ENVE203
Environmental Engineering Ecology
(Nov 19, 2012)

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'Biological Communities'

Biological Communities
COMPETITION

Occurs when 2 or more individuals attempt to use an essential common resource such as food, water, shelter, living space, or sunlight.

Tree in a dense forest growing taller than surrounding trees, it absorbs more of the incoming sunlight, and less sunlight is available for nearby trees.

Biological Communities
COMPETITION

Biological Communities
COMPETITION

In the past:

Ecologists: ‘Competition is the most important determinant of both the number species found in a community and the size of each population’

Today:

Ecologists : ‘Competition is only one of the many interacting biotic and abiotic factors that affect community structure’

Biological Communities
COMPETITION

A variety of flowering plants live in a pine forest competing with conifers for resources as soil moisture, and soil nutrient minerals.

Their relationship however is more than simple competition

Flowering plants produce nectar consumed by some insect species, reducing the number of insects feeding on pines

conifer

insects feeding on pines

Biological Communities

COMPETITION

If the flowering plants were removed from the community, would the pines grow faster because they were no longer competing for necessary resources?

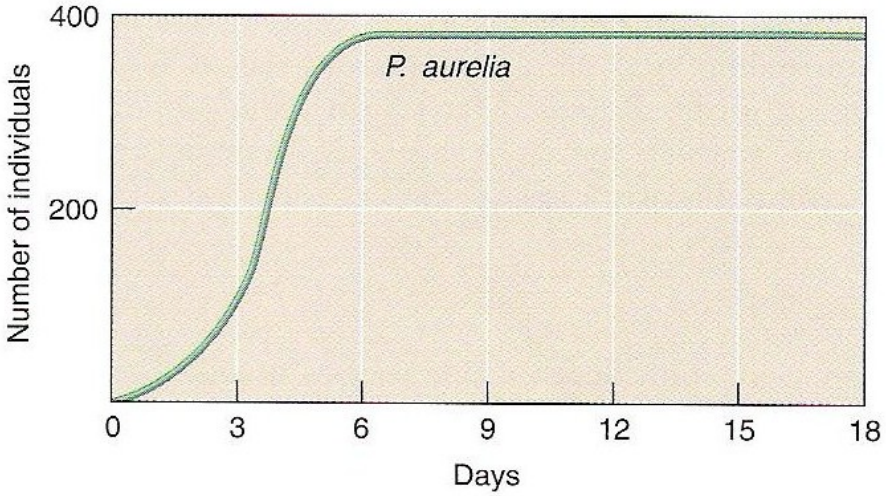
Would the increased presence of needle-eating insects caused by fewer omnivorous insects inhibit pine growth?

Biological Communities

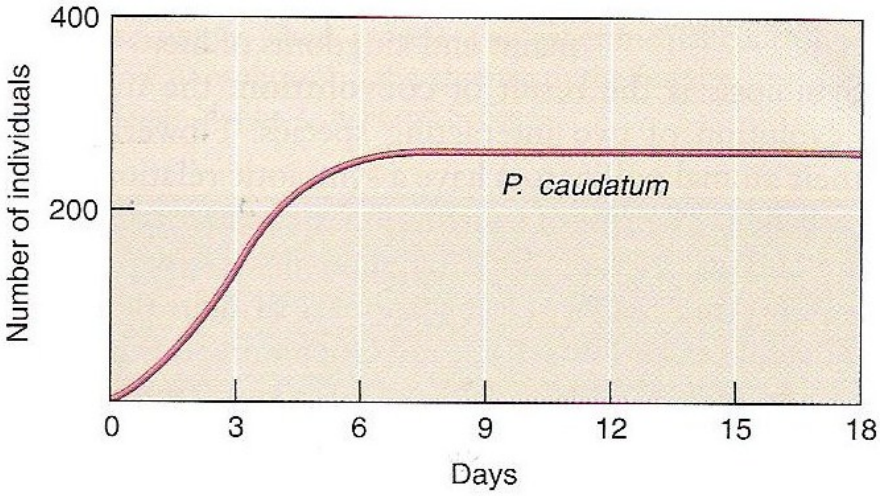
COMPETITION

Competitive Exclusion and Resource Partitioning

No two species indefinitely occupy the same niche in the same community because competitive exclusion eventually occurs.



A population of *P. aurelia* grown in a separate culture (in single species environment)



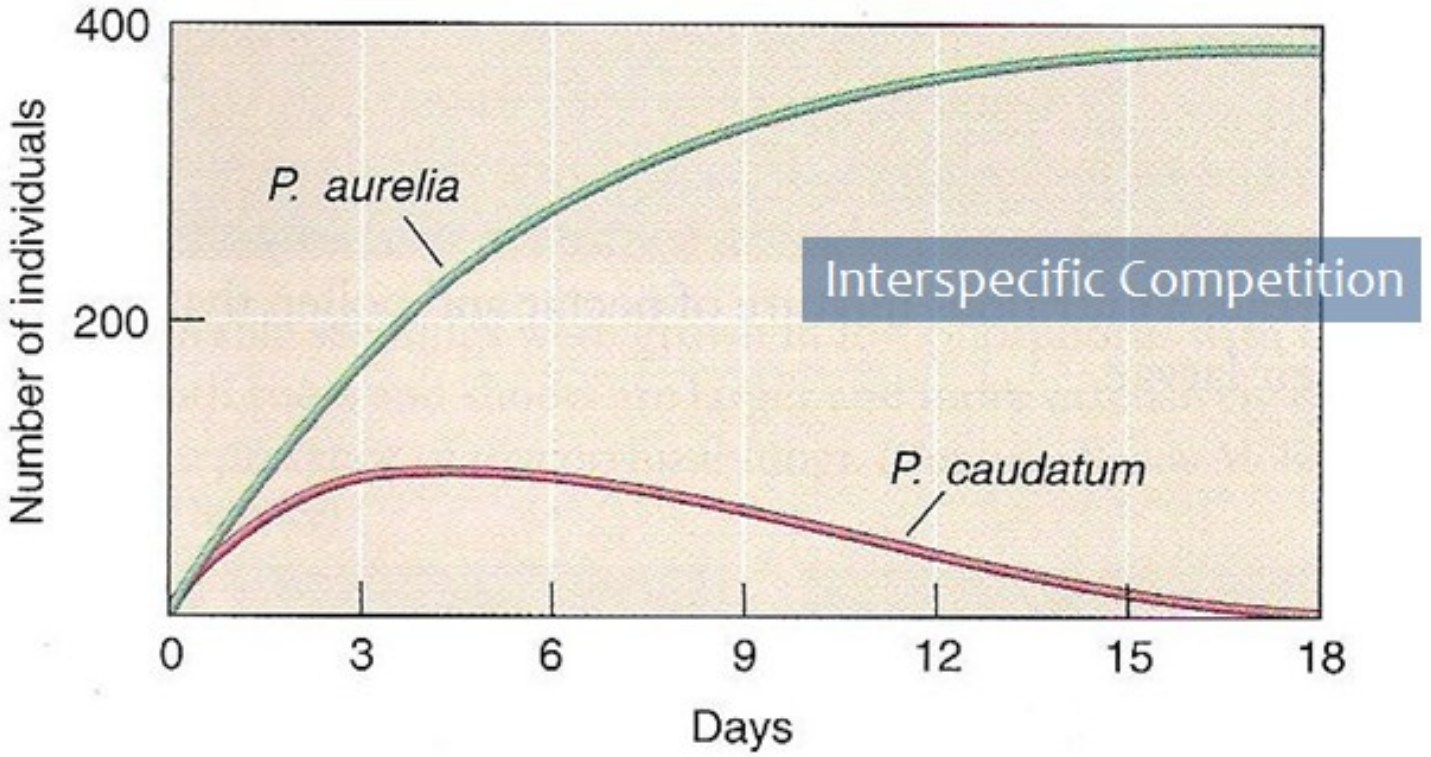
A population of *P. caudatum* grown in a separate culture (in single species environment)

Biological Communities

COMPETITION

Competitive Exclusion and Resource Partitioning

No two species indefinitely occupy the same niche in the same community because competitive exclusion eventually occurs.



Two species grown in a mixed culture, in competition with each other. *P. aurelia* outcompetes *P. caudatum* and drives it to extinction.

Biological Communities

COMPETITION

Competitive Exclusion and Resource Partitioning

In resource partitioning, coexisting species' niches differ from each other.

(a) Yellow-rumped warbler (b) Bay-breasted warbler (c) Cape May warbler (d) Black-throated green warbler (e) Blackburnian warbler

Robert MacArthur's study:

It initially appeared that their niches were nearly identical

However, Robert MacArthur determined that individuals of each species spend most of their feeding time in different parts.

Biological Communities
SYMBIOSIS

Individuals of one species usually live in or on the individuals of another species.

At least one of the species –and sometimes both- uses its partner's resources.

Symbionts: Partners of a symbiotic relationship

1. May benefit from the relationship
2. May be unaffected by the relationship
3. May be harmed by the relationship

Biological Communities
SYMBIOSIS

Symbiotic associations fall into three categories:

- Mutualism
- Commensalism
- Parasitism

One of the downsides to the symbiotic relationship

Biological Communities

SYMBIOSIS - Mutualism

Different species living in close association provide benefits to each other.

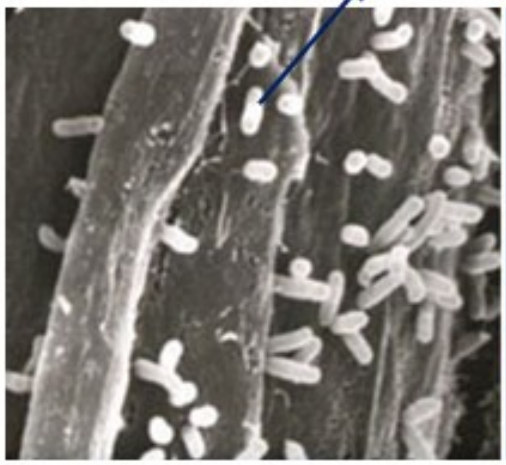
Example:

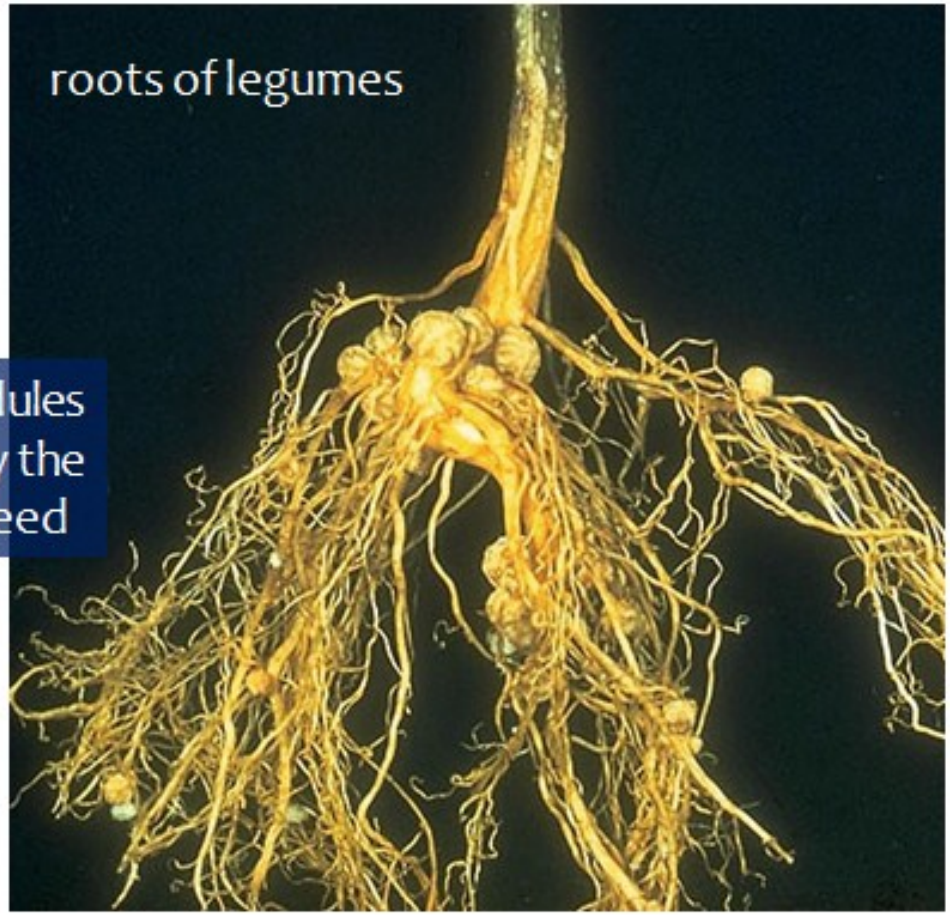
The interdependent association between nitrogen-fixing bacteria and legumes (plants such as peas, beans)

Biological Communities

SYMBIOSIS - Mutualism

Nitrogen-fixing bacteria live in nodules in the roots of legumes and supply the plants with all the nitrogen they need





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SYMBIOSIS - Commensalism

Association between 2 different species in which one benefits and the other is unaffected.

Example:

Relationship between social insects and scavengers that live with the social insects.

Certain kinds of silverfish move along in permanent association with the marching columns of army ants and share the plentiful food caught. The army ants derive no apparent benefit or harm from the silverfish.

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SYMBIOSIS - Commensalism

marching columns of army ants

Army ants

silverfish

Biological Communities

SYMBIOSIS - Commensalism

Another Example:

Relationship between a tropical tree and epiphytes (smaller plants such as mosses, orchids that live attached to the bark of the tree's brances).

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SYMBIOSIS - Commensalism

Small plants located on the tree obtain

- Adequate light
- Water (as dripping down the branches)
- Required nutrient minerals (washed out of the tree's leaves by rainfall)

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SYMBIOSIS - Parasitism

One organism, the *parasite*, obtains nourishment from another organism, its *host*.

Example:

Some parasites, such as ticks, live outside the host's body. Other parasites, such as tapeworms, live within the host.

More than 100 parasites live in or on the human species alone!

Biological Communities

SYMBIOSIS - Parasitism

Tick in a dog's fur

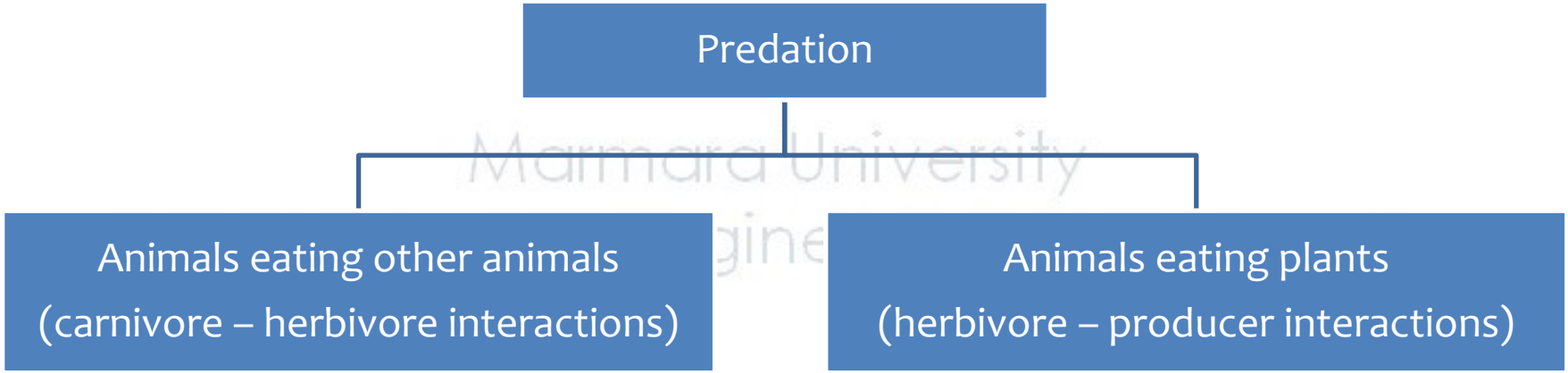
Many parasites do not cause disease.

When a parasite causes disease and sometimes death of a host, it is known as a pathogen.

Biological Communities

PREDATION

Predators kill and feed on other organisms.



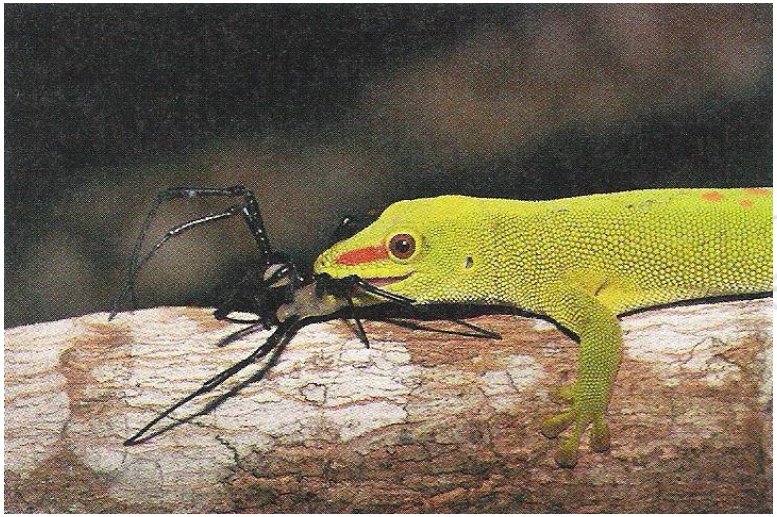
Predator strategies:
More efficient ways to catch prey

Prey strategies:
Better ways to escape the predator

Biological Communities

PREDATION

Pursuit & Ambush



Any trait that increases hunting efficiency, such as speed, intelligence, favors predators that pursue their prey.

Biological Communities

PREDATION

Pursuit & Ambush

Ambush is another effective way to catch prey.

The goldenrod spider camouflages itself from the insects that visit the flower for nectar

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PREDATION

Plant Defenses Against Herbivores

Plants can not escape predators by fleeing, but they possess adaptations that protect them from being eaten.

Biological Communities
PREDATION

Defensive Adaptations of Animals

MECHANICAL DEFENSES

LIVING IN GROUPS

Biological Communities

PREDATION

Defensive Adaptations of Animals

poison arrow frog

bright color avoid the experienced predators

some animals blend into their surroundings to hide from predators

cyrptic coloration of pygmy sea horse

CHEMICAL DEFENSES

Biological Communities

KEYSTONE SPECIES

Certain species are more crucial to the maintenance of their community than others.

Usually not the most abundant species in the ecosystem.

They are vital in determining the nature and structure of the entire ecosystem, i.e. its species composition, its ecosystem functioning.

Biological Communities

KEYSTONE SPECIES

Example:

A top predator such as the gray wolf

Wolves were hunted to extinction → Populations of deer, elk, and other herbivores increased explosively → Overgrazing the vegetation: Many plant species disappeared

Many small animals such as insects were lost from the ecosystem: Because the plants that they depended on for food were now less abundant

Disappearance of the wolf resulted in an ecosystem with considerably less biological diversity

Species Richness in A Community

Species richness, the number of species in a community, varies greatly from one community to another.

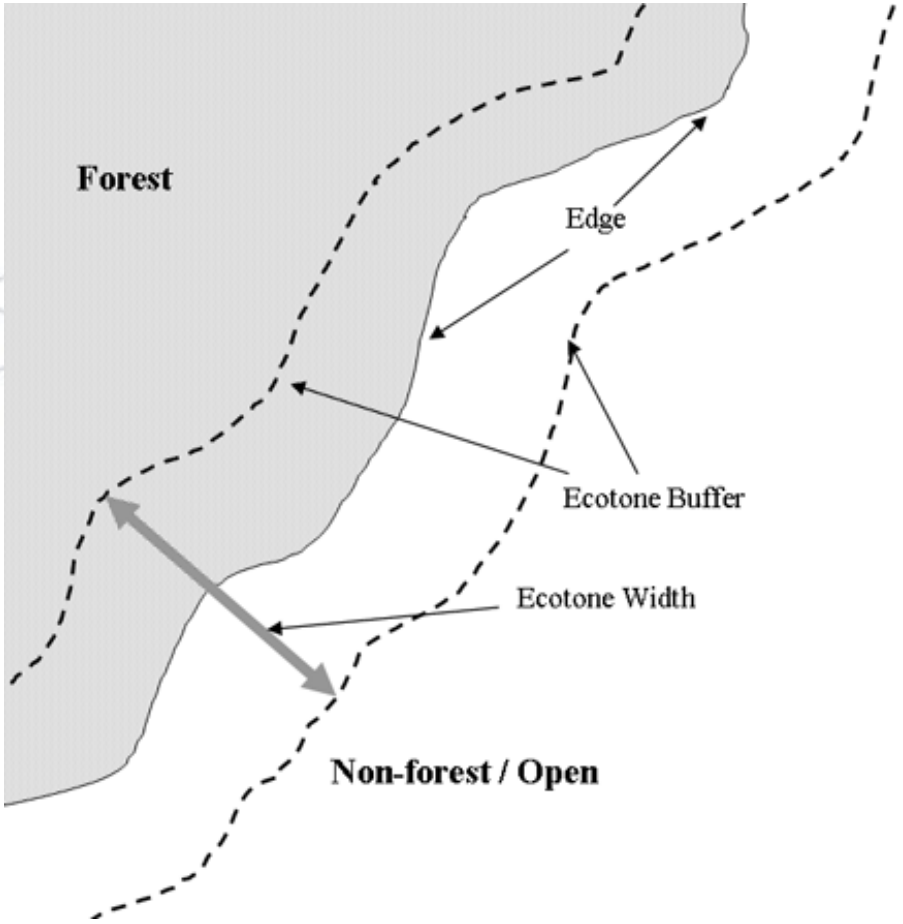
Tropical rain forests & coral reefs: Extremely high species richness

Geographically isolated islands and mountaintops exhibit low species richness.

Species Richness in A Community

Species richness is usually greater at the margins of adjacent communities communities than in their centers.

This is because an ECOTONE, a transitional zone where two or more communities meet, contains all or most of the ecological niches of the adjacent communities as well as some niches unique to the ecotone.



http://www.basic.ncsu.edu/segap/Vertebrate.html

Species Richness in A Community

Ecosystem Services

Ecosystem services:

Important environmental benefits that ecosystems provide to people; include clean air to breathe, clean water to drink, and fertile soil in which to grow crops.

Ecosystem Services

Ecosystem	*Services Provided by Ecosystem*
Forests	Purify air and water; produce and maintain soil; absorb carbon dioxide (carbon storage); provide wildlife habitat; provide humans with wood and recreation
Freshwater systems (rivers and streams, lakes, and groundwater)	Moderate water flow and mitigate floods; dilute and remove pollutants; provide wildlife habitat; provide humans with drinking and irrigation water, food, transportation corridors, electricity, and recreation
Grasslands	Purify air and water; produce and maintain soil; absorb carbon dioxide (carbon storage); provide wildlife habitat; provide humans with live-stock and recreation
Coasts	Provide a buffer against storms; dilute and remove pollutants; provide wildlife habitat, including food and shelter for young marine species; provide humans with food, harbors, transportation routes, and recreation
Sustainable agricultural ecosystems*	Produce and maintain soil; absorb carbon dioxide (carbon storage); provide wildlife habitat for birds, insect pollinators, and soil organisms; provide humans with food and fiber crops

*Sustainable agricultural ecosystems are human-made, different from other ecosystems

Species Richness in A Community

Community Stability

Community Stability:

The absense of change, a consequence of community complexity.

Stability is the result of resistance and resilience.

Ability of a community to withstand environmental *disturbances*, natural or human events that distrupt a community

Ability of a community to recover quickly to its former state following an environmental disturbance

Community Development

A community develops gradually, through a sequence of species.

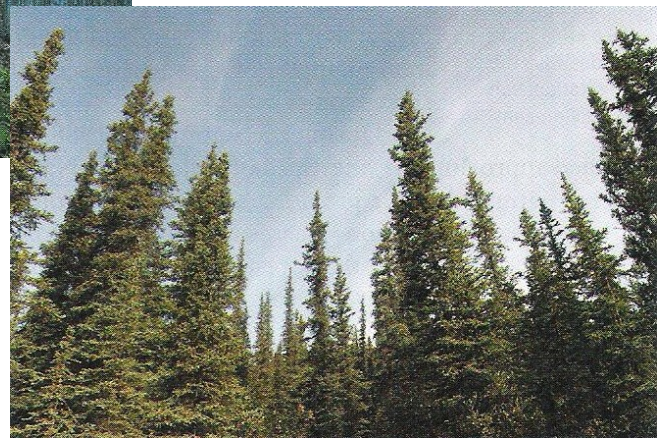
Ecological Succession:

The process of community development over time, which involves species in one stage being replaced by different species

Community Development
Primary Succession

The change in species composition over time in a previously uninhabited environment.

No soil exists when primary succession begins



Community Development
Secondary Succession

The change in species composition that takes place after some disturbance destroys the existing vegetation; soil is already present.