Geog 1000 - Lecture 25

Ecosystem Energy Pathways

http://scholar.ulethbridge.ca/chasmer/classes/

Today's Lecture (Pgs 485 – 495)

Question: What happens to plant photosynthesis in winter?

1. Trophic relationships between producers and consumers
2. Limits to development: species distribution and population
3. Biodiversity and biological evolution
4. Ecosystem stability
5. The current state of biodiversity
6. Ecosystem restoration
7. Terrestrial and aquatic succession

Assignment 3 due on Monday

→ Will skip soils (not enough time, but may try to discuss last week with environmental change).

What happens to photosynthesis in winter?

Preparing for winter:

→ Shorter days: Less light, lower temperatures (less water)

Leaves no longer able to produce glucose → shut down chloroplasts and cells die.

→ Healthy leaves require red, yellow; blue, violet (photosynthetically active radiation – PAR) for photosynthesis.

→ Reflect green and near infrared radiation in summer

→ Red & orange reflected when not needed, in fall

What happens to photosynthesis in Winter?

Most vegetation → becomes dormant in winter/night

→ deciduous lose leaves

→ conifer needle stomata freeze shut when cold…

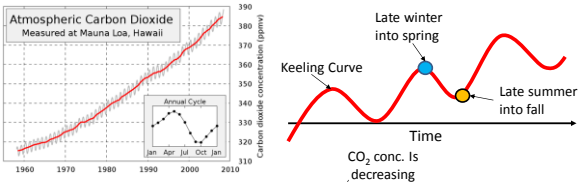
**Maintenance results from consumption of stored organic material = CO_2 release into atmosphere*

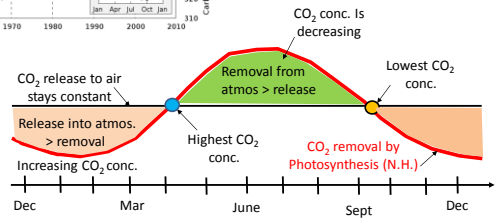
CO_2 added → from animals, plants, breaking down of organic materials, fossil fuel combustion

CO_2 removed → photosynthesis, oceans

What is the impact of seasonal photosynthesis on global warming?

What happens to photosynthesis in Winter?





Atmospheric CO_2 will decreases as long as **removal from atmosphere > release**

Today in Geography

A dirty $10 diamond was found by U of Alberta: Clues that water exists 410-660 kms below Earth's surface (Nature).

→ Bumpy diamond sculpted by fluids

→ Amount of water could be same *mass* as all worlds oceans.

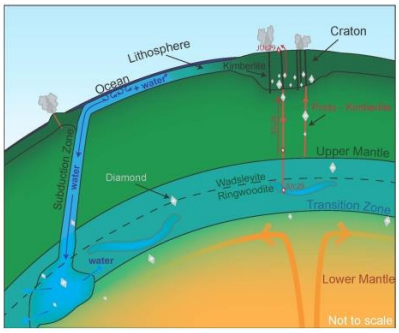
→ Important implications for water cycle, tectonics

Evidence: Tiny grain of rock 4 hundredths of a mm in diameter in diamond
→ Rock made of ringwoodite, contains 1.5% water

→ "An oasis of water in the transition zone"

→ Moves up to the surface quickly via kimberlite volcanic rock – erupts quickly from extreme depths.

Today in Geography



http://www.cbc.ca/news/technology/deep-earth-has-oceans-worth-of-water-10-diamond-reveals-1.2569564

What is going on with Lethbridge Water?

Trophic Relationships between Producers and Consumers

Basic Food Chain

Autotrophs
- → Self feeders: Fix and use carbon, energy
- → Primary *producers* of the ecosystem
- → Feed higher levels of *consumers*

Heterotrophs
- → Feed on others
- → *Consumers* of the ecosystem

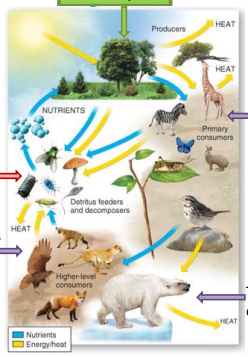
Detritivores, Decomposers
- → Feed on the refuse on what is left over
- → Final link
- → Release inorganic compounds

Energy, Nutrient and Food Pathways

Omnivores (eats producers and consumers)

Detritivores, Decomposers

Secondary consumers (carnivores)

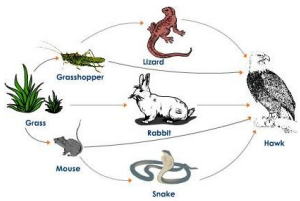


Heterotrophs

Primary consumers (herbivores)

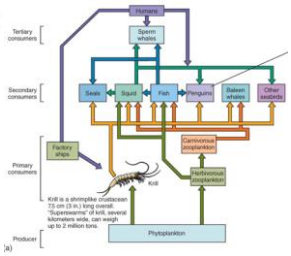
Tertiary consumers (top of the food chain)

Examples of Food Webs:



Grassland Food web

Antarctic Food web



Food Web Efficiency:

Efficiency of Energy Flow:

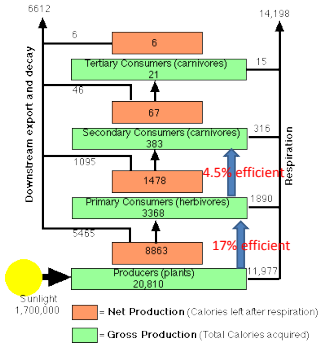
Gross Production minus *Respiration* = *Net Production*

What this means is:

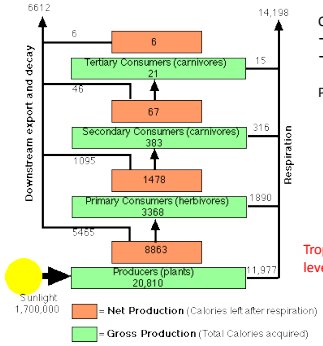
- → Organisms must expend energy to survive.
- → Differences greater between consumers than producers
- → Substantial losses in energy lost

Conversion Efficiency:
Net production (level 1) / Net production (level 2) (etc.

Units = kcal/m_2/yr)

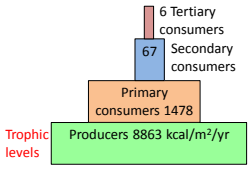


Energy Pyramid:



Conversion efficiency always < 100%
→ Animal farming <10%
→ Energy to secondary consumers < 1%

Pound of meat = $$ than pound of corn

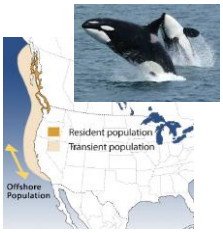


Species Distribution: Limiting Factors

Limiting Factors → Physical, chemical or biological → Determines species distributions. Know some of the limiting factors (pg 488).

What might be the limiting factors?

Tree Line

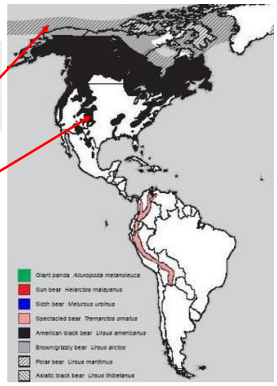


Killer Whales

Species Distribution: Limiting Factors

What might be the limiting factors?

Bear Distribution



Ecosystem Stability and Evolution

Ecosystems → Constantly evolving, forced by growth/resistance factors

→ Changes due to changing environment

→ Gradual transitions to catastrophic events

Catastrophic Landslide + regeneration

Field gradually turning into a forest

Ecosystem Stability and Evolution

Factors Increasing growth → Population imbalance ← Factors Decreasing growth

Abiotic:
→ Favourable Light
→ Adequate Water, temperature, nutrients

Biotic:
→ Reproductive success
→ Adaptive to change
→ Competition, migration
→ Food

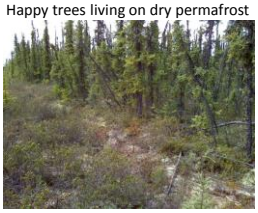
Abiotic:
→ Weather
→ Water
→ Climate change
→ Change in chemistry

Biotic:
→ Habitat (lack of)
→ Food (lack of)
→ Predators, parasites, disease

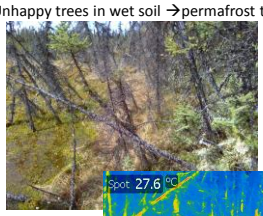
An Example:

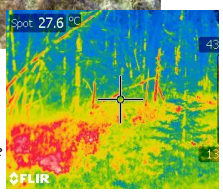
Changing black spruce tree distribution in the NWT as a result of permafrost thaw:

Happy trees living on dry permafrost



Unhappy trees in wet soil → permafrost thaw

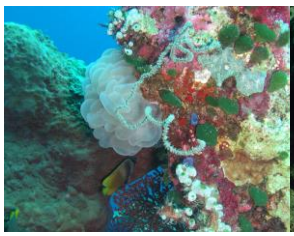




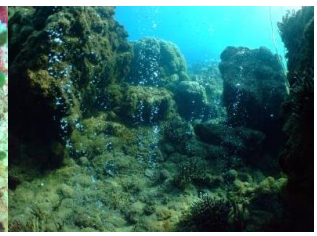
Thermal image – unhappy trees are heating up, exacerbating thaw
→ Changing landscape
→ Trees are at their *range of tolerance*
→ *Ecosystems are always changing*

Biodiversity and Biological Evolution

Biodiversity → *Bio*-logical *diversity*
→ Species richness, variability (genetic variations, species variations or ecosystem variations within a biome).



High biodiversity



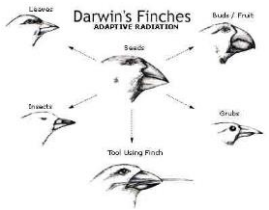
Low biodiversity

Evolution

Evolution → adaptation and development of single cell organisms to more complex forms over generations.

→ Genetics shaped by environment
→ Leads to greater rates of survival

Traits in genes maximise use of niches = *Natural Selection* → genetic favoritism



Vicariance → Separation from other species due to barrier change.

Ecosystem Stability

Greater biodiversity = greater long-term stability, productivity.

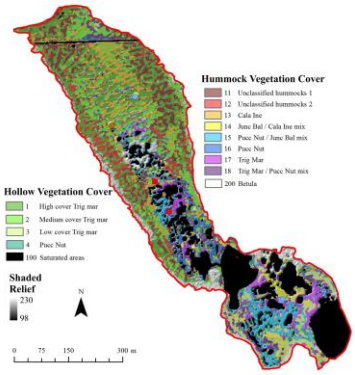
E.g. Cedar Creek Ecosystem Science Reserve

→ More diverse communities = greater resilience to drought

Inertial stability: Ability to resistance small disturbance

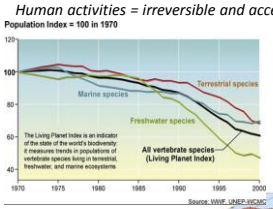
Resilience: Ability to recover

Examining Wetland Biodiversity in Alberta



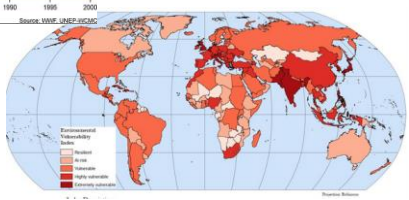
Declining Biodiversity Problem

Human activities = irreversible and accelerating decline in biodiversity



Extent to which a country is prone to damage, degradation:

Canada listed "At Risk"
USA → Vulnerable
Europe → Highly vulnerable
India → Extremely vulnerable



5 Greatest Threats to Biodiversity

1. Habitat loss, degradation, fragmentation
   → Urban development, agriculture

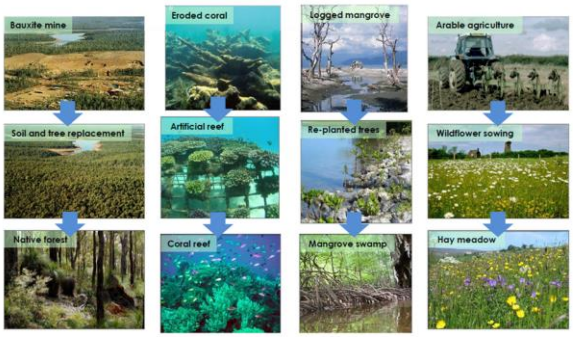
2. Pollution air, water, soils

3. Resource use at unsustainable levels

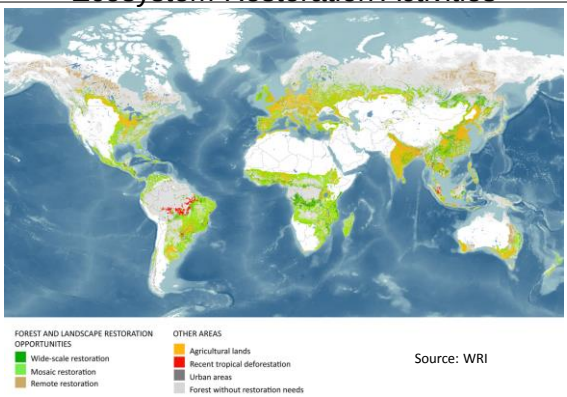
4. Human induced climate change

5. Introduction of non-native plants, animals

Ecosystem Restoration



Ecosystem Restoration Activities

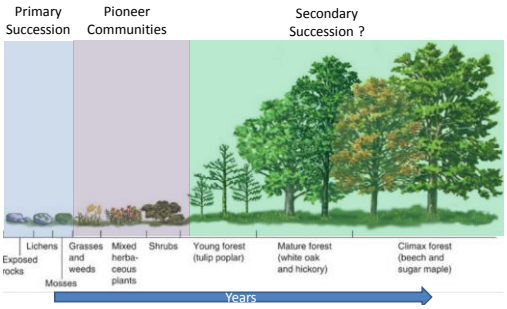


Source: WRI

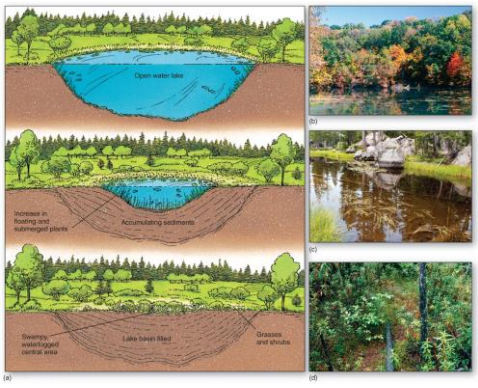
Ecological Succession: Terrestrial

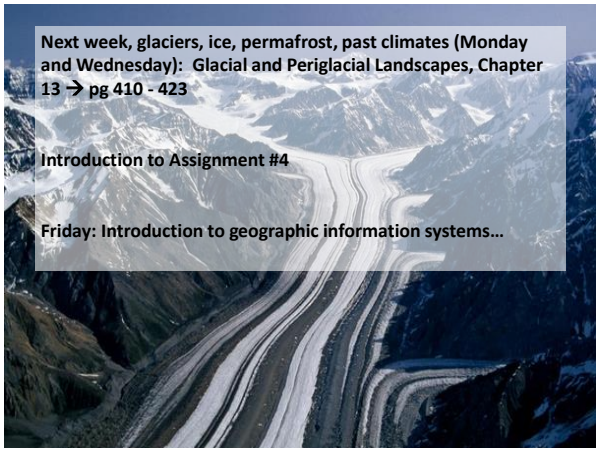
Ecological Succession → Newer communities (complex) replace older ones (simpler) = hopefully more mature condition.

→ Requires disturbance: Deforestation, fire, volcanic eruption, wind storm, etc.



Ecological Succession: Aquatic




Next week, glaciers, ice, permafrost, past climates (Monday and Wednesday): Glacial and Periglacial Landscapes, Chapter 13 → pg 410 - 423
Introduction to Assignment #4
Friday: Introduction to geographic information systems…