Today's Lecture Outline

Biological Processes and Models

1) Introduction
2) The Flow of Matter in the Biosphere
3) The Flow of Energy in the Biosphere
4) Natural Variations of Energy and Matter
5) Human impact on ecosystems

Readings: pp. 37-40, 44-55, 63-67, 80-100

Introduction

- Availability of energy and matter are highly variable from place to place and account for the diversity of life on Earth

Introduction

- **Limiting factors** = physical, chemical and biological characteristics that restrain population growth ...
- For example, plant productivity (e.g. photosynthesis) is limited by the requirement in least supply

- **Environmental resistance** = All limiting factors taken together

limiting factors in this photo
--> its a desert, therefore its dry, hot, few nutrients and no soil

Introduction

Anything growing here has to be adapted to this climate.

Introduction

probably the only environment lacking limiting factors
--> the biggest limiting factor in tropical environments like this is competition because of the large biodiversity

Introduction

limiting factor in this region is that its in the arctic
--> water is frozen, roots cant extract water from ice
--> sunlight is an issue

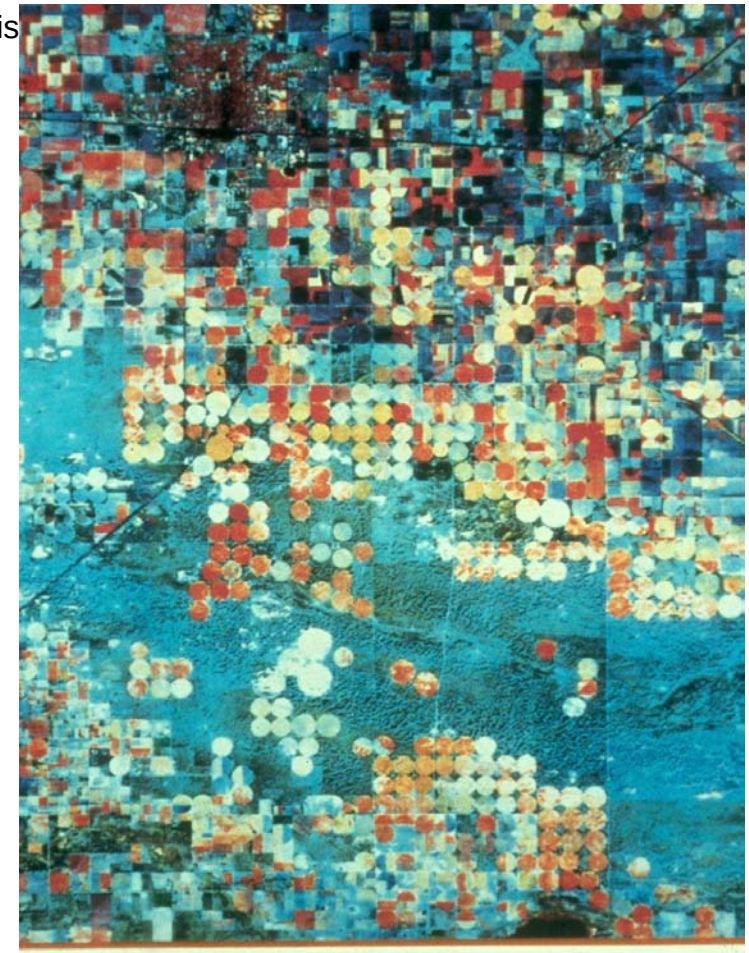
humans can create their own biome/biosphere (e.g. acc play hockey in summer etc)

Introduction

here is a desrt environment, with agri, added nutrients to soil, water, etc

Introduction

its a pivot-irragiation system (above)
and this map shows all the places with this type of agri



LANDSAT COLOR INFRARED COMPOSITE IMAGE,
TEXAS–NEW MEXICO BORDER

The Flow of Matter in the Biosphere

FIGURE 5.10

Dramatic growth of algae in water treated with phosphate

- **Nutrients** = elements and compounds required for survival that are consumed by organisms

Ex: Iron, Calcium, Magnesium, Copper, Phosphorous etc.

The Flow of Matter in the Biosphere

1) Sedimentary Cycles: nutrients spend much of their time locked up in rock but are released for use by life as a result of weathering processes.

Examples?

--> Calcium, limestone
--> Phosphorous
--> Copper, iron

The Flow of Matter in the Biosphere

2) Gaseous Cycle: Nutrients spend much of their time in the atmosphere. Nutrients are exchanged between the biosphere and the atmosphere.

Examples?

--> Oxygen, Carbon Dioxide, Nitrogen

phosphorous is a scarce element
--> tends to be conserved in vegetation (cycled), a limiting factor

when it ends up in the water, it goes into sediment at the bottom and going into rock
1 way this may be retuned to the living system is by waves crashing on the shore (seaspray)
another way, fishing can return phosphorous back into the system since thier bones carry it
cycle needs to be rapid

The phosphorus cycle

crops are sometimes limited due to small amounts of phosphorous
--> creating industrial phosphorous (phosphate fertilizer)

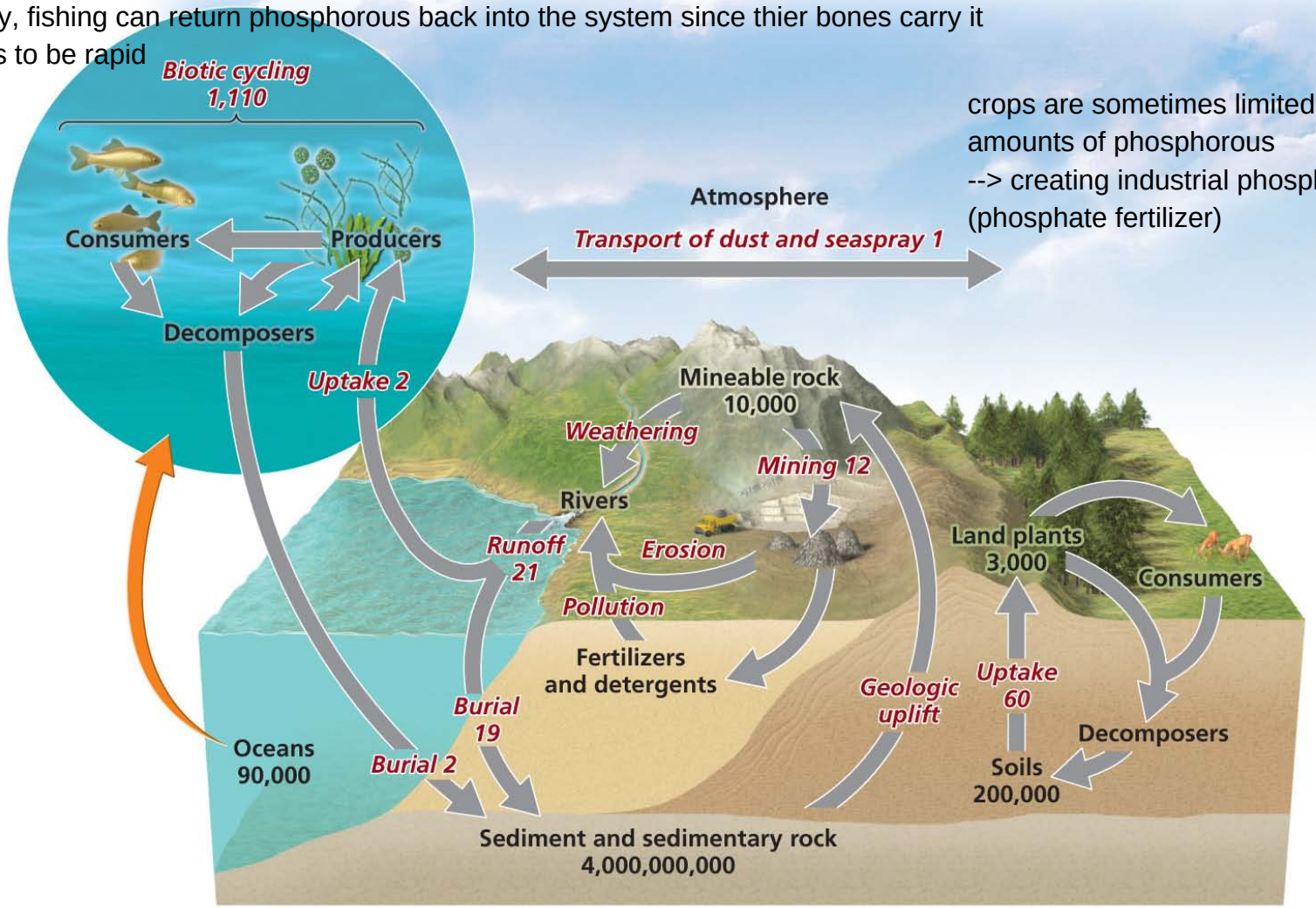


FIGURE 5.20

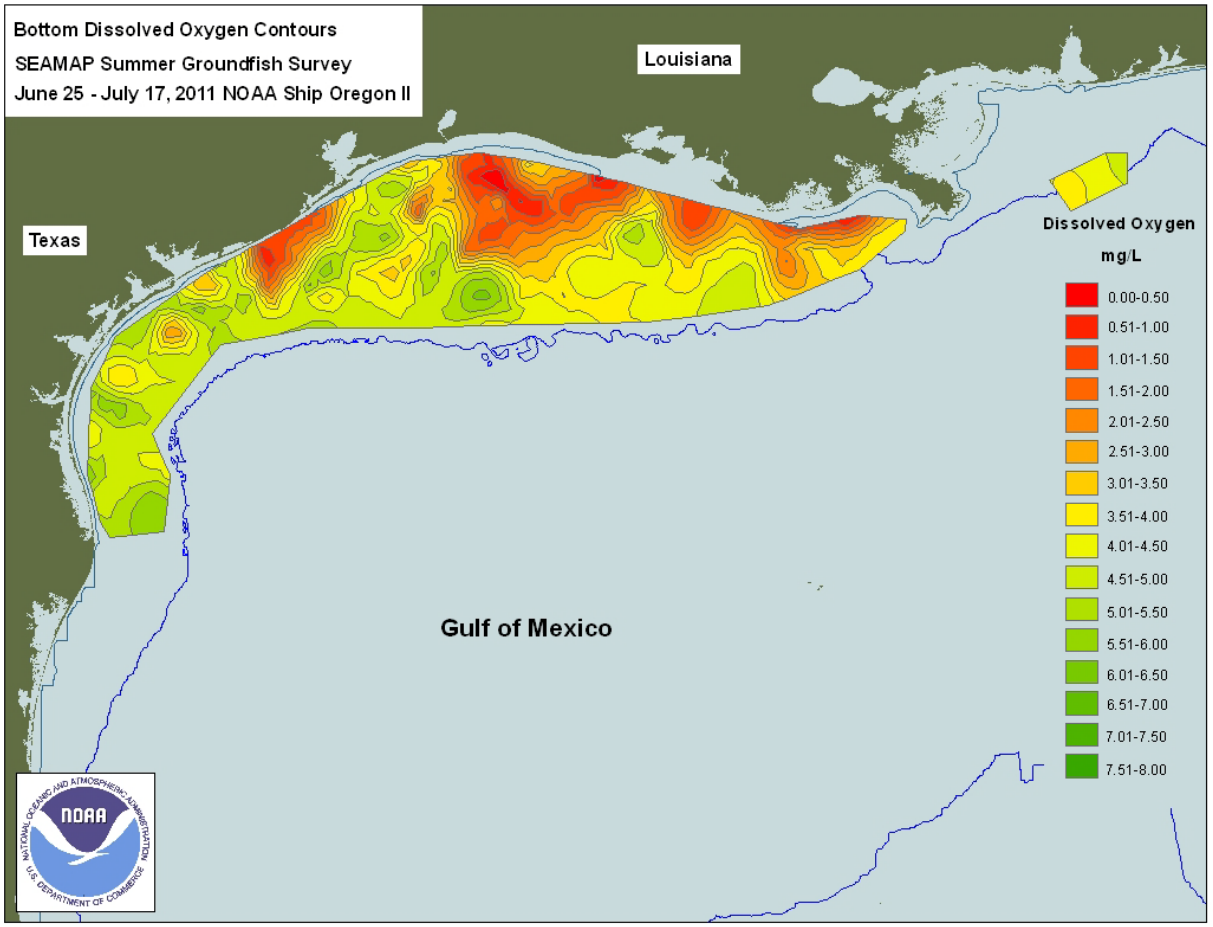
The Flow of Matter in the Biosphere

FIGURE 5.10

Dramatic growth of algae in water treated with phosphate

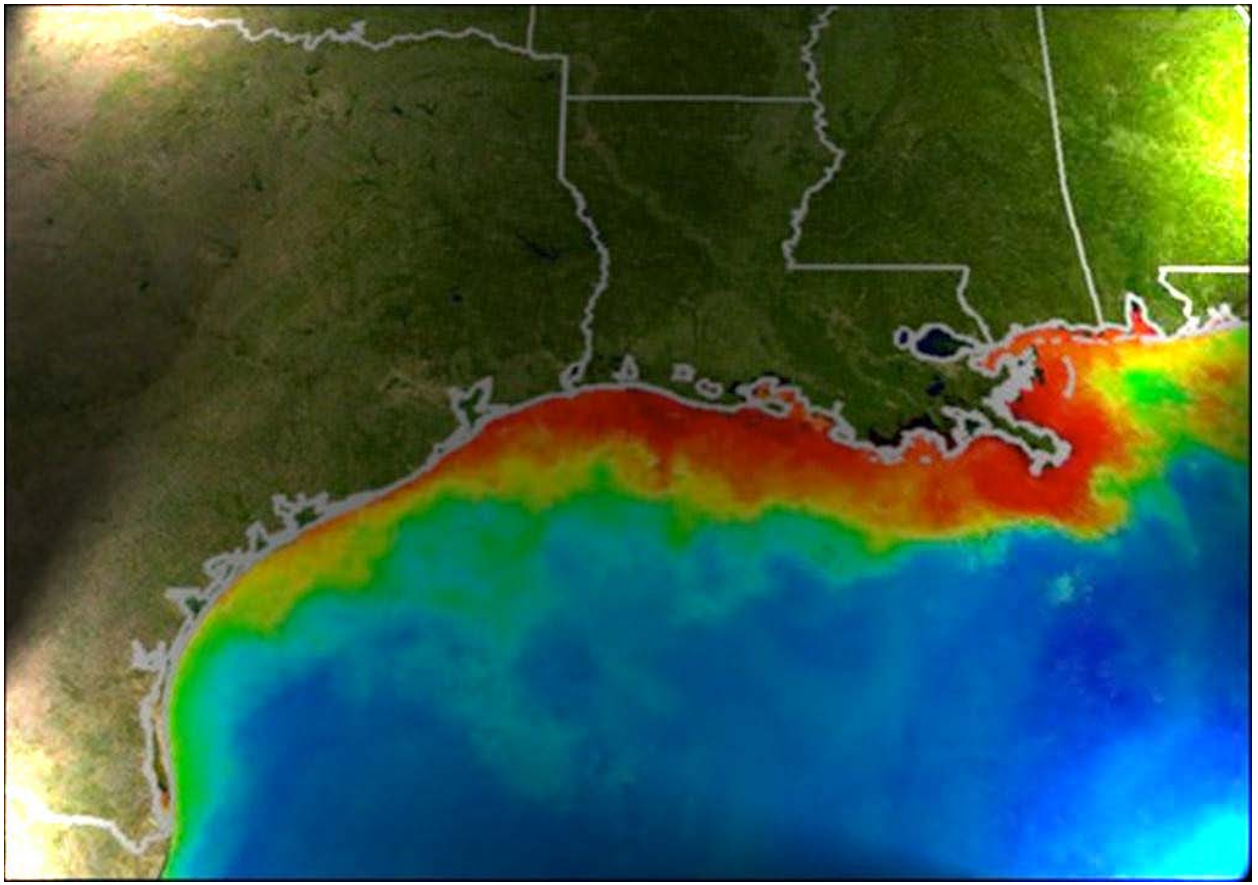
- **Nutrients** = elements and compounds required for survival that are consumed by organisms

this is due to the industrial phosphorous
when this is done, there is very little O in water
killing aqautic life and creating hypoxic conditions



Hypoxic conditions

more hypoxic conditions



alot N2 in atmosphere, everywhere else much less, therefore its a gaseous cycle
bacteria with enzymes that change inorganic N2 in atmosphere into organic N2 so plants and life can make use of it

The nitrogen cycle

the input is Nitrification, output is denitrofication that changes organic back to inorganic

N2 is limit factor
can create it into fertilizer
(cant put 2 much, or 2 less) but never can know how much to put
Prblm with this is that N2 is highly mobile in water, creating algae zones, creating hypoxic zones again

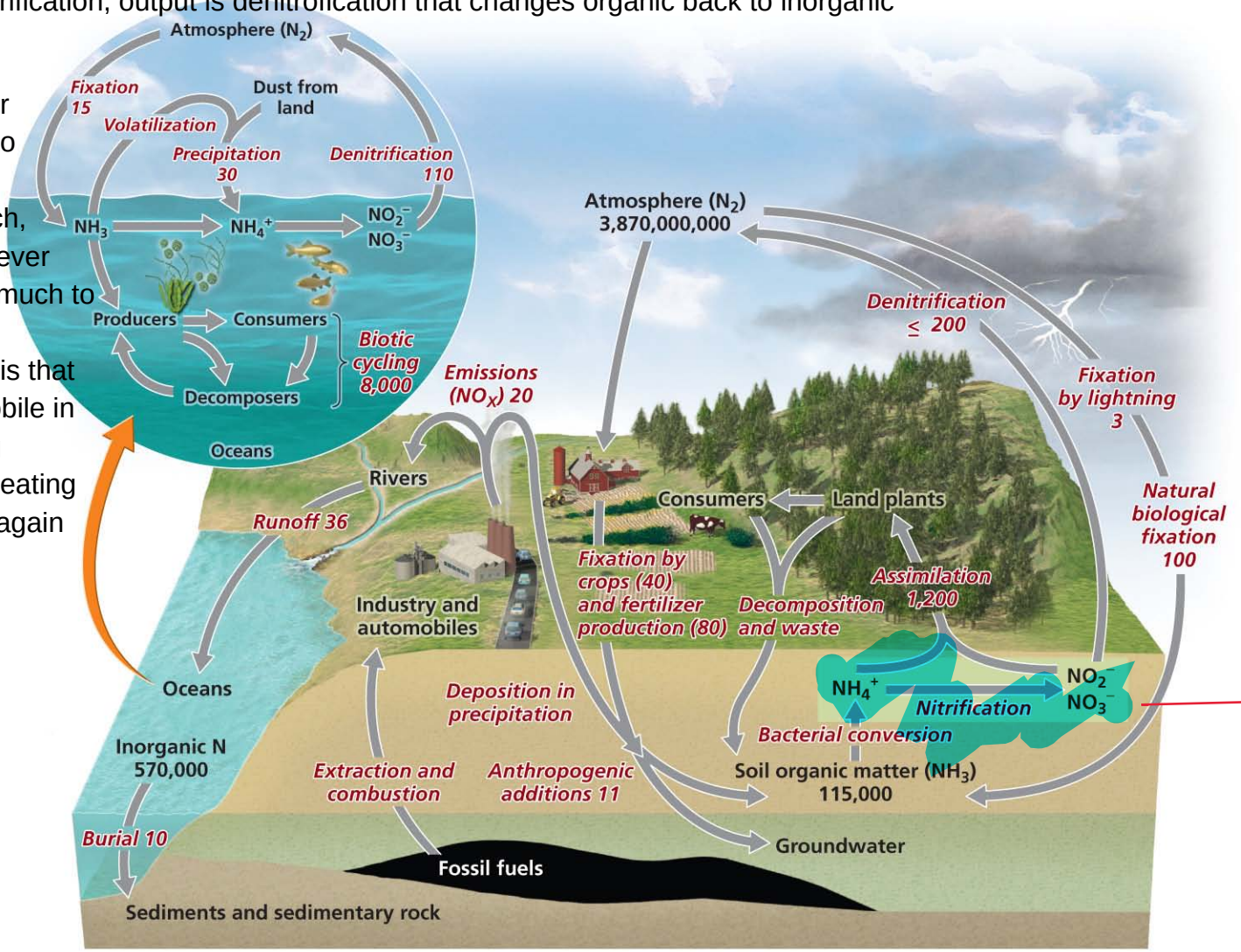


FIGURE 5.17

The carbon cycle

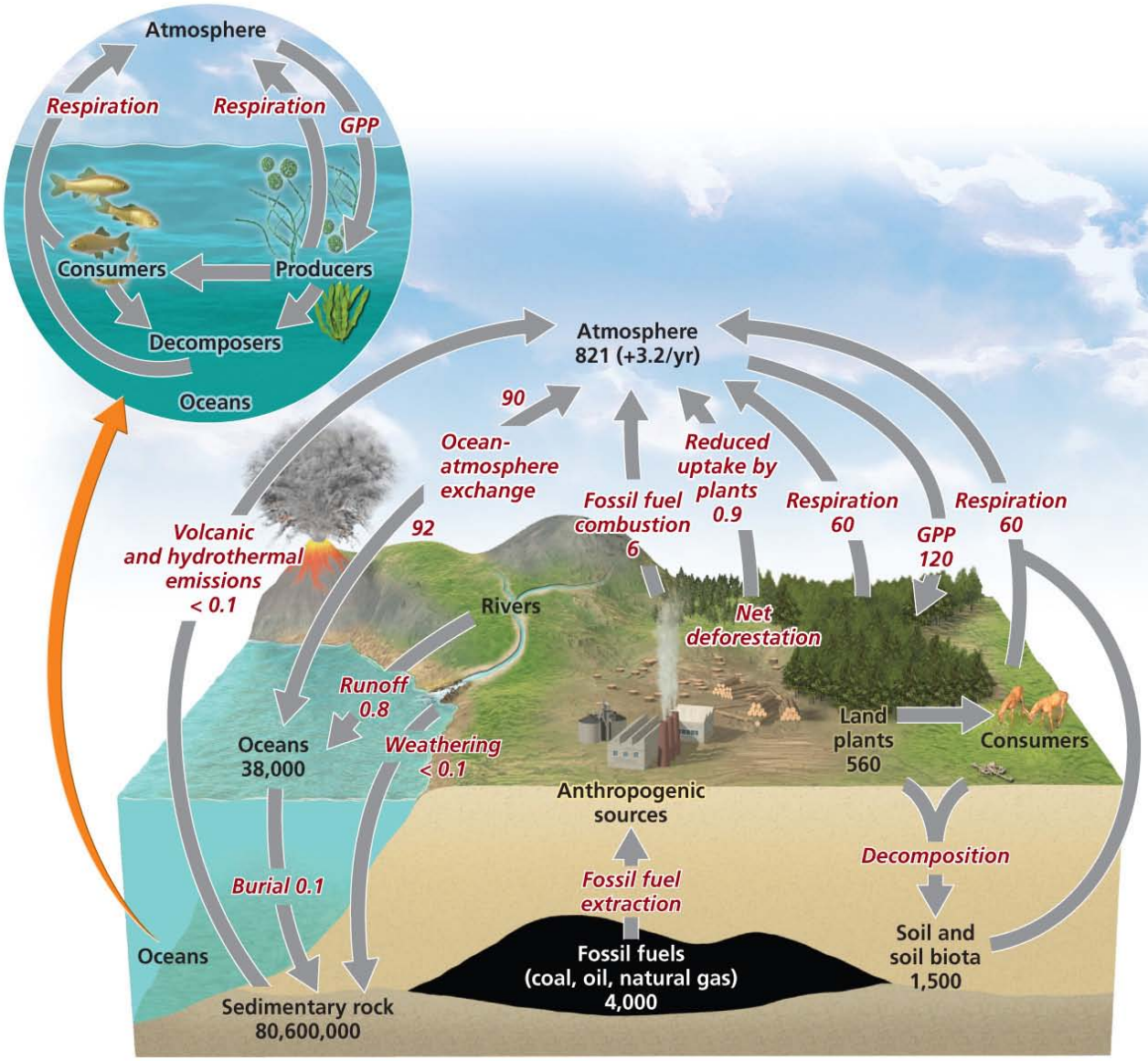


FIGURE 5.16

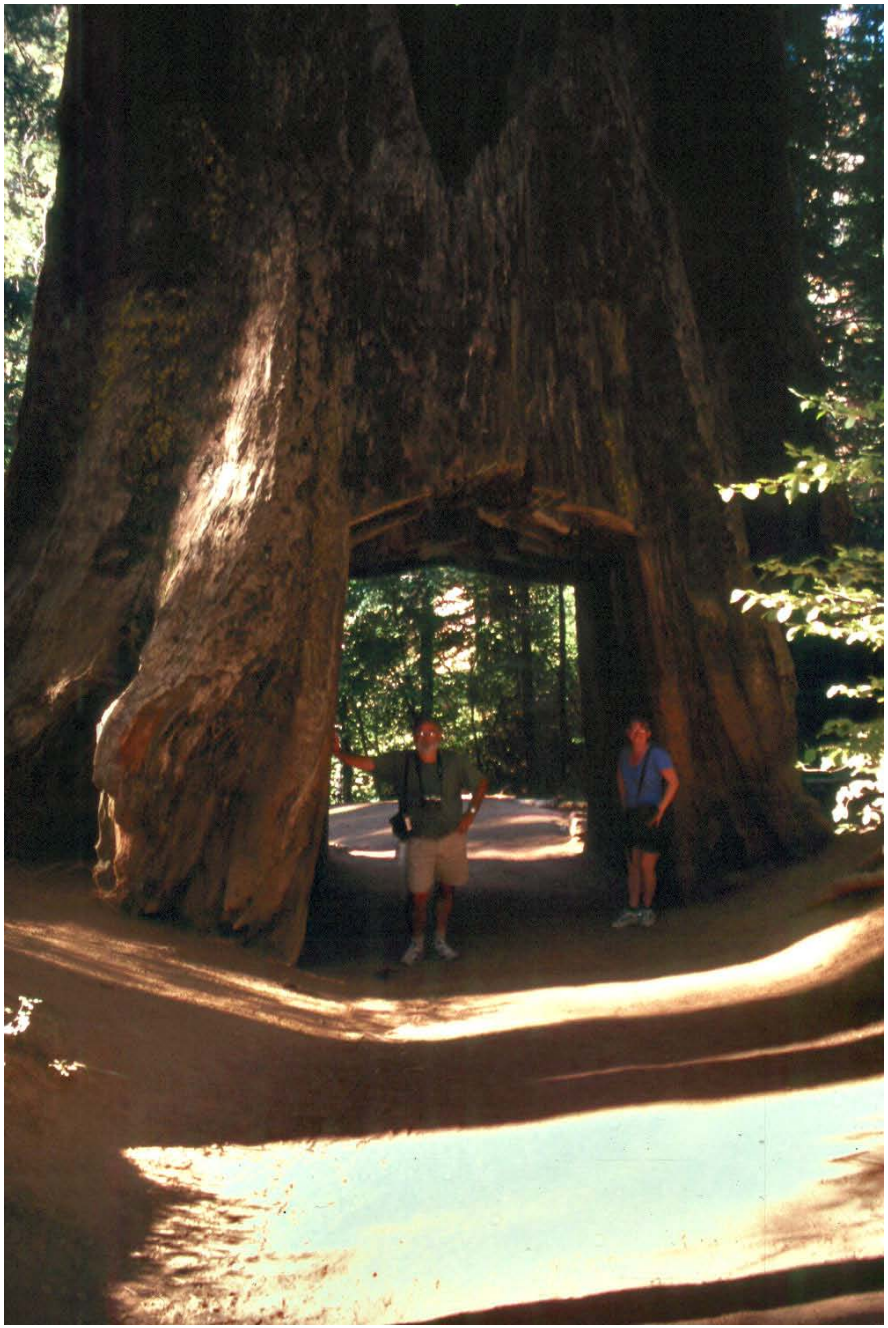
The Flow of Matter in the Biosphere

The Carbon Cycle and Human History

1. Burning simple carbons
2. Controlling carbon life-forms
3. Burning complex carbons (hydrocarbons)
4. Controlling carbon micro-lifeforms

fire lets us extend our habitat, cook (kill pathogens)--> increase pop, provide w/ new hunting strategies
(we could burn fields, releasing nutrients)

absorbs HUGE amounts of CO_2, its a carbon sink, when it decomposes, it would release into atmosphere, soil etc



Ancient sequoia, California

The Flow of Matter in the Biosphere

The Carbon Cycle and Human History

1. Burning simple carbons
2. Controlling carbon life-forms
3. Burning complex carbons (hydrocarbons)
4. Controlling carbon micro-lifeforms

we've cloned plants and animals

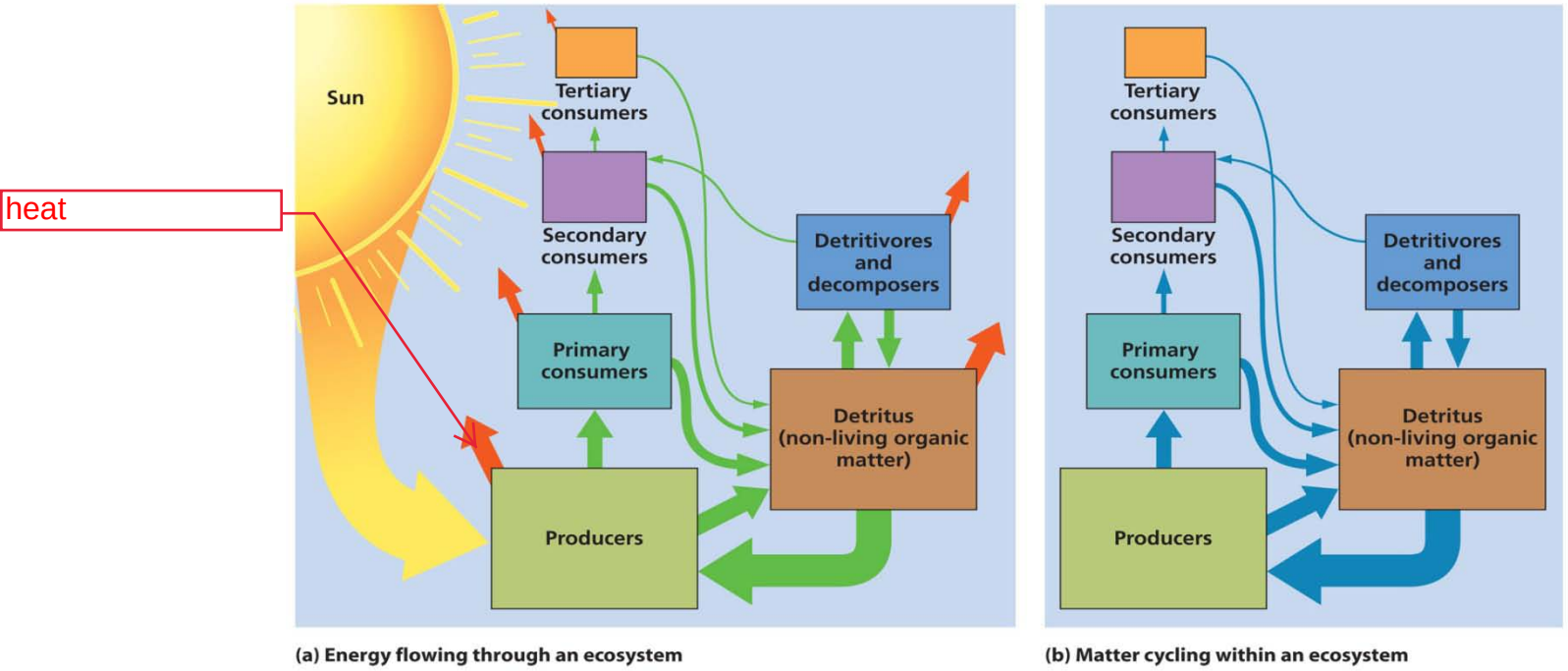
Today's Lecture Outline

Biological Processes and Models

1) Introduction
2) The Flow of Matter in the Biosphere
3) The Flow of Energy in the Biosphere
4) Natural Variations of Energy and Matter
5) Human impact on ecosystems

The Flow of Energy in the Biosphere

Food Chain: a sequence of organisms in an ecosystem, each eating or decomposing its prey



The Flow of Energy in the Biosphere

Food Web: a set of interconnected food chains by which energy and matter circulate through an ecosystem

The Flow of Energy in the Biosphere

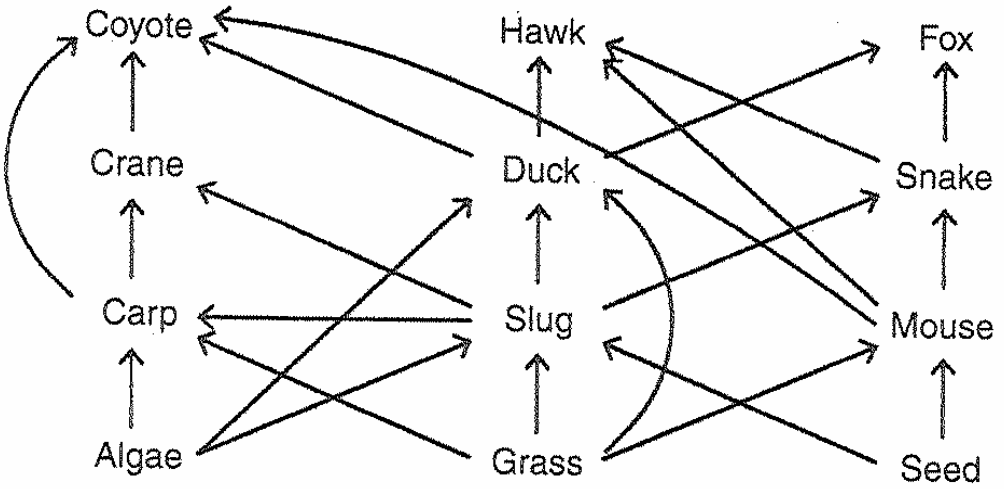


FIGURE 5.1 *(a) Illustration of three simple food chains. The lower diagram (b) shows the interconnections among the food chains that form food webs.*

Marsh and Grossa, 2005

Food webs show feeding relationships and energy flow

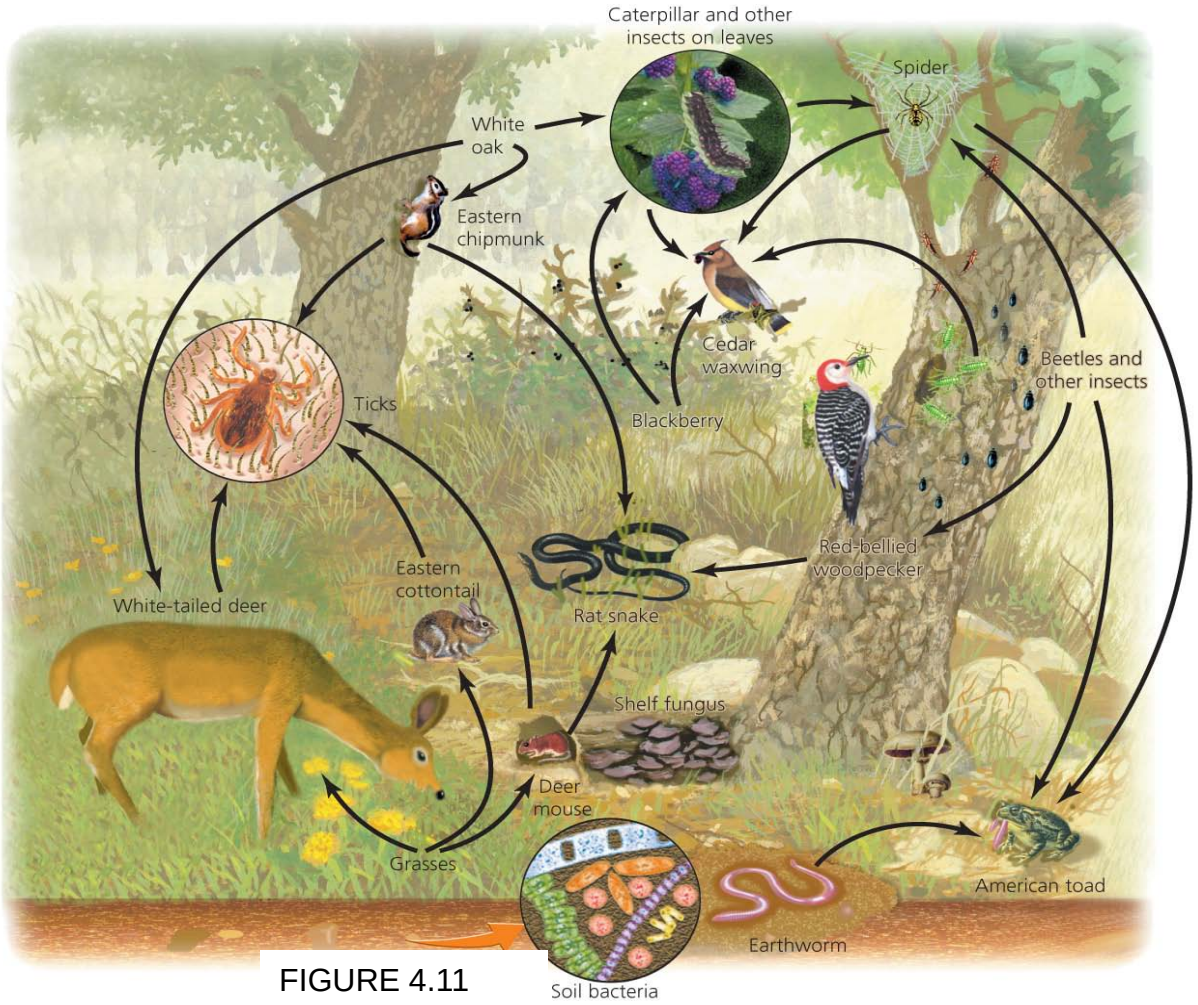


FIGURE 4.11

how to deal with loss of food 1. adapt 2. migrate 3. death

The Flow of Energy in the Biosphere

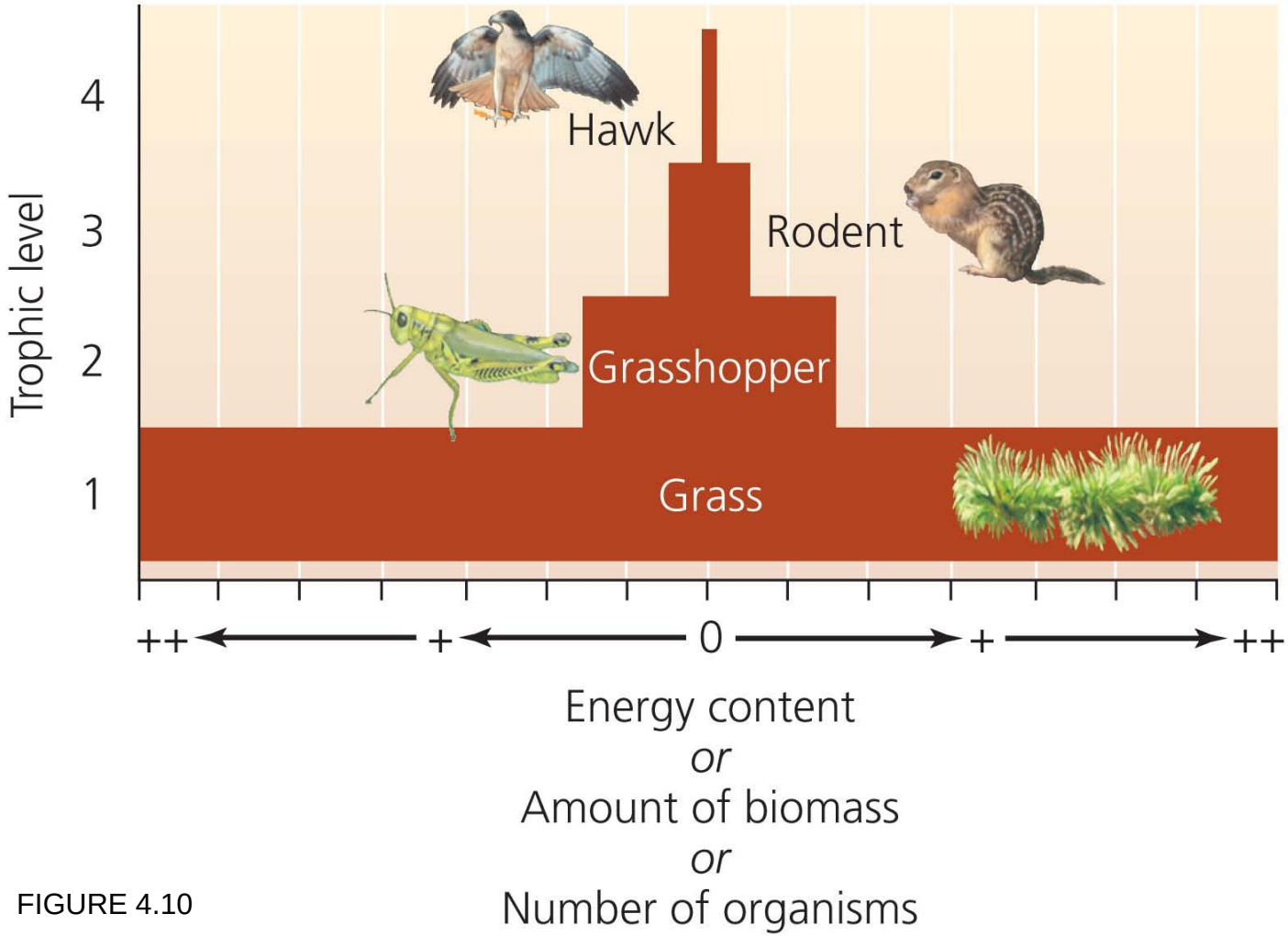


FIGURE 4.10

The Flow of Energy in the Biosphere

Karner Blue Butterfly

Baltimore Oriole

The Flow of Energy in the Biosphere

randeau provincial park

Human Disturbance

Actual White-tailed Deer

Today's Lecture Outline

Biological Processes and Models

1) Introduction
2) The Flow of Matter in the Biosphere
3) The Flow of Energy in the Biosphere
4) Natural Variations of Energy and Matter
5) Human impact on ecosystems

Natural Variations in Energy and Matter

- Biome = major regional complex of similar communities recognized by
  - Plant type
  - Vegetation structure

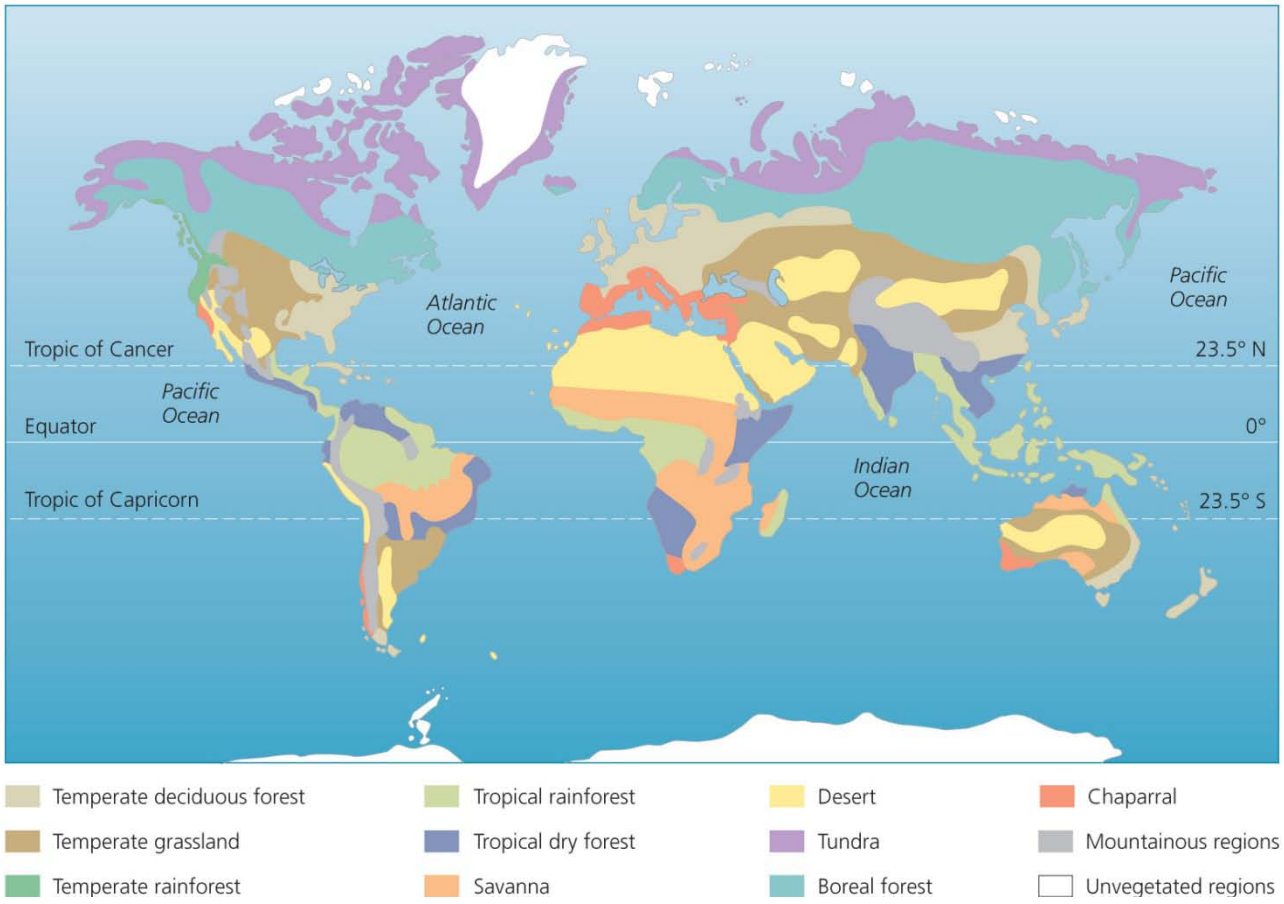


FIGURE 4.16

Today's Lecture Outline

Biological Processes and Models

1) Introduction
2) The Flow of Matter in the Biosphere
3) The Flow of Energy in the Biosphere
4) Natural Variations of Energy and Matter
5) Human impact on Ecosystems

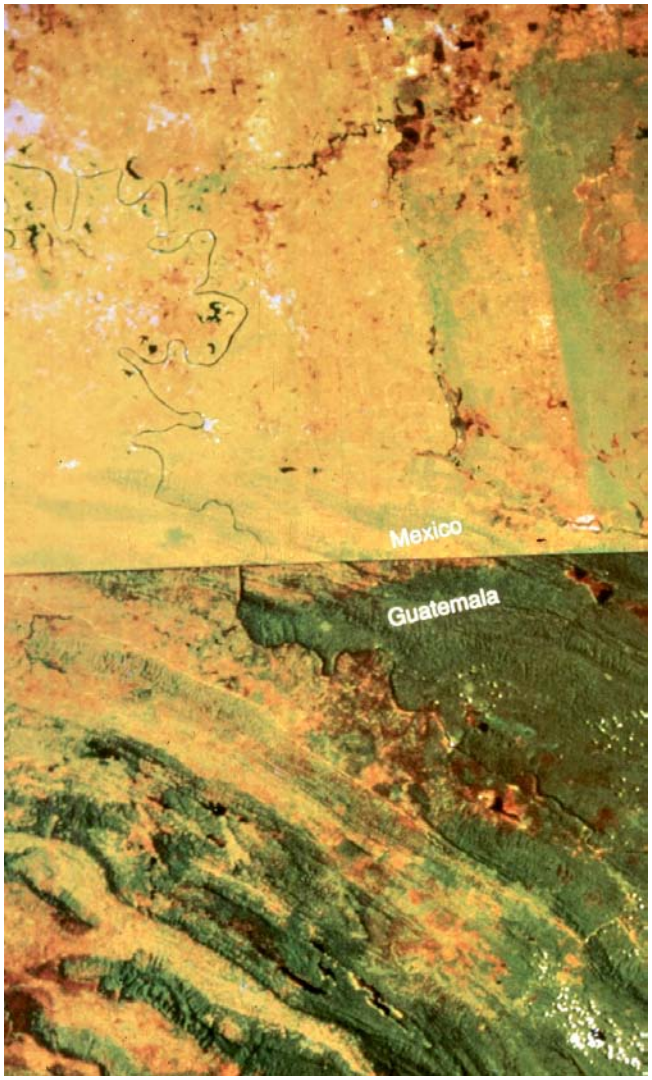
Human Impact on Ecosystems

1) Reduction: the loss of an area or coverage of an ecosystem as a result of burning, agricultural development, urbanization and lumbering

Example ?

mine, quarry etc

Human Impact on Ecosystems



Human Impact on Ecosystems

reduction to the extreme here

Human Impact on Ecosystems

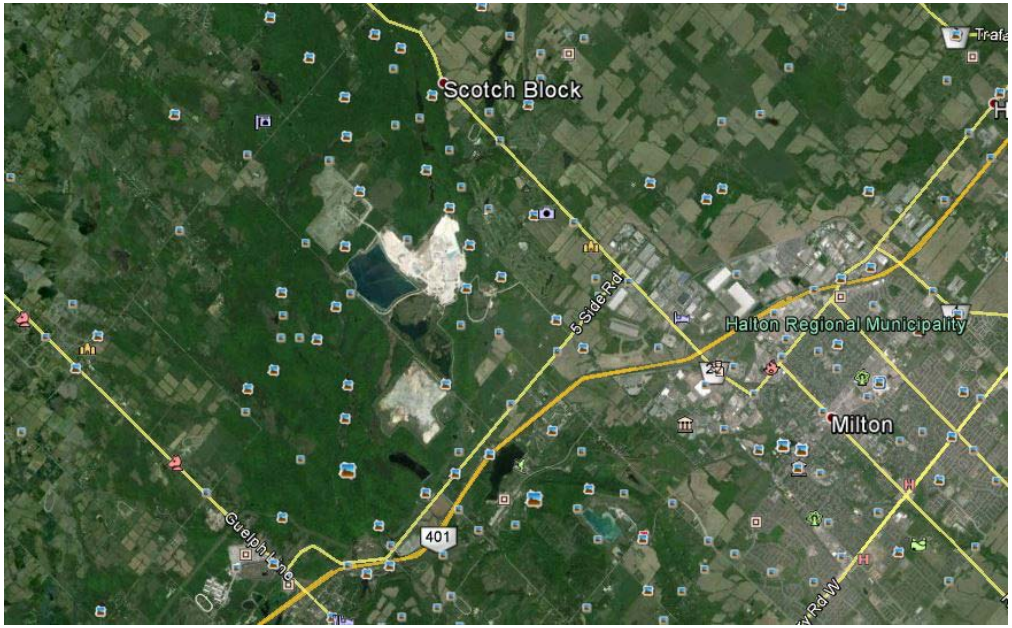
Human Impact on Ecosystems

Fragmentation: results of ecosystems broken down from large continuous areas into smaller parcels

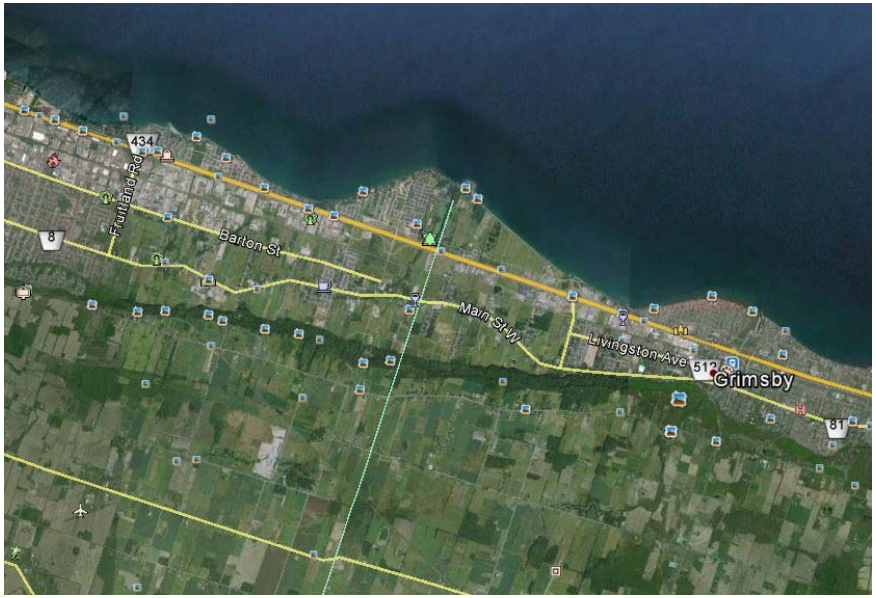
Example ?

Human Impact on Ecosystems

Human Impact on Ecosystems



the niagara escarpment , reduction so much that its only a belt now
problem is that roads go through this belt



Google Earth, 2015

Human Impact on Ecosystems

3) Substitution: the replacement of one species of organism in an ecosystem with another

Example ?

Simplification: reduction of the biodiversity of an ecosystem (an extreme form of substitution)

Example ?

forest is gone in order for corn
or front lawns only one type of grass

Human Impact on Ecosystems

Human Impact on Ecosystems

4) Extinction: the permanent loss of a species

Examples ?

these trees were logged to extiction
(white pine)

-the Sixth Great Extinction...

Human Impact on Ecosystems

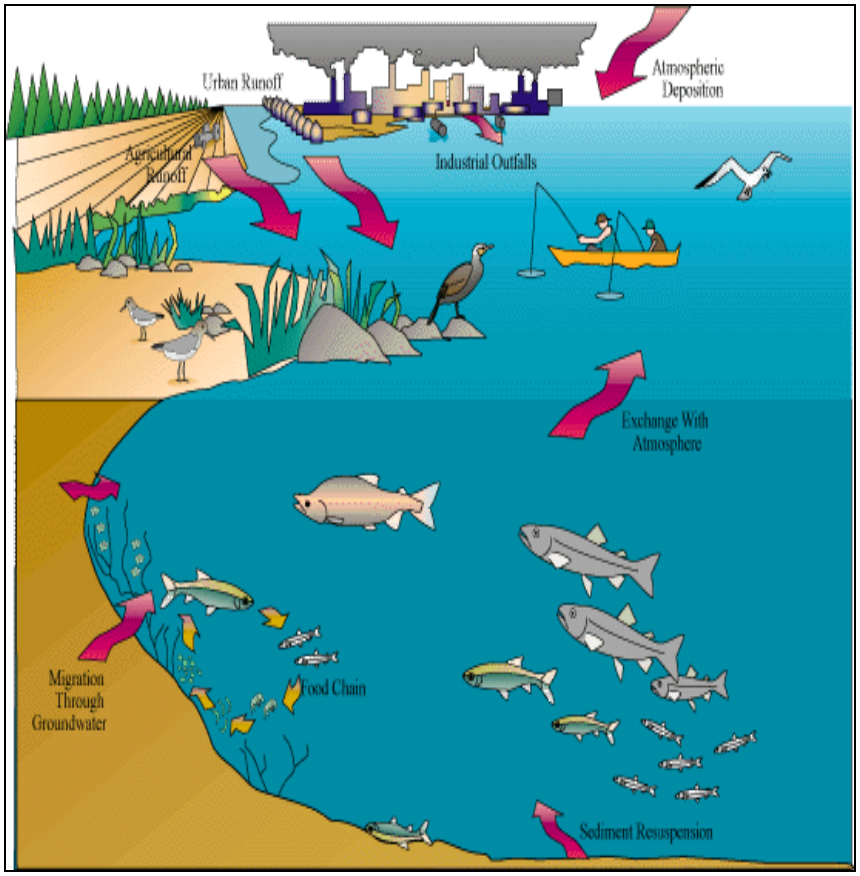
Human Impact on Ecosystems

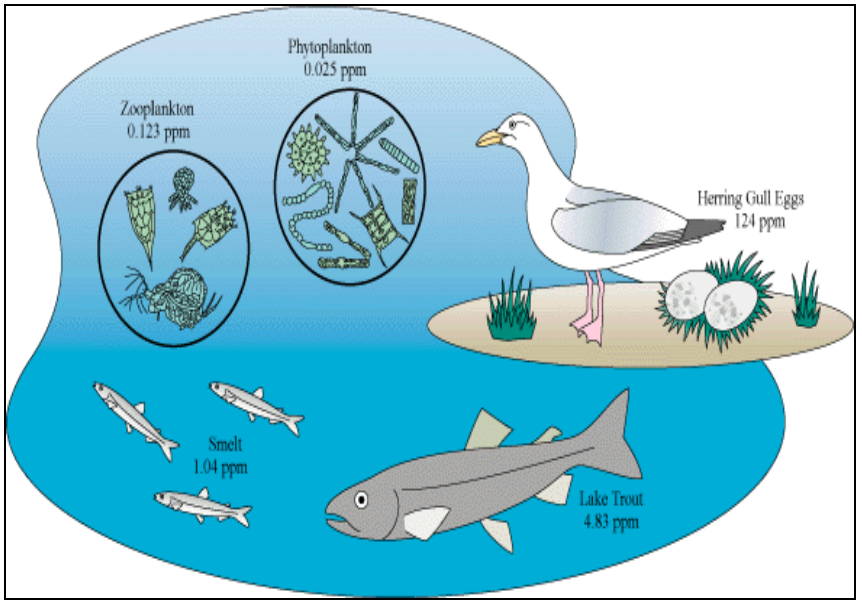
5) Contamination: incorporation of pollutants into the ecosystem

Example: contaminants in the Great Lakes

Human Impact on Ecosystems

Contamination in the Great Lakes





Sources → Contamination

Human Impact on Ecosystems

Bioaccumulation: the build-up of contaminants over time in an organism

Example: wildlife in the Arctic

Human Impact on Ecosystems

Biomagnification: occurs when contaminates are passed up the food chain and concentrated along the route

Example: dead beluga whales within the St. Lawrence watershed have been declared hazardous waste because of the concentrations of toxins/chemicals found within them

Human Impact on Ecosystems

Synergism: occurs when two chemicals act together to produce greater impacts than each individually

Review

You must be familiar with:

1. The flow of matter (nutrient cycles or biogeochemical cycles)
2. Sediment cycles (i.e phosphorous) and gaseous cycles (i.e. nitrogen and carbon)
3. Terms such as micronutrients, macronutrients
4. A history of humans and carbon
5. Human impact on natural flows of matter
6. The flow of energy (food webs, food chains)
7. Human impact on natural flows of energy
8. Terms such as producers, consumers, energy pyramid, biome
9. Terms such as photosynthesis, respiration, primary and secondary relationships

Review

10. Human impact on ecosystems: 1) reduction, 2) fragmentation, 3) substitution (and simplification), 4) extinction, and 5) contamination (and bioaccumulation versus biomagnification, synergism)
11. Principle of Limiting Factors
12. Readings as outlined at beginning of unit