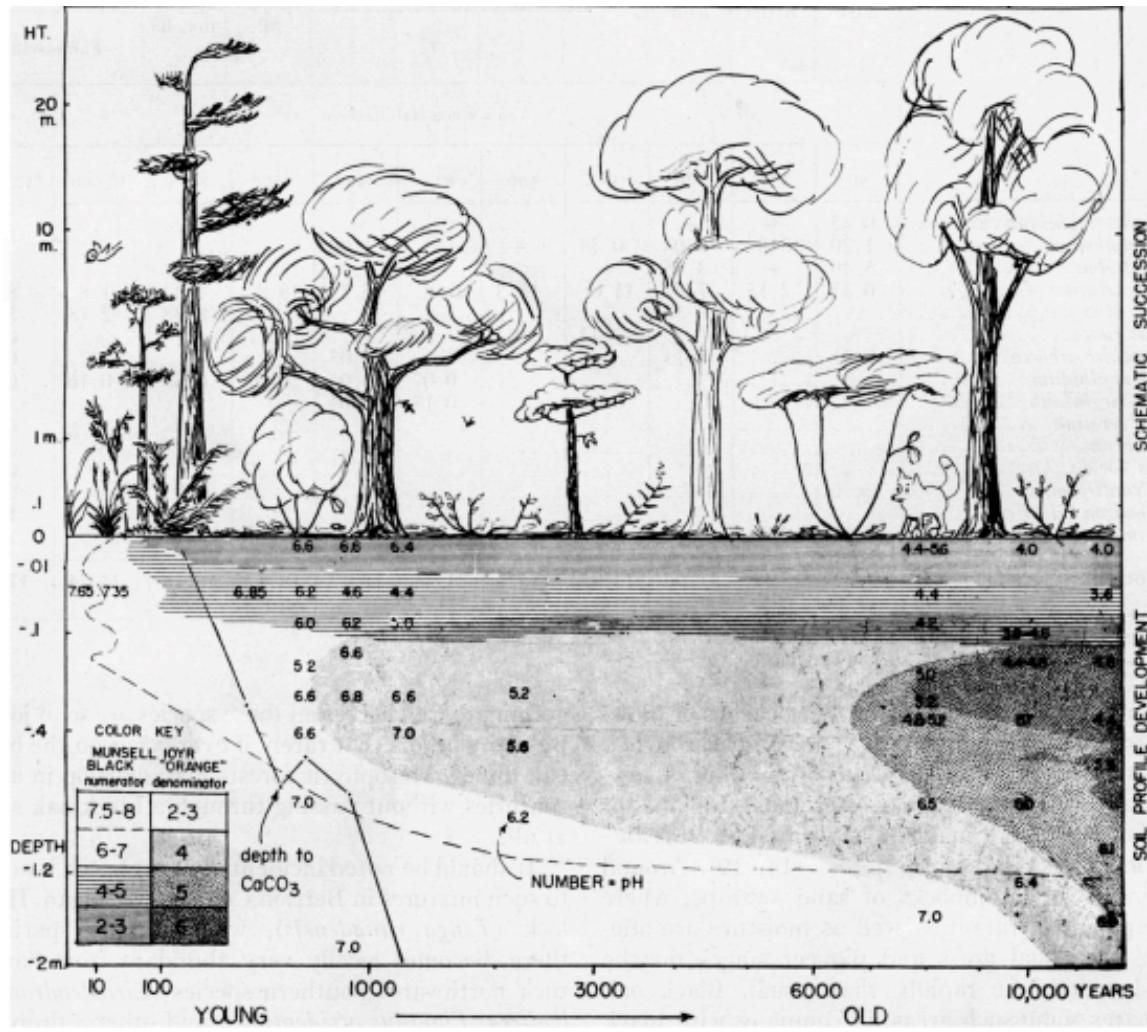
## Evolution



# Lake Michigan dunes



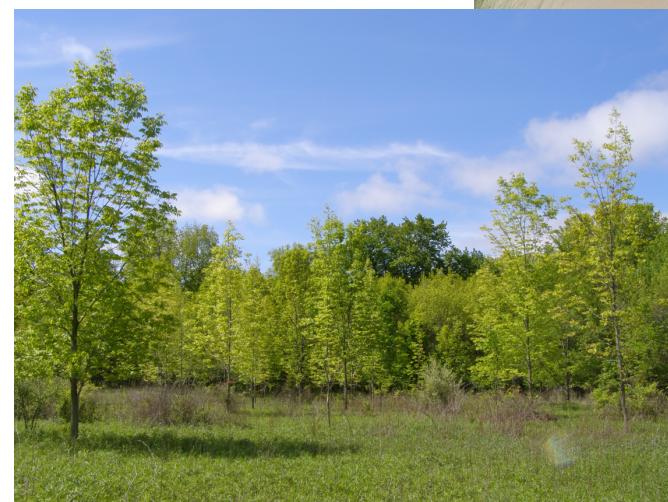
# Lake Michigan dunes



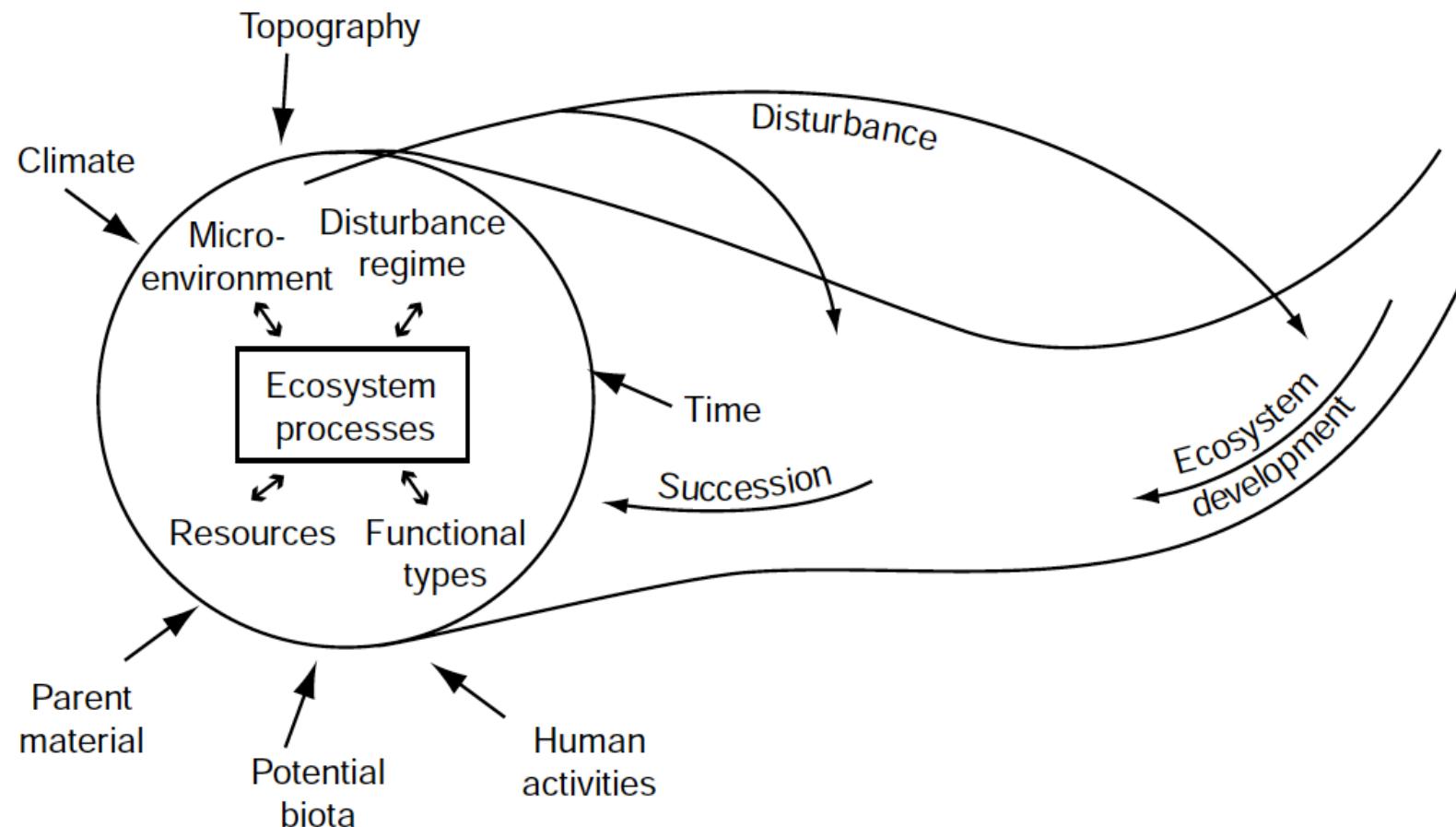
**Figure 22.4.** Diagrammatic profiles across Indiana sand dunes at the southern end of Lake Michigan. Successively older dune systems originated along earlier and higher beaches. (After Olson 1958.)

# Lake Michigan dunes

- Beaches
  - Low nutrient environments
  - Unstable soils
  - Few plants (sea rocket)
- Foredunes
  - Soil stabilized by grasses
  - Low nutrient soils
  - Grasses and wildflowers
- Dune forests
  - Better soils
  - Competition is for light (tall plants)



Olson (1958)



In your book, but modified from Chapin et al. (2006)



# Climate



Wet ----- Dry

# Organisms



Diverse ----- Depauperate

# Topography



Steep ----- Flat

# Parent Material



Igneous



Sedimentary



Basalt

# Time

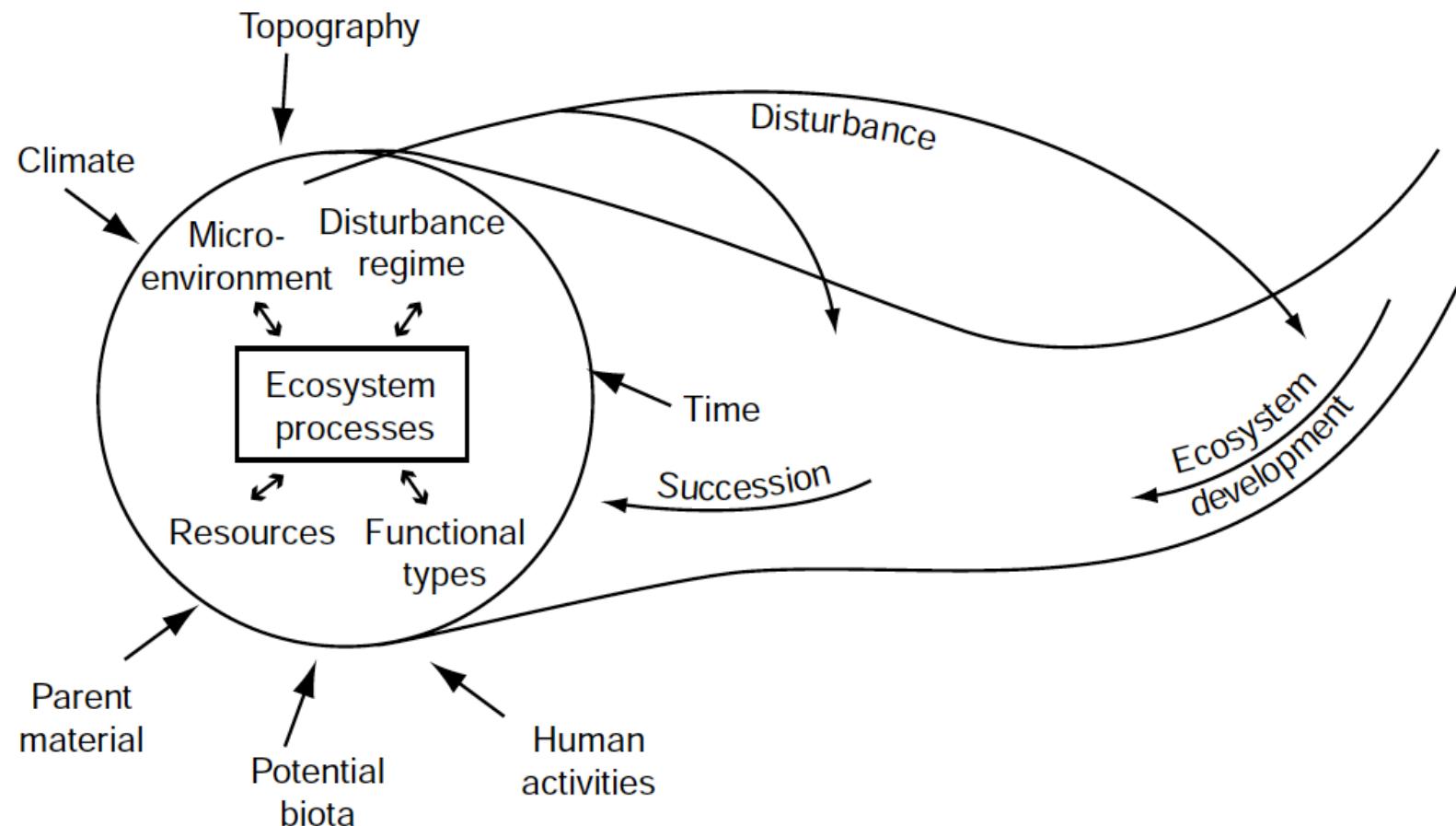


Old

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Recent





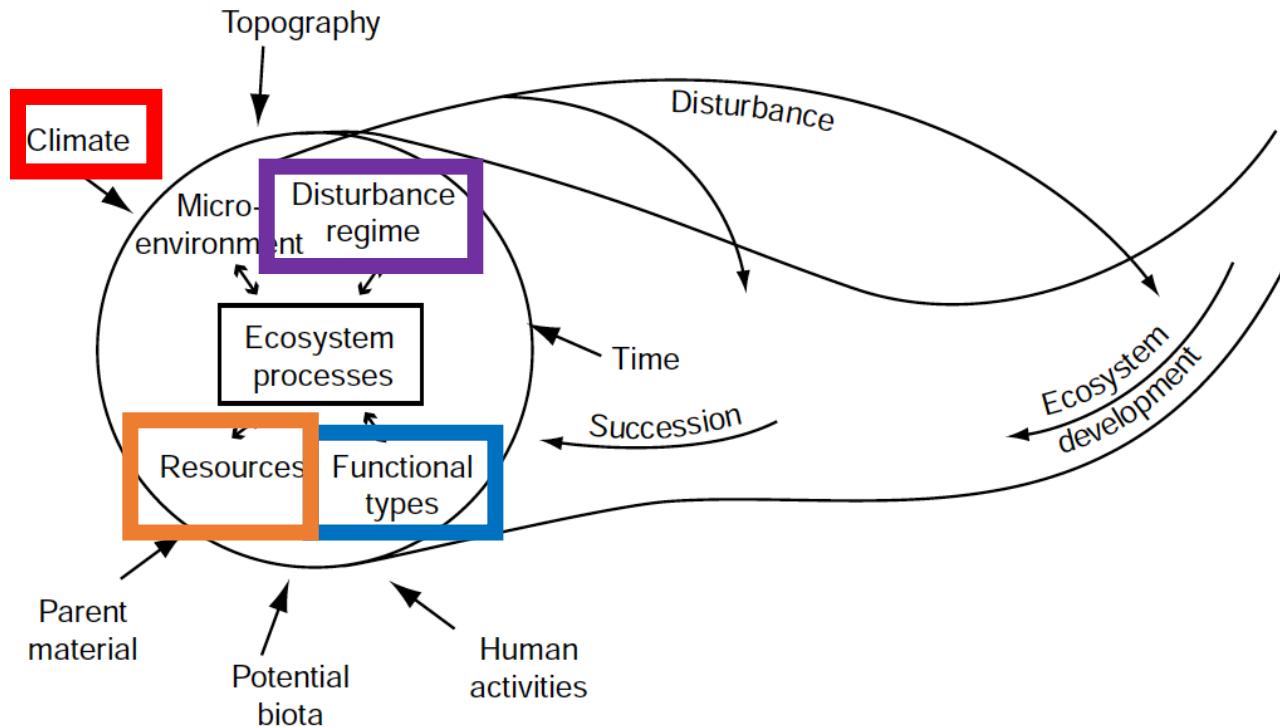
In your book, but modified from Chapin et al. (2006)

Ecosystem Services: “things an ecosystem provides”

What do humans get from  
ecosystems?

# Systems Thinking Exercise

# Humans are altering things! What does this mean for an ecosystem?



## Climate

Elevated CO<sub>2</sub>

Elevated Temperatures

More variable precipitation

## Functional types

Invasive species

Woody encroachment

## Disturbance regime

Fire frequency

Land clearing

## Resources

Nutrient addition

# Assignment (groups of 4)

- Pick an ecosystem
  - Pick an anthropogenic disturbance
  - Use a box (pool) and arrow (flux) diagram to explain the ecosystem effects
- Climate  
Elevated CO<sub>2</sub>  
Elevated Temperatures  
More variable precipitation
- Functional types  
Invasive species  
Woody encroachment
- Disturbance regime  
Fire frequency  
Land clearing
- Resources  
Nutrient addition