Symbiosis

• Symp = together    Bio = living
  – Symbiosis means living together

• Types of symbiosis
  – Parasitism
    • One benefits at the other’s expense
  – Mutualism
    • Both organisms benefit from the relationship
  – Commensalism
    • One benefits while the other organism is neither helped nor harmed
Termites eat wood and accelerate the rate of decomposition in old growth forests. However, termites do not produce the enzyme cellulase which is necessary to digest wood.

Termites harbor a symbiotic organism in their gut, *Trichonympha*, that digests the cellulose for them. The gut of the termites protects and provides food for *Trichonympha*.
Lichens

• Lichens are symbiotic organisms made up of a fungus partnered with an algae and/or cyanobacteria.

• The algae makes sugar via photosynthesis. Cyanobacteria capture nitrogen from air and convert it to biologically useful forms of nitrogen.

• Lichens provide an important food source for organisms such as Roosevelt elk in old growth forests and contribute to soil fertility.

• Lichens are an example of a type of symbiotic relationship called mutualism.
A lichen is not a single organism. It is a combination of a fungus and an organism capable of photosynthesis. Lichen fungi live in association with green algae or cyanobacteria.

The photosynthetic component of the lichen feeds the fungus sugar. The fungus provides a protective home for the algae and moisture.
The Cabbage Leaf Lichen: *Lobaria*

- An epiphyte (it lives on other plants)
- It has nitrogen fixing cyanobacteria sandwiched between layers of fungus
- The constant rain of *Lobaria* from the canopy to the forest floor provides the forest ecosystem with over ½ its input of nitrogen
Roosevelt Elk

- These large herbivores graze on grasses and sedges from late spring to early fall.

- Roosevelt elk eat lichens that fall to the forest floor in the winter when the ground is covered with snow. Lichens are an important source of dietary nitrogen in the winter. Remember that nitrogen is required for building proteins.

- Roosevelt elk are dependent on old growth during the winter. The forest has 20 times less snow cover than un-forested areas and lichens are an important source of winter food.
Northern Spotted Owl

• The spotted owl feeds on flying squirrels, wood rats, mice, small birds, bats, and insects.

• The northern spotted owl’s habitat is rapidly disappearing due to logging.

• Spotted owls are dependent on old growth forests. The old trees that this species needs for survival take more than 3 centuries to grow.
Mountain Lion Food Web

- **Preferred prey**
  - Roosevelt elk
  - Cabbage leaf lichen
  - Red-squirrel or Chickaree
- If it is hungry and no large prey are available
  - Long-tailed weasel
  - Pine seeds
Fungi

- This is a fruiting body of a wood decaying fungus.

- Fungi are important decomposers of woody debris in old growth forests. They secrete enzymes that break down cellulose.

- As the tree decomposes nutrients are recycled into the ecosystem.
Truffles are the Fruiting Bodies of Underground Fungi

- Top: The truffle of the fungus of *Hysterangium coriaceum*. Its thread-like hyphae are colonizing a tree rootlet.

- Bottom: The spores pass unharmed through rodents’ digestive tracts and are thereby widely distributed.
Truffles are the below ground spore producing fruiting bodies of fungi.

Flying squirrels disperse the spores of the fungus to other areas in the forest when they defecate.
The Flying Squirrel:

- Spends most of its life in trees.
- Descends to forest floor in search of food.
- Eats primarily truffles.
- During spring and summer a typical acre of old growth may harbor as many as 8 pounds of truffles.
Mychorrhizal Fungi

- Mychorrhizal fungi are associated with the roots of conifers.
- They extract minerals and water from the soil and pass it on to the tree roots.
- These fungi live off sugars produced by the tree.
- The symbiotic relationship between mychorrhizal fungi and tree roots is called mutualism.
Salamanders

- Salamanders are animals that are very sensitive to forest disturbance since their habitats are downed logs, dead logs, hollow trees, and thick leaf litter.

- Salamanders, like frogs and toads, are amphibians. Amphibians can absorb oxygen and water across their very thin skin surface. This means that they can also absorb pollutants across their skin surface.

- Amphibians are very sensitive to pollution.

Pacific Giant Salamander
Salamanders

Salamanders are carnivores. Small salamanders feed on insects and spiders. These species rely on snags and coarse woody debris to provide moist habitat and insects.

Olympic Torrent Salamander
Characteristics of Old Growth Forests

- Large and very old trees
- Trees of different ages and sizes (A multilayered canopy).
- Various layers of shrubs and trees
- Snags or standing dead trees
- Downed logs
- Logs in streams
Snags are Dead Standing Trees

- Trees that are dead but still standing, called snags, are crucial for wildlife that need cavities for nests, dens, or resting places.
- For many species only trunks of large diameter seem to offer sufficient insulation to survive cold winter temperatures.
Primary Cavity Nester

The Pileated Woodpecker is an important member of healthy older forest communities. As a primary tree cavity excavator, the Pileated Woodpecker plays a significant ecological role by excavating nest and roost cavities that are subsequently used by other birds and small mammals. Thus the pileated woodpecker is a keystone species in old growth forests. *A keystone species is a species that other animals in the ecosystem depend on for their survival.*

Woodpeckers feed on insects and insect larvae in the tree. They do this by probing their long tongues deep into crevices in the bark and wood of trees. Note the long tongue of the woodpecker on the diagram to the left.

The geniohyoid muscle controls the tongue.
Termites and Fungi soften wood. This enables cavity nesters to excavate their cavities in soft wood.
Secondary Cavity Nesters:
Pygmy Nuthatch

- These are animals that use cavities abandoned by woodpeckers.

- Unique among songbirds, the Pygmy Nuthatch uses three energy saving mechanisms on cold nights: it uses a protected roost site (a hole in a tree), huddles in a group (sometimes with more than 100 in a single cavity), and lets its body temperature (and metabolism) drop overnight (a poikilothermic endotherm).

- The winter diet consists of insects and seeds. The summer diet consists of insects and spiders.
Secondary Cavity Nesters: Mountain Chickadee

- These are animals that use cavities abandoned by woodpeckers.
- These animals are dependant on primary cavity nesters to build the cavities they nest in.
- Mountain chickadees eat insects and seeds from pine cones.
Secondary Cavity Nesters: Mountain Bluebird

- These are animals that use cavities abandoned by woodpeckers.
- These animals are dependant on primary cavity nesters to build the cavities they nest in.
- Their diet consists of a combination of insects and berries. Insects make up the majority of the diet.
The Flying Squirrel

- Flying squirrels often nest in abandoned woodpecker holes in standing dead trees (snags).
Epiphytes: Note the Epiphytic Lichens Growing on the Tree Below

- Epiphytes are plants that grow on other plants.
- These hanging gardens provide nutrients to trees and prime nesting locations for small birds and mammals.
- Epiphytic lichens are an important winter food source for Roosevelt Elk and Black Tailed Deer.
Downed Logs

- Downed logs are a reservoir of water during drought.
- They provide shelter for many insects and small vertebrates.
- Decaying material continually replenishes the soil by slowly releasing nutrients.
Downed logs in streams are vital to the ancient forest ecosystem. They provide habitat for many aquatic animals; they slow the flow of water, easing erosion; they create pools, falls, riffles, and eddies that fish require; and they slowly release nutrients to the stream community.
Salmon are animals not usually associated with old-growth forests, but they spawn in rivers and streams enriched and purified by the ancient forest ecosystem.
Ecological Niches

• The ecological niche of a species incorporates the role the species plays in its community, its habitat, and its interactions with other species.

• The niche includes the specific organisms the animal eats and its survival demands.
The Red Backed Vole

• This small mammal spends most of its time under the old-growth forest floor in its subterranean burrow.

• Although it eats seeds, grasses, and other green plants, it prefers truffles.

• It is a favorite food of the spotted owl.
White Footed Vole

- This mammal occurs in the humid coastal forest region from the Columbia River in Oregon southward to Humboldt County, California.

- This is a poorly known species. It is considered rare. It is associated with streams in forested areas and is sensitive to logging.

- It eats roots and green plant material.
Red Tree Vole

• Red tree voles are found along the Pacific coastal lowlands in Oregon and northern California. They are considered rare.
• Clearing trees for agriculture, home sites, and logging have significantly reduced available habitat and fragmented populations.
• These voles live, nest, and feed in the forest canopy. They feed on the needles, buds and tender bark of twigs.
• Large nests are constructed in trees, typically 20 to 60 feet above the ground.
The Pacific Yew

Many Pacific yew trees originate as sprouts from cut or broken trunks.

Taxol, a drug used to effectively treat ovarian cancer, is extracted from the bark of the Pacific yew.
Some Mammals Found in
Old Growth Forests

Red-tree Vole

Shrew

Roosevelt Elk

Red squirrel or Chickaree

Red-backed Vole

Flying squirrel
Red tree voles live in the canopy of large, old, Douglass firs. They eat the needles and the bark and buds of young twigs.

Ancient Douglass Fir
Mammals Found in Old Growth Forest

Roosevelt elk need the tempering microclimate of old growth to get through summer’s heat and winter’s cold.

Snow accumulation is 6 times greater in clear-cuts which decreases winter forage.

Clear cuts lack lichens and fungi which are important winter forage items.
Conifers produce cones. The seeds produced by the cones are an important food source for many animals in the forest.

The red squirrel or chickaree is primarily granivorous and eats conifer seeds. Since they do not hibernate they stockpile unopened pine cones to get them through the winter. The fallen scales from consumed seed cones collect in piles called middens. They will also eat truffles. They lay the truffles on the branches of trees to dry them in the sun.

In fall the chickaree gathers unopened pine cones and stores them in piles.

The above picture shows a midden of consumed cones.
Mature Versus Old Growth Forests

• **Mature Forest**
  - Tight, closed, one story canopy
  - Uniform cylindrical trees
  - Low understory diversity

• **Old Growth Forest**
  - Multilayered canopy
  - Snags and downed logs
  - High understory diversity due to light gaps created by downed trees
Old Growth Forests
Multilayered Canopies: Trees of different sizes and different ages.
Old Growth Forest Have Multilayered Canopies

Mature Forest or Secondary Forest

Old Growth Forest

Old Growth Forest
Clear-cutting results in forest fragmentation and creates ecological islands.

Wearing the dark green of never-cut forest, a southeastern portion of Olympic National Forest in Washington—prime old-growth habitat—shows almost no loss to logging across its 217 square miles.

Most of the area's mature private timber having been cut, logging advances into state and Indian reserves. In Olympic's southeast section about one-fourth of the old growth has been cut under Forest Service license.

Only 14 percent of the old growth remains in scattered pockets. Federal and state agencies replant for wood-crop sales in 60 to 100 years. An ecological web centuries in the growing has been made a woodlot.
A Clear Cut Near Olympic National Park, Washington
Old Growth Forest

Clear Cut

What is the problem of having a clear cut next to old growth?

- Climatic impact is maximized
- Maximum habitat differences are created for wildlife
- Edge effects are maximized

**Edge Effects**: Wind penetrates 2-3 tree lengths (60m) from clear cut edge.
Monoculture tree plantation growing in an area that was clear cut

Clear Cut in Olympic National Forest
Figure 9.2  Edge effects are believed to be directly related to age differences between adjacent stands. Little edge effect occurs between old growth (upper left) and large sawtimber (upper right) or between two recent clearcuts. When summed over a complete rotation, maximum edge effects will occur by putting clearcuts next to mid-rotation-aged stands.
Some Invertebrates Common to Old Growth Forests

- Bark Beetles
- Wood Boring Beetle
- Earwigs
- Millipedes
- Termites
- Ambrosia Beetle
Bark Beetle

Douglass fir bark beetle larvae.
Eggs hatch into white legless larvae.

Bark beetle larva
Earwig

Earwigs scavenge and eat dead animal matter. They will also eat small insects, plants, fruits and flowers.

Earwig life cycle

Egg  Hatchling  1  2  3  4  5
Millipedes are detritivores. They feed on decomposing vegetation and organic matter mixed with the soil.
Wood Boring Beetle

Wood boring beetles most often attack dying or dead trees.

They are important as primary decomposers of trees allowing for the recycling of nutrients.
Ambrosia Beetle

Ambrosia beetles typically colonize the xylem (sapwood) of dead or dying trees. They are highly specialized and feed on fungi that they cultivate on the walls of the tunnels that they excavate in the wood. Both adults and larvae feed on fungi.