

The Ecosystem Concept

What is ecosystem ecology?

Ecology: definition

The study of the relationships between organisms and:

1. Each other
2. The environment

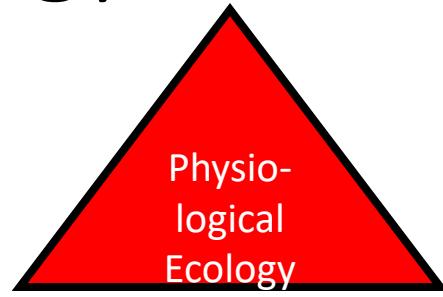
Ecology: definition

The study of the relationships between organisms and:

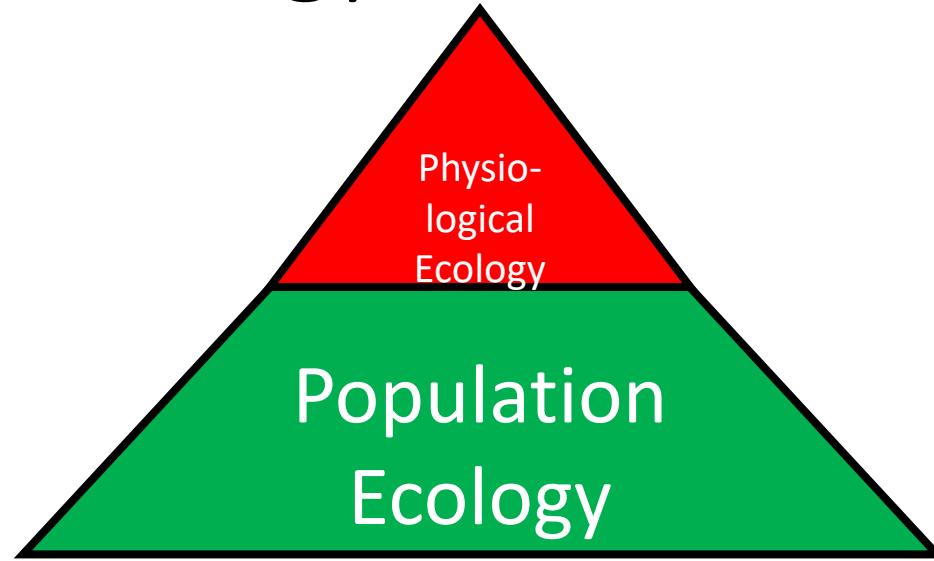
1. Abiotic environment
2. Biotic environment

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

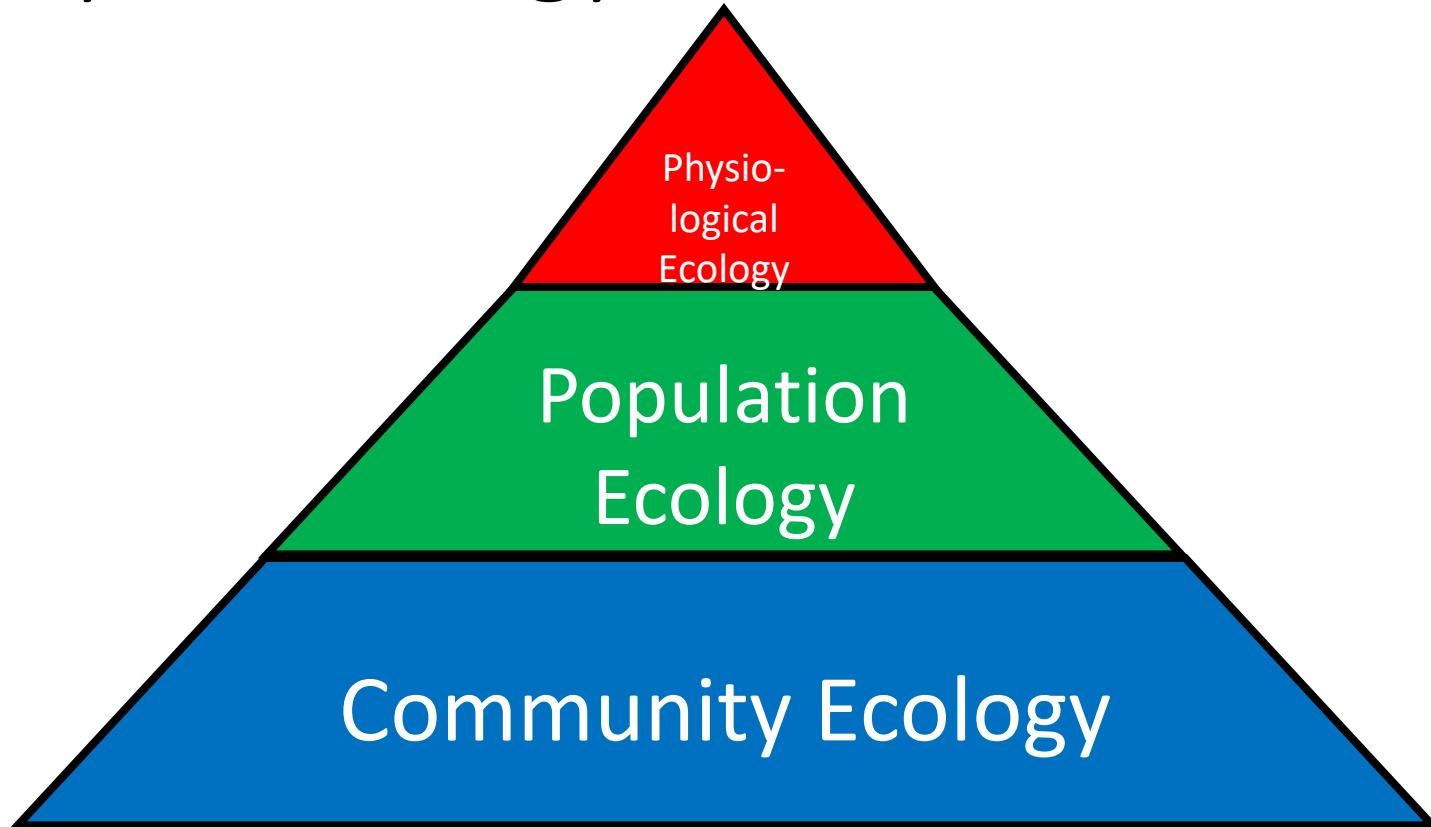
Hierarchy of Ecology



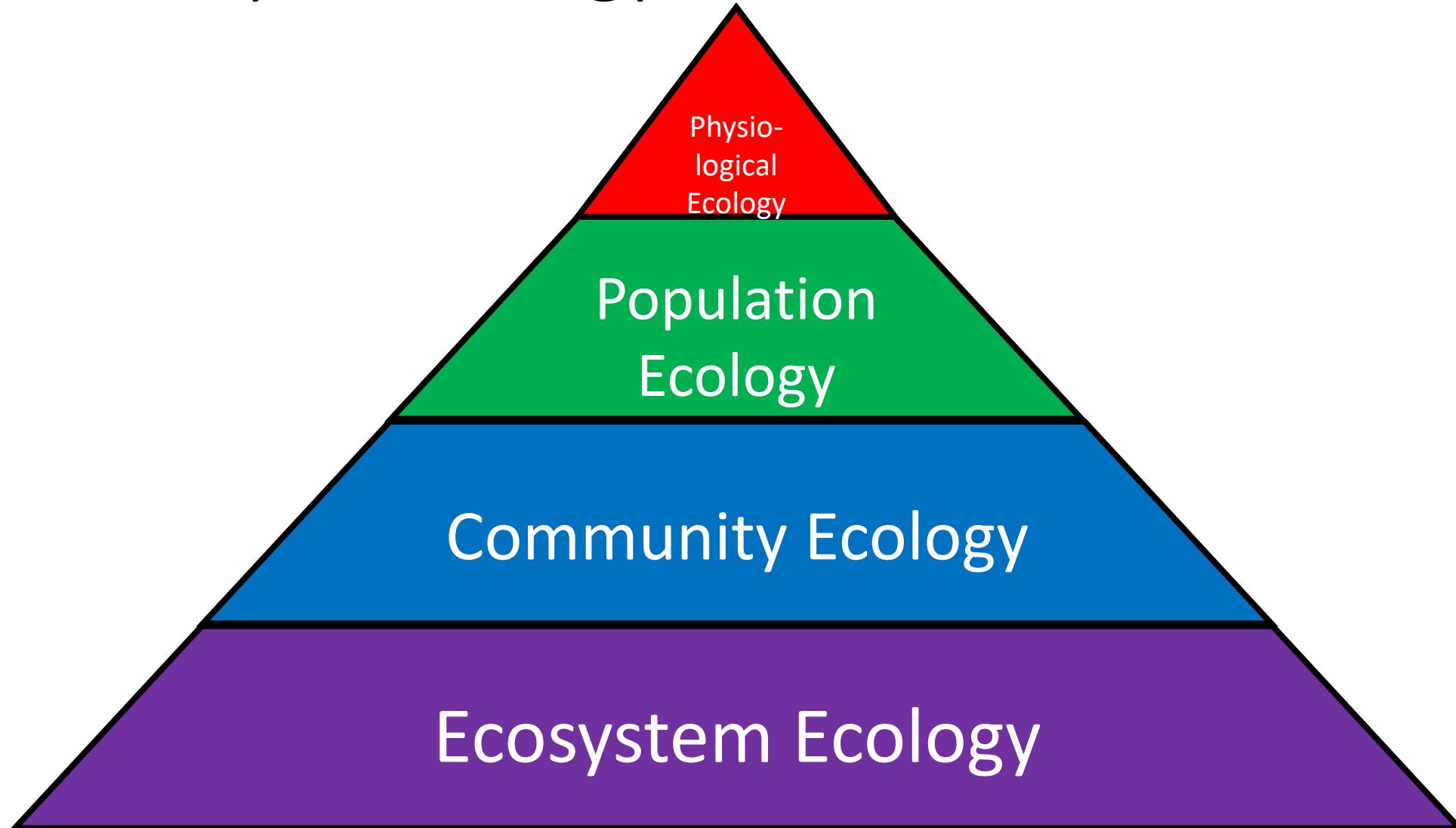
Hierarchy of Ecology



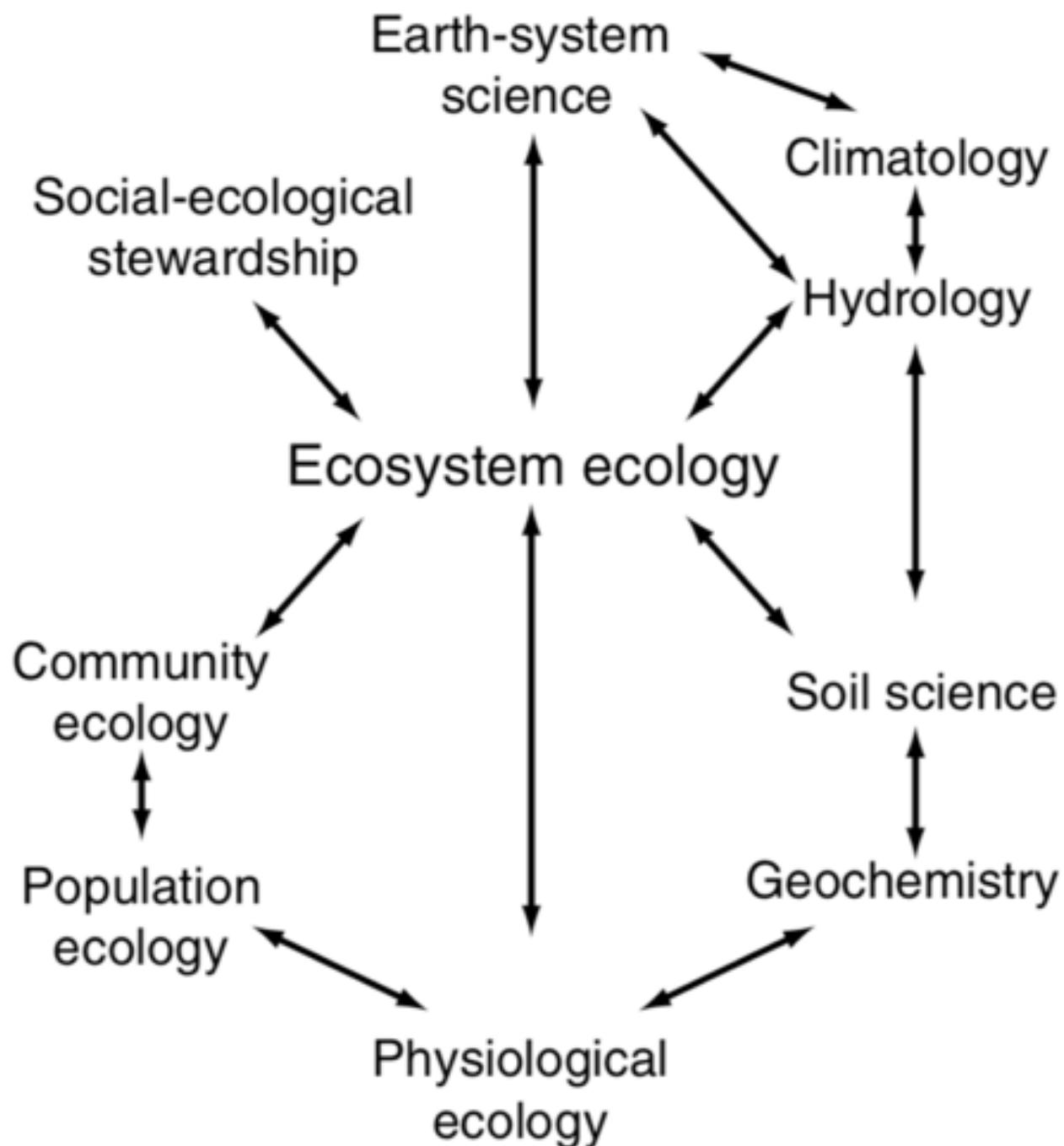
Hierarchy of Ecology



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

A scale bar consisting of two vertical lines with a shorter horizontal line connecting them at the top.

5,000 km

**b**

Drainage basin

A scale bar consisting of two vertical lines with a shorter horizontal line connecting them at the top.

10 km

**c**

Forest ecosystem

A scale bar consisting of two vertical lines with a shorter horizontal line connecting them at the top.

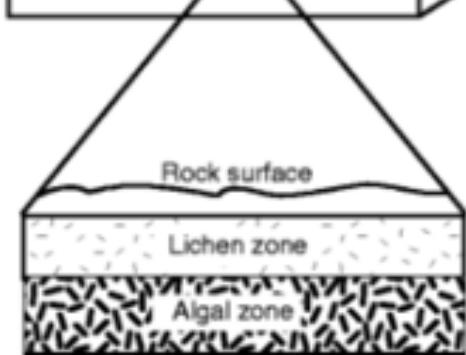
1 km

**d**

Endolithic ecosystem

A scale bar consisting of two vertical lines with a shorter horizontal line connecting them at the top.

1 mm



Ecosystems can vary in size!

a
Global ecosystem



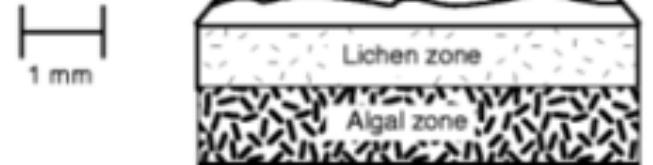
b
Drainage basin



c
Forest ecosystem



d
Endolithic ecosystem



Ecosystems can vary in size!

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

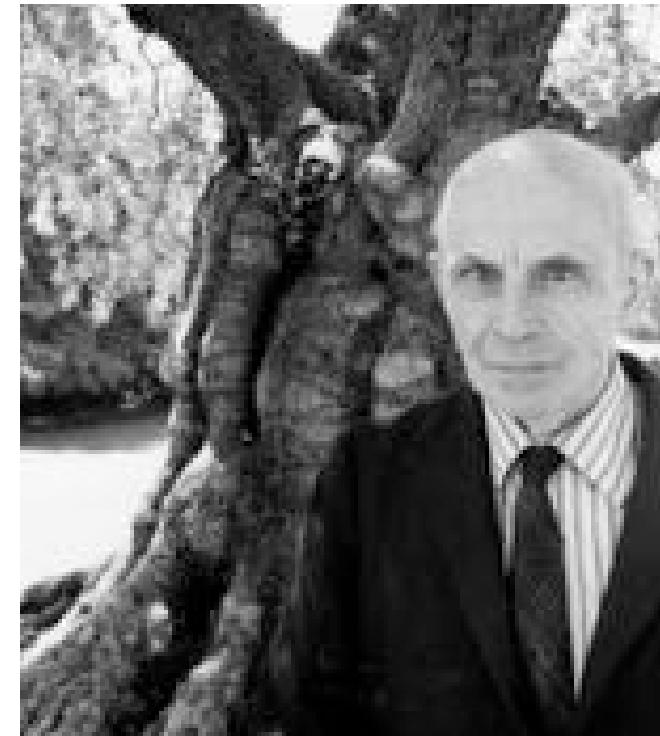
Ecosystem Processes: “things an ecosystem does”

What are some examples of
ecosystem processes?

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

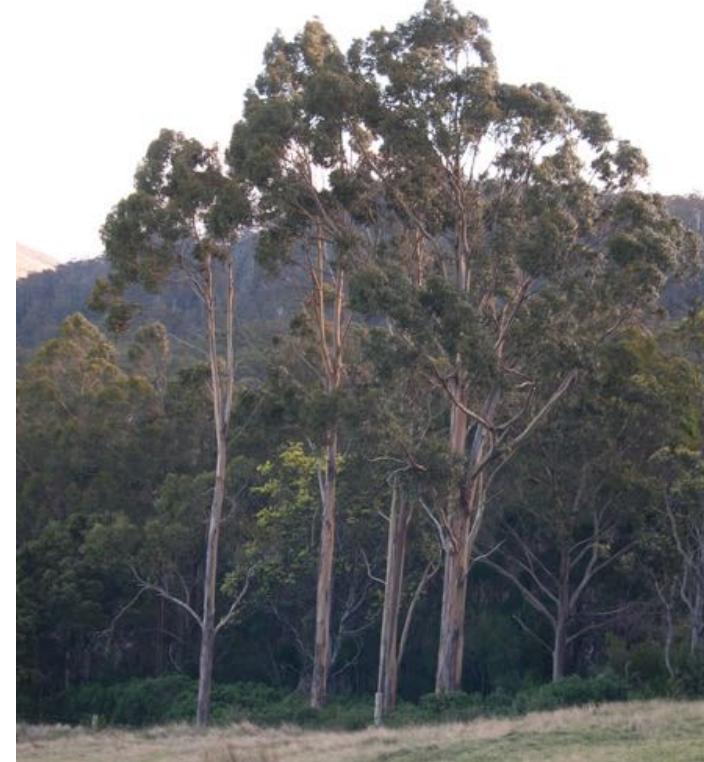


- * Precipitation
- * Temperature

C
I
O
R
P
T



Organisms



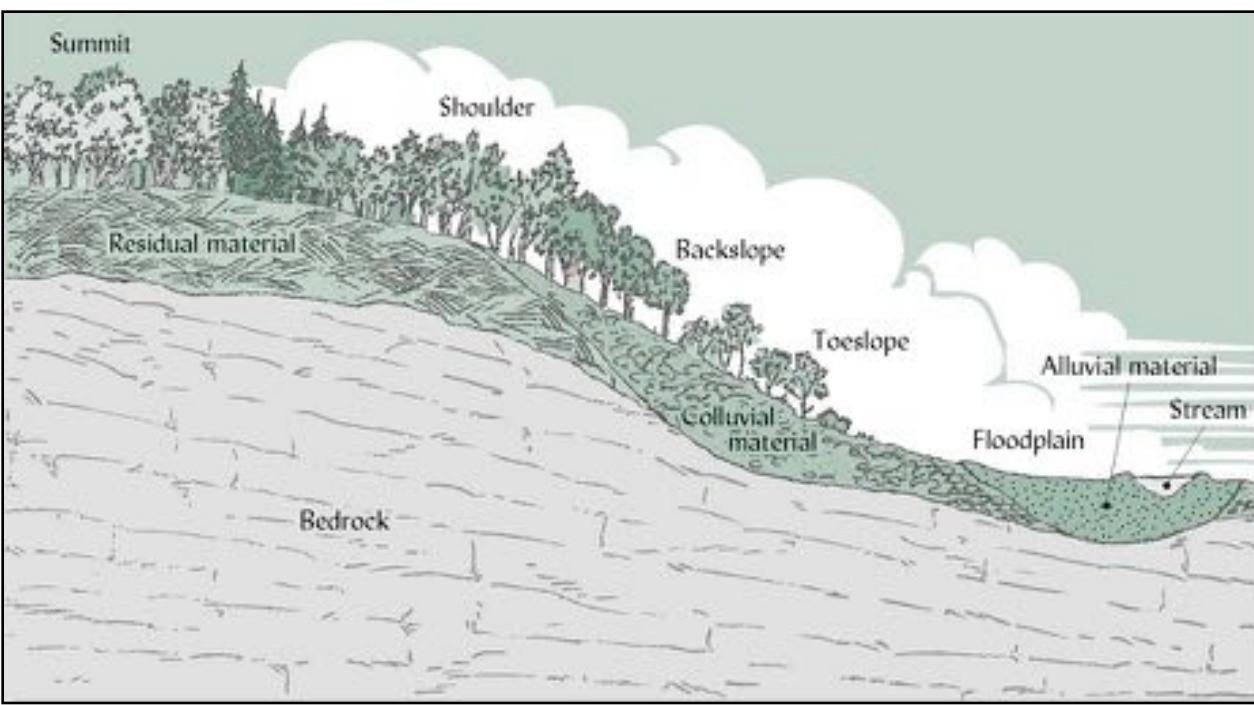
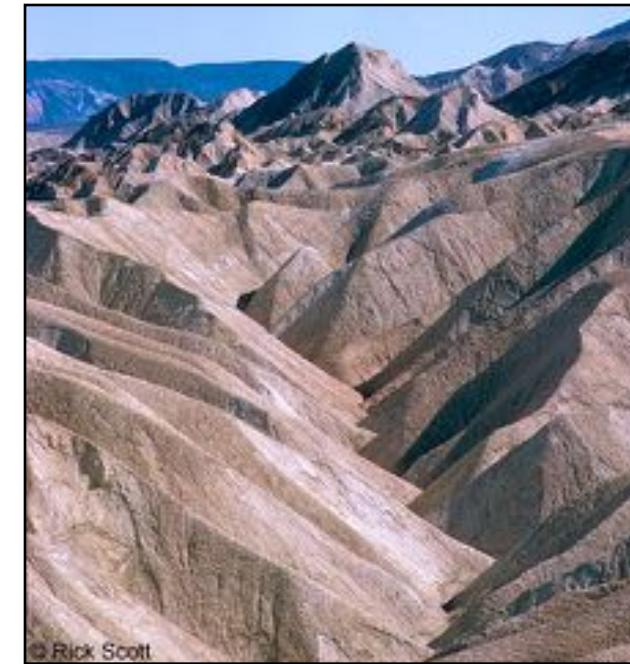
C

O

R Relief/Topography

P

T



C
O
R



Igneous (basalt)



Metamorphic (schist)

P Parent Material

T

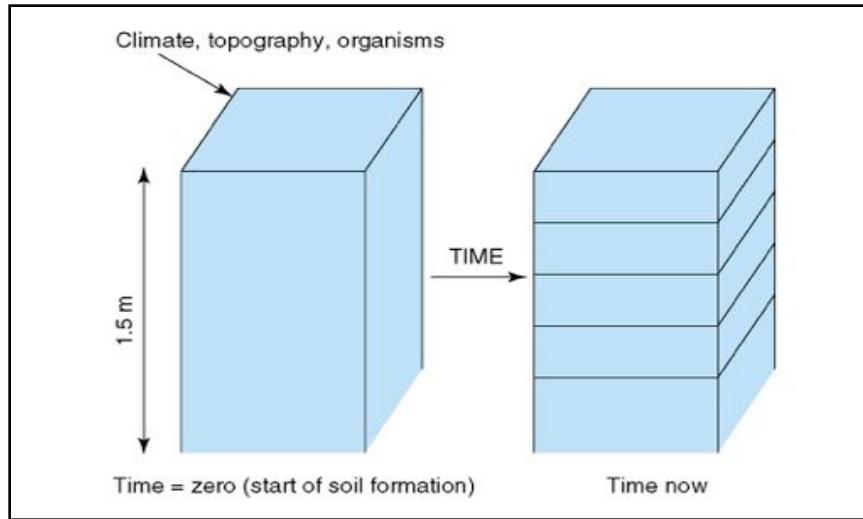
Sedimentary
(sandstone)



C
O
R
P
T

Time

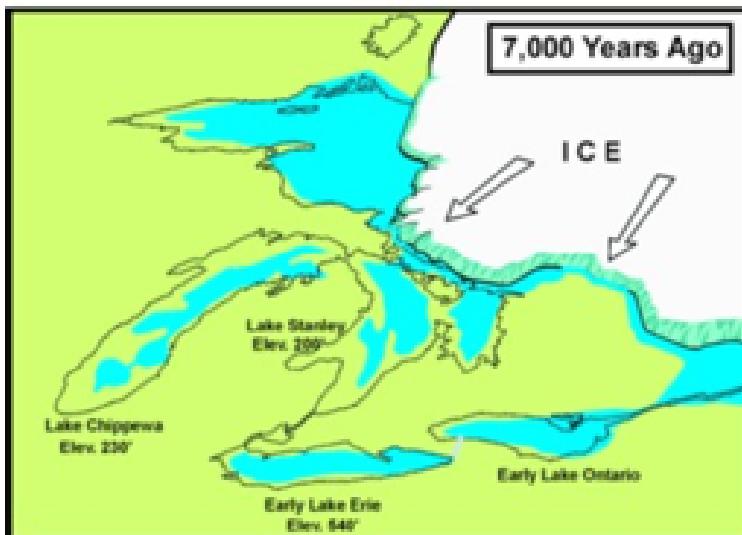
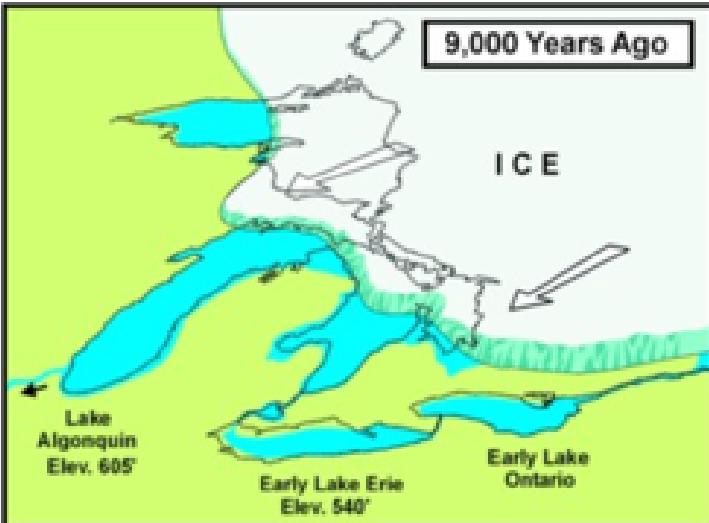
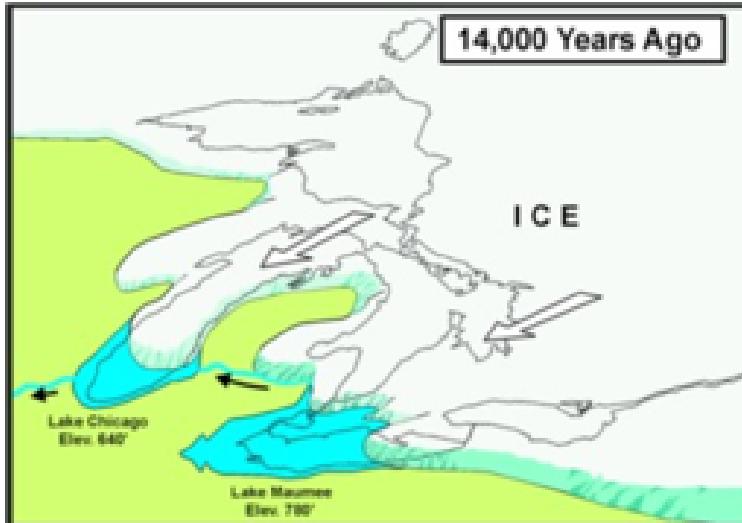
Development of Soil



Evolution



Lake Michigan dunes



Lake Michigan dunes

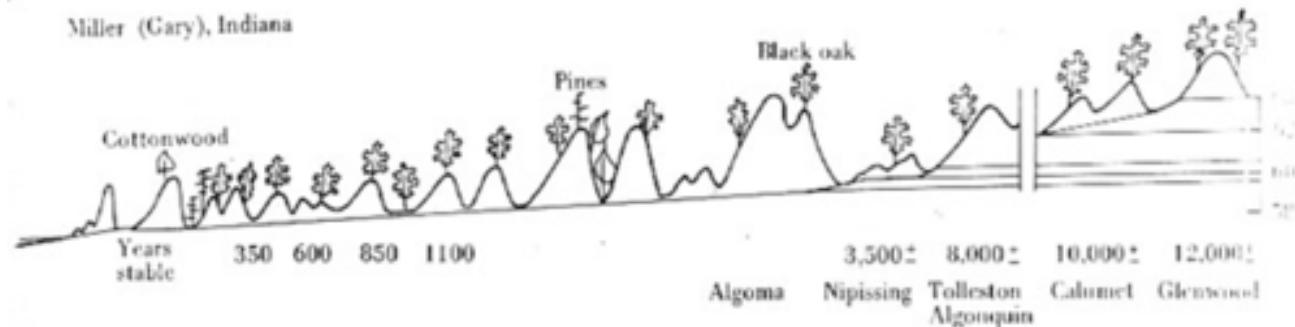
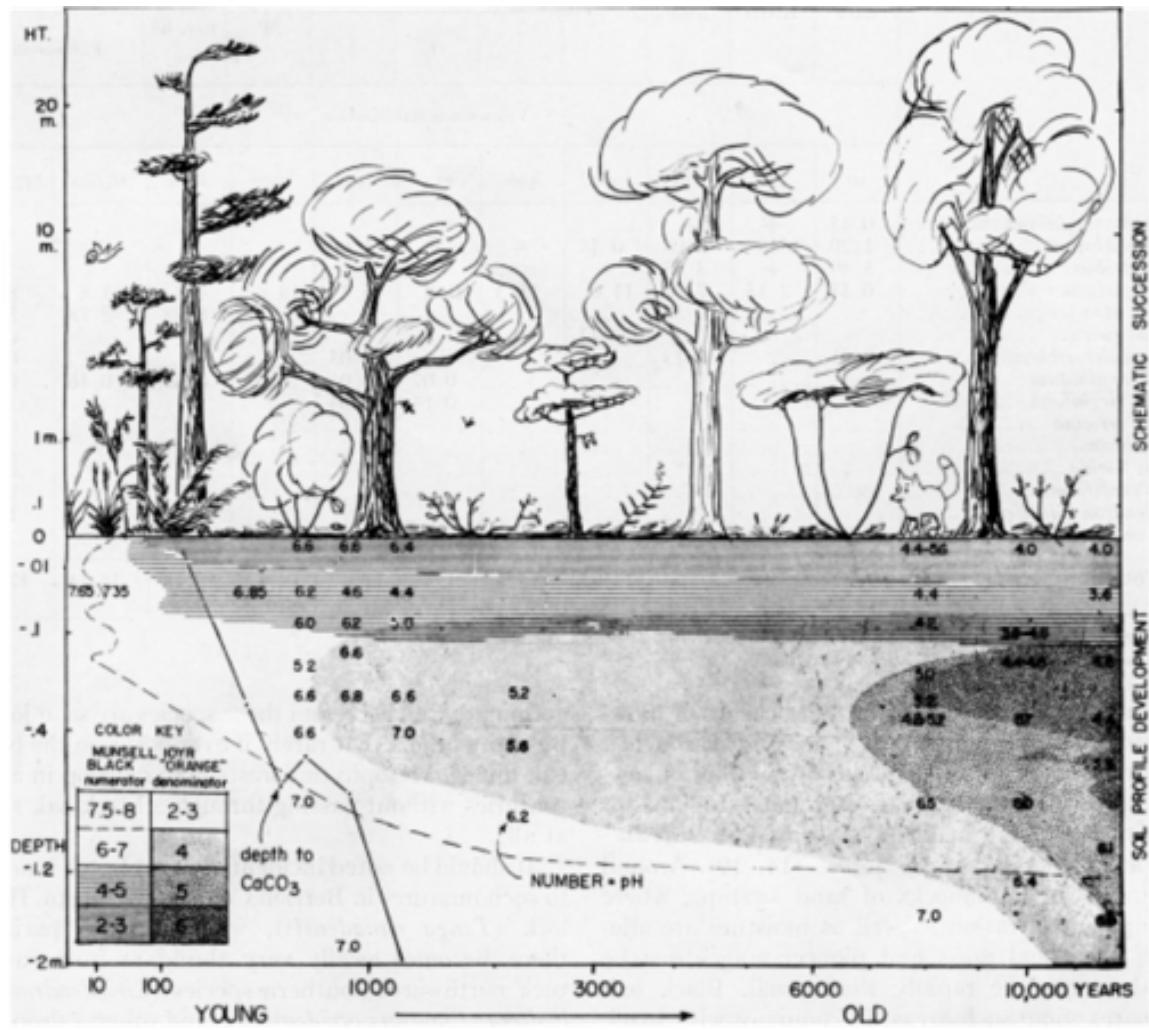


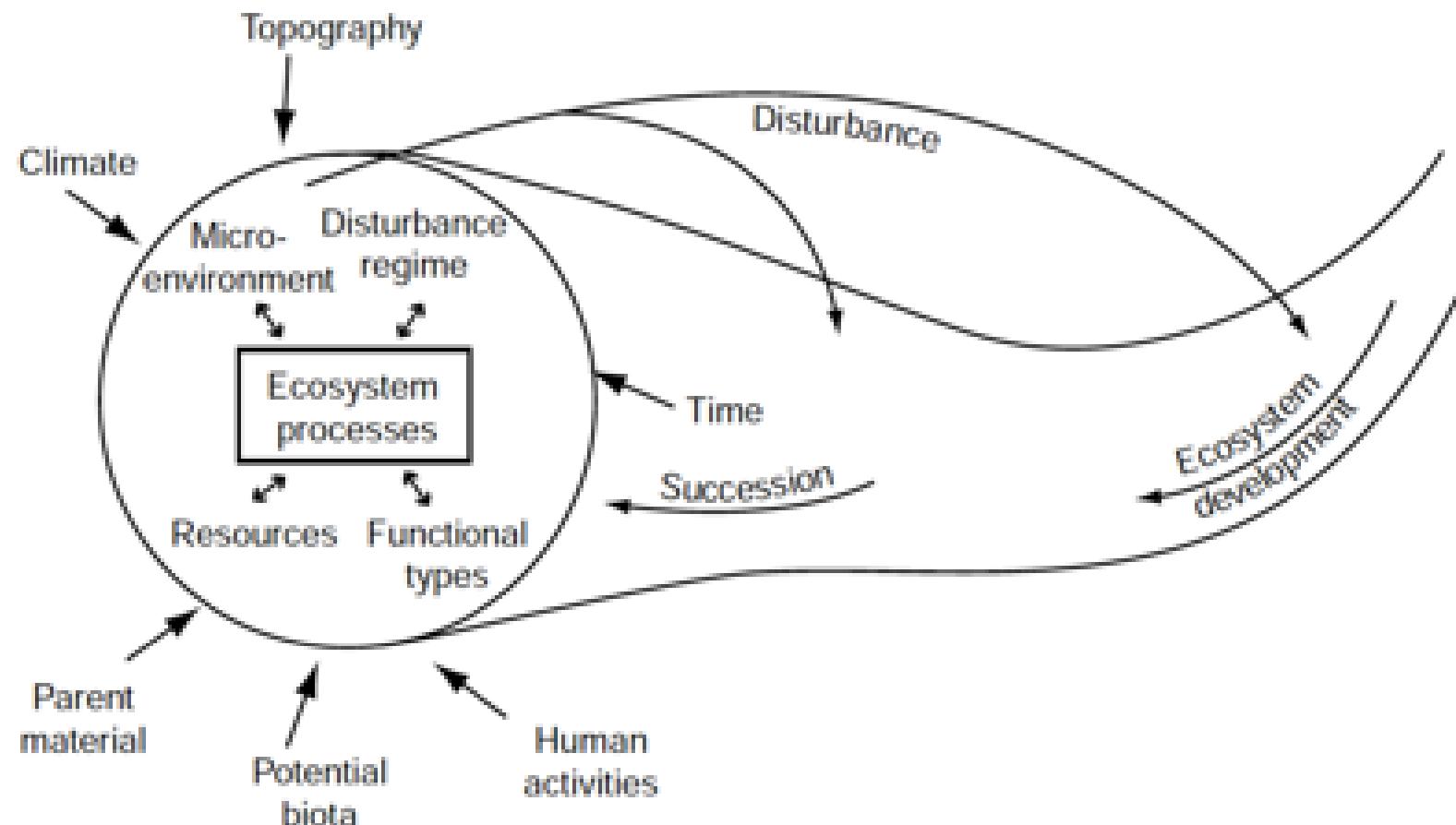
Figure 22.4. Diagrammatic profiles across Indiana sand dunes at the southern end of Lake Michigan. Successively older dune systems originated along earlier and higher beaches. (After Olson 1958.)

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

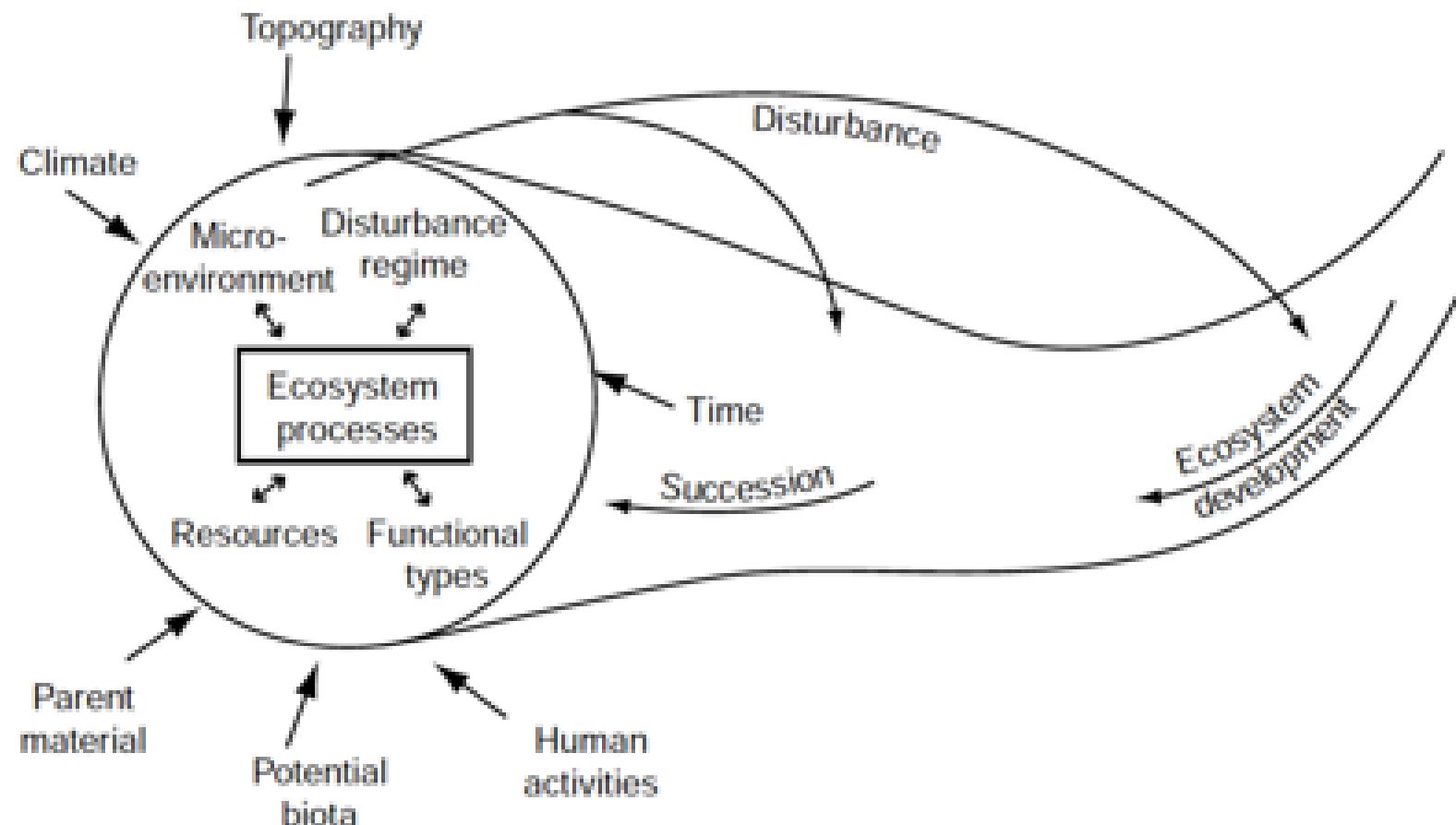
Time



Old

Recent





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

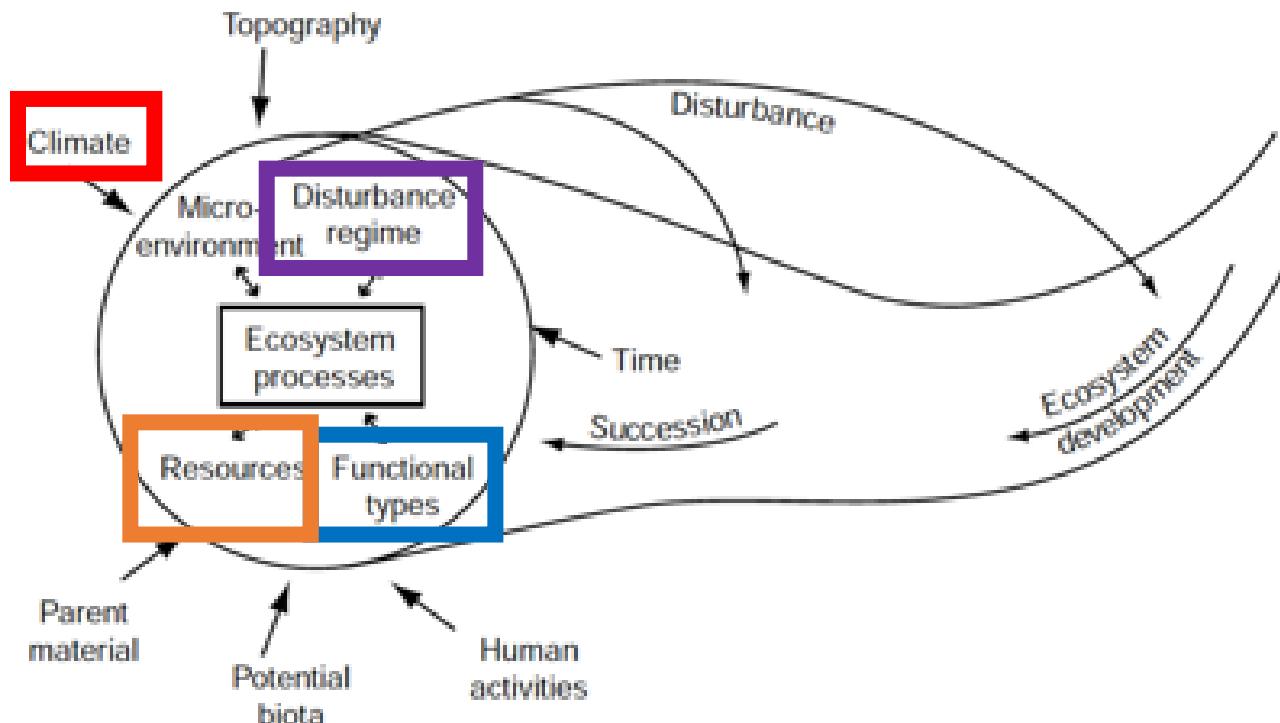
Ecosystem Services: “things an ecosystem provides”

What do humans get from
ecosystems?



Systems Thinking Exercise

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



Climate

Elevated CO₂

Elevated Temperatures

More variable precipitation

Functional types

Invasive species

Woody encroachment

Disturbance regime

Fire frequency

Land clearing

Resources

Nutrient addition

Assignment (groups of 2-4)

- Pick an ecosystem
- Pick an anthropogenic disturbance
- Use a box (pool) and arrow (flux) diagram to explain the effect on ecosystem processes and services

Climate

Elevated CO₂

Elevated Temperatures

More variable precipitation

Functional types

Invasive species

Woody encroachment

Disturbance regime

Fire frequency

Land clearing

Resources

Nutrient addition