

# Population Ecology



# Predator-Prey Relationships



# Predation

- The most obvious population interaction in a community are those in which a **predator eats its prey**
- Predators that specialize in eating only one prey species play an important role in controlling the population size of the prey species
  - Eg. Canada lynx and snowshoe hare
- The terms **predator and prey** apply not only to animals that eat other animals, but to any type of **producer and consumer relationship**
  - Eg. Plants and Herbivores

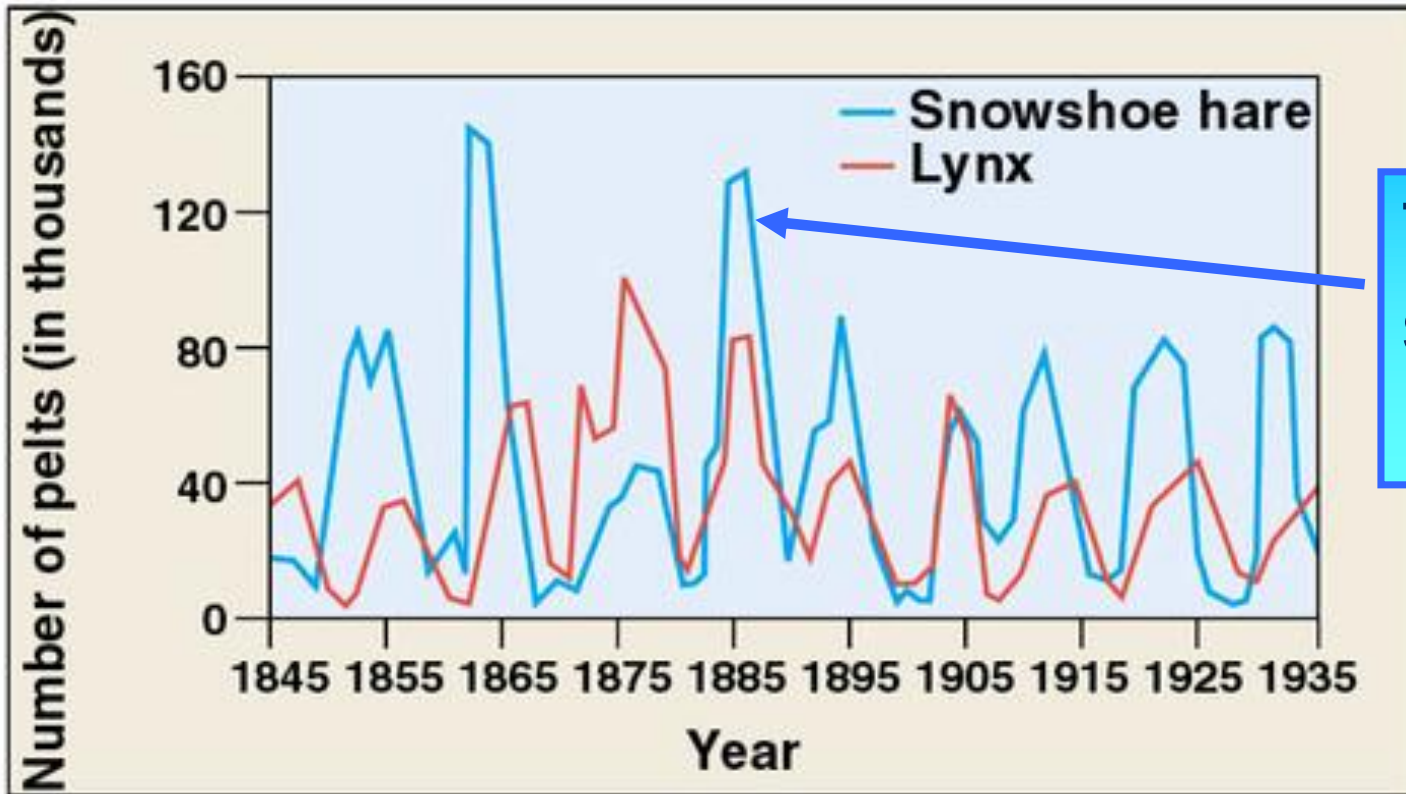
# Predation

Plant defense mechanisms against herbivores:

- Thorns
- Microscopic crystals in their tissues
- Spines or hooks on leaves
- Distasteful or harmful chemicals
  - Some well-known poisons and drugs are secondary compounds produced by plants:
    - Strychnine
    - Morphine
    - Nicotine
    - Mescaline



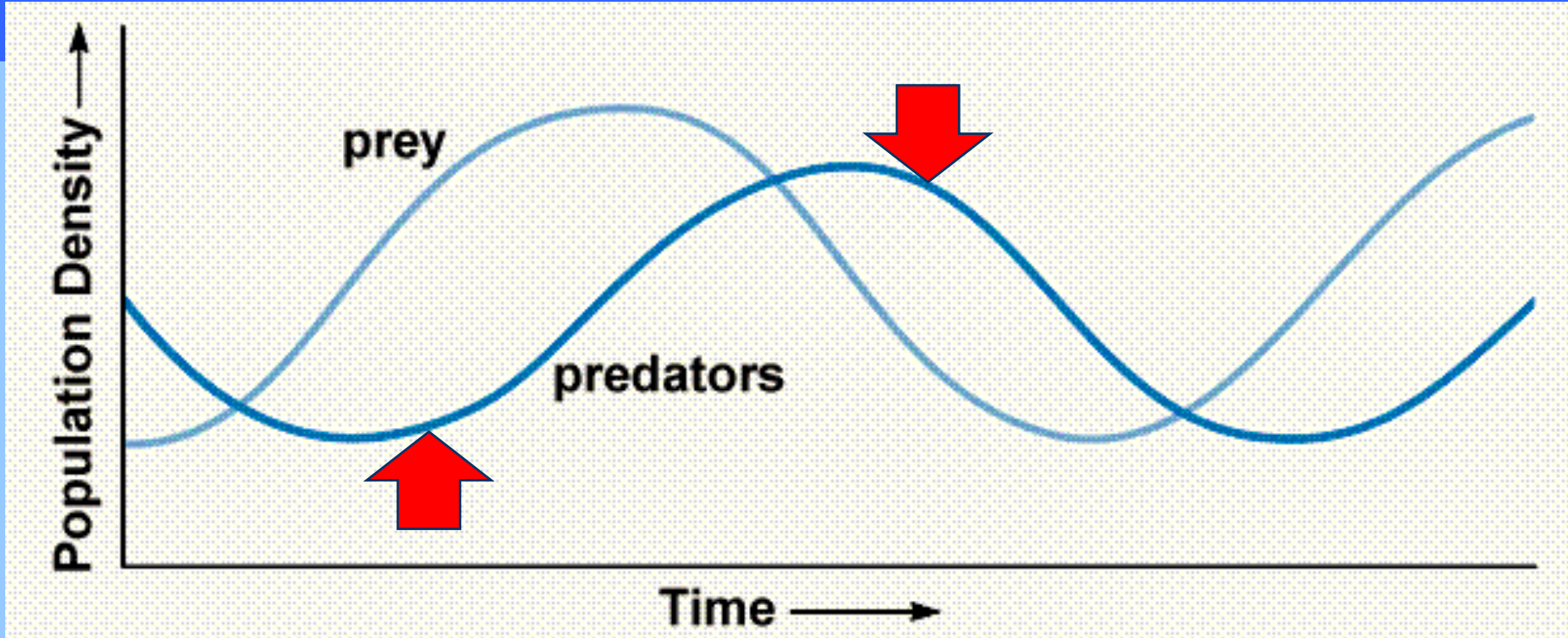
# Predator-Prey Cycle



The prey is the species with the higher numbers.

The population of the **PREDATOR** must always be smaller than the population of the **PREY** otherwise the cycle will **BUST!**

# Predator and Prey



Pick point on the predator graph (ARROWS)...what is happening to the number of prey

Prey # increases, then the predator numbers increase

Prey # decrease then the predator numbers decrease

# Predator Interaction

Some predators work together



# Avoiding Predators

● Prey have counter strategies to avoid being detected, subdued, and eaten:

1. Mechanical Defenses
2. Visual Deception & Camouflage
3. Group Defense
4. Chemical Defense
5. Warning Colouration
6. Mimicry



Group vigilance and alarms in meerkats



Hiding is a common strategy of fawns



# Structural / Mechanical Defenses



Webbed burrfish



Spiny sea urchin



Elk (male)

# Armor / Quills



Stag beetle

Pill millipede



Tortoise

# Visual Deception

- Markings, such as fake eyes, may deceive predators allowing prey to escape.
- **Camouflage** is used to avoid detection.

Shape shifting/ camouflage octopus:

[http://www.youtube.com/watch?v=PmDTtkZIMwM&safety\\_mode=true&persist\\_safety\\_mode=1](http://www.youtube.com/watch?v=PmDTtkZIMwM&safety_mode=true&persist_safety_mode=1)



Owl butterfly

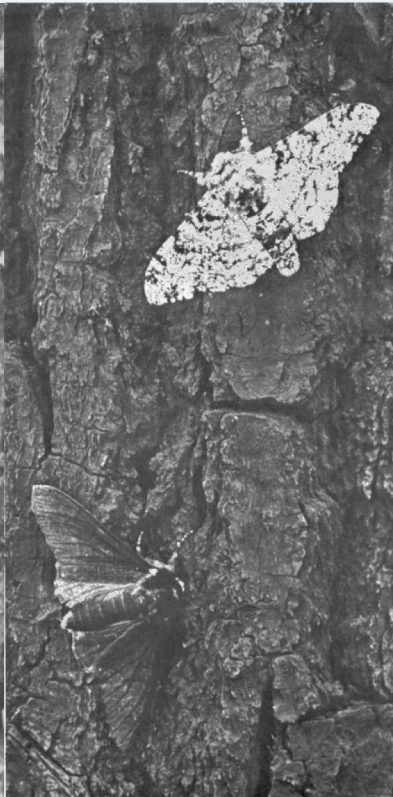


Leaf insect



Butterfly fish













# Group Defense

- Large groups are each less vulnerable to attack... (*more intimidating for predators*)
- Large flocks of birds and schools of fish move together as one mass to confuse predators and make it hard to isolate individuals.
- Large groups also provide greater surveillance.

Zebra Stripes

<http://www.animalplanet.com/tv-shows/other/videos/fooled-by-nature-zebras-stripes/>



Flamingoes congregate in large flocks



Large schools confuse predators

# Chemical Defense

- **Chemical defenses** may include noxious fluids or venoms.



A scorpion's defensive posture warns potential attackers of its venomous sting.



Rattlesnakes have a venomous bite, but rely first on camouflage and a warning rattle.



**Pentatomid (stink) bug**



**North American skunk**

# Toxin Example: monarch butterfly



The monarch larvae feeds upon the milkweed plant and stores the toxins in its fatty tissue.



*(Danaus Plexippus)*  
County Master Gardener

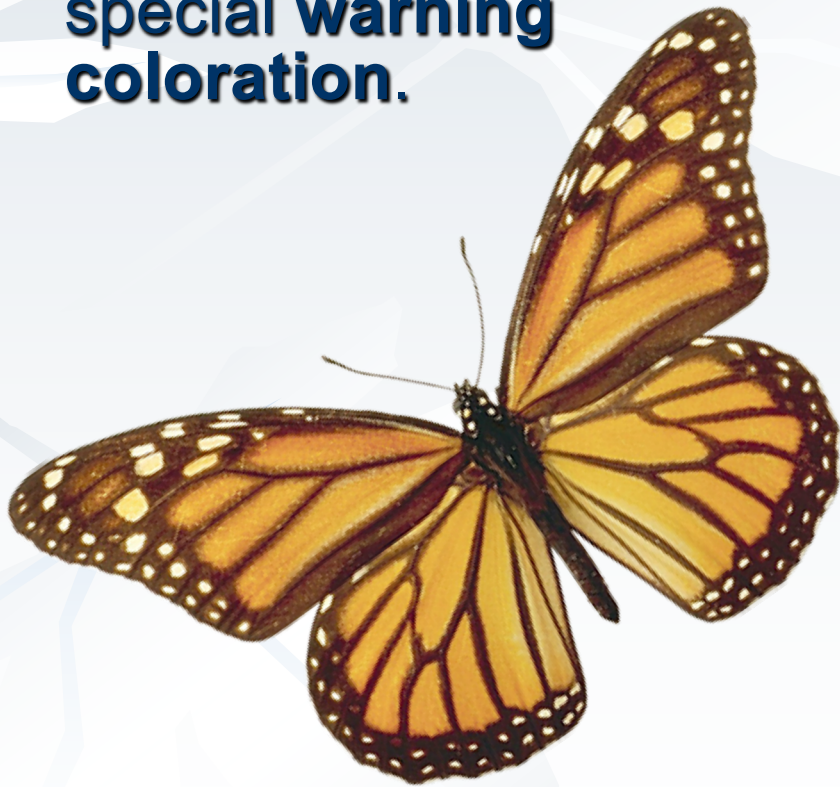
This makes both the larvae and the adult butterfly unpalatable to predators



Blue jays will actually regurgitate a swallowed prey because of it being unpalatable.

# Warning Colors

- Many prey species that taste bad, are toxic, or inflict pain on attackers have a special **warning coloration**.



Monarch butterfly

Arrow poison frog



Lionfish



## Example: the poison-arrow frog







# Mimicry

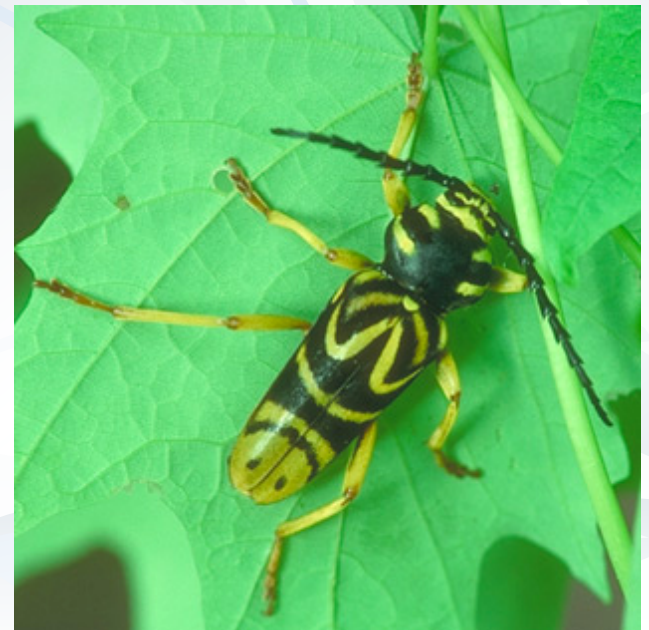
- Occurs when a harmless, palatable species resembles a toxic or dangerous species.
- OR several unpalatable species may resemble each other.
  - ex Orange and black, or yellow and black are common warning colors in insects.*



Monarch butterfly



The dangerous common wasp



...and its harmless mimic, the wasp beetle

Watch this baby bird perfectly mimic a toxic caterpillar.

[https://www.youtube.com/watch?v=FwSGk1\\_Y4rY](https://www.youtube.com/watch?v=FwSGk1_Y4rY)



- **Example: viceroy butterfly**
- **looks similar to the monarch butterfly, but does not contain toxins in its fatty tissues.**





Viceroy at Singing Meadows by Joe Constanza



# Mimicry

The mimic octopus takes on the shape and behavior of a flounder, a lionfish and a sea snake. By doing this, it is **protected from predators.**

Mimic octopus video:

[http://www.youtube.com/watch?v=H8oQBYw6xxc&safety\\_mode=true&persist\\_safety\\_mode=1](http://www.youtube.com/watch?v=H8oQBYw6xxc&safety_mode=true&persist_safety_mode=1)

[Octopus video 2](#)



# Mimicry ..only one dangerous!!





Unpalatable



Palatable





- This hawkmoth larva puffs up its head to mimic the head of a snake



# Competition

## 1. Inter-specific Competition:

- Competition between 2 members of **different** species in same community
- The more similar the niches of a species, the greater the competition
- Niche- the role that an organism takes in an environment

## 2. Intra-specific competition:

- between 2 members of **same** species

**Competition can be for food, space, mates, oxygen, water or sunlight**

# Competition

**INTERSPECIFIC - DIFFERENT**

between 2 members of **different** species

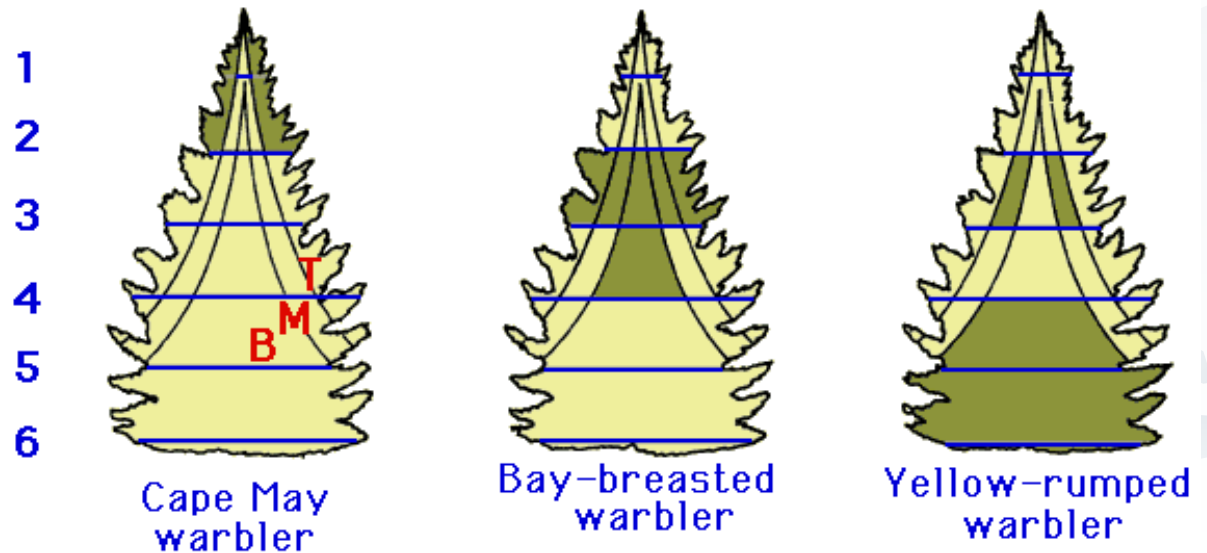
**INTRASPECIFIC - SAME**

between members of **same** species

# Inter-specific Competition

Competition is less fierce, when populations have slightly different niches (resource partitioning)

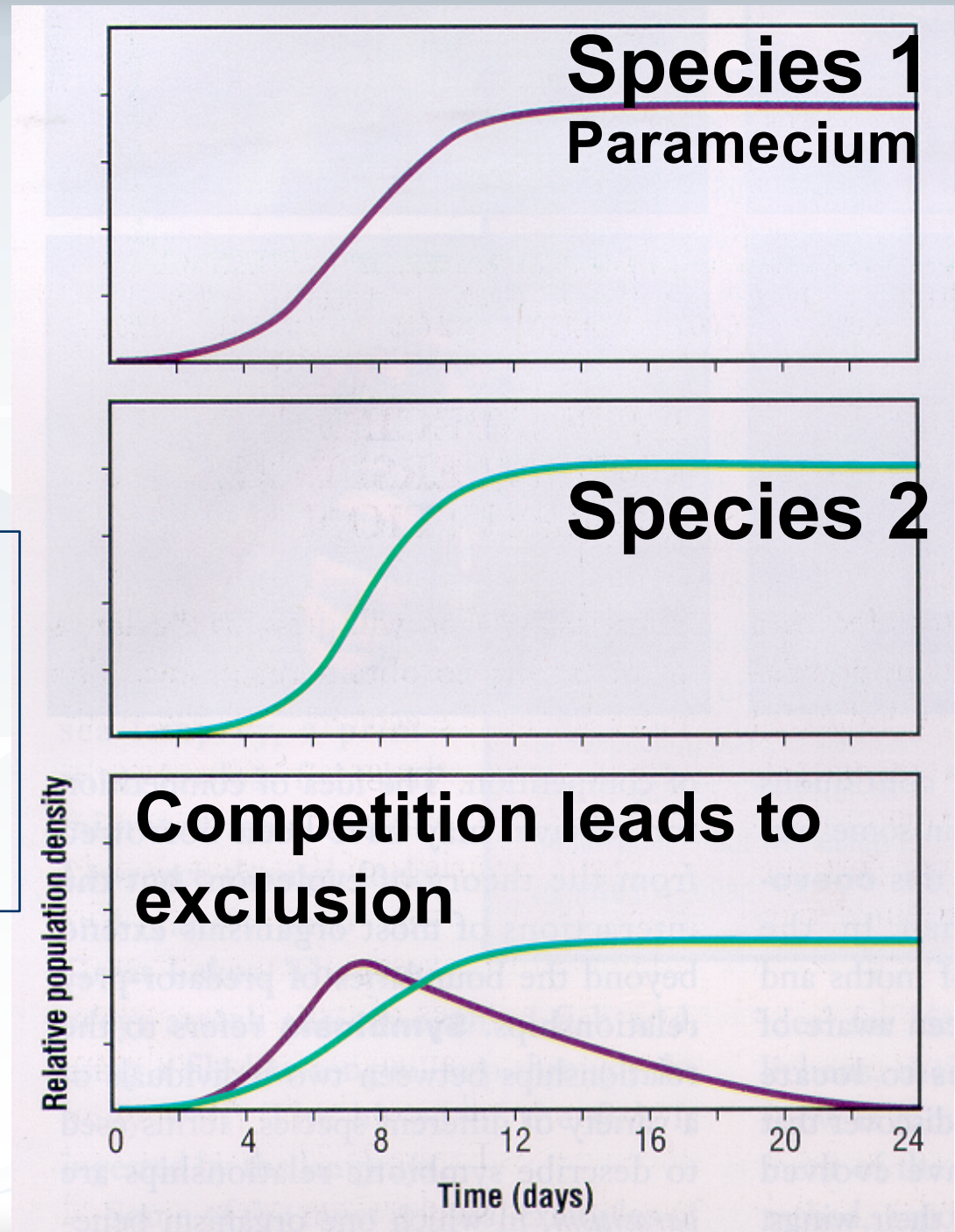
- Example – 5 species of warblers can feed on insects on a spruce tree – eat insects on different areas of tree



# Gause's Principle or Competitive Exclusion

No two species can occupy the same ecological niche **without one being reduced in number or eliminated**

-One species will always have an advantage over the other



# Symbiotic Relationships

Organism

1

2

## 1. Mutualism

Both benefit

**Ex.** cleaner wrasses and whale sharks, e.coli and humans, bees and flowers

+

+

## 2. Parasitism

One benefits, other harmed

Parasites get nutrients from host, and do not usually kill host.

**Parasites:** Mosquitoes, lice, mites, round worms, tapeworms.

**Hosts:** many animals

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## 3. Commensalism

One species obtains food or shelter from another species.

Does not harm or help the other species.

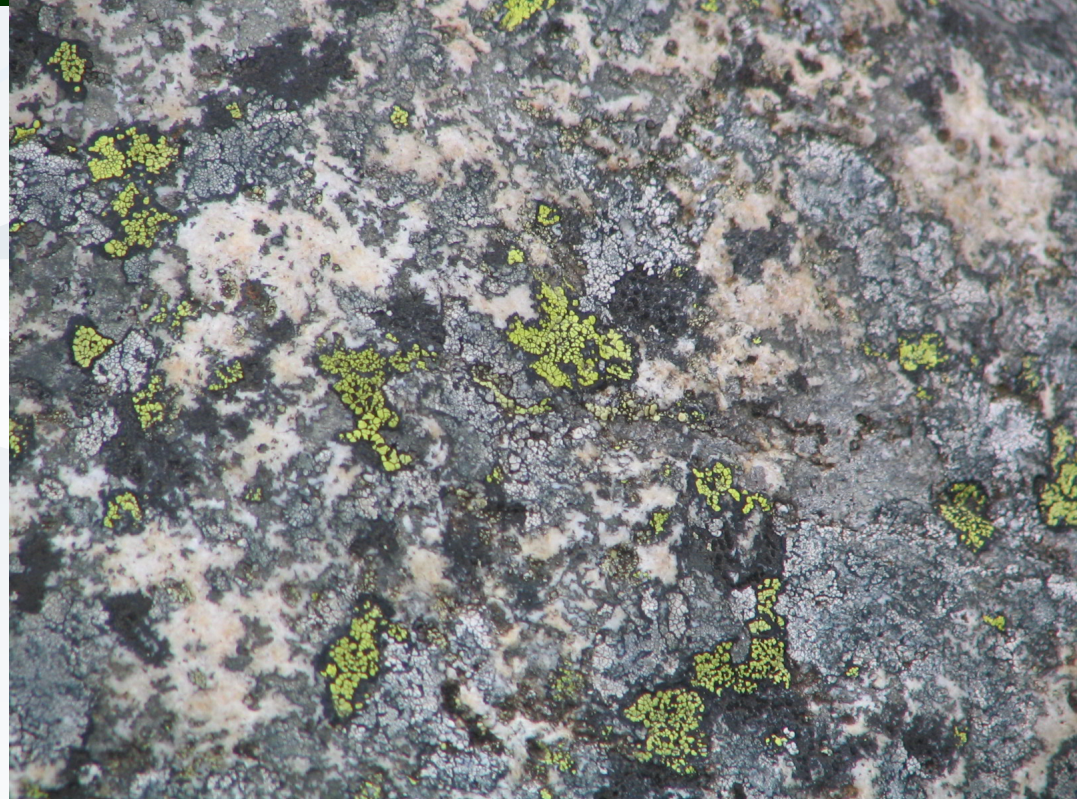
**Ex.** Shark and ramora, buffalo and birds

+

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# 1. Mutualism

- **Two organisms living together - both benefit**



**eg. Lichen (fungus + algae)**  
-fungus provides rooted structure and algae provides nutrients

**Together they eventually break down rock, creating soil**

# 1. Mutualism

## Clownfish and anemones

<https://www.youtube.com/watch?v=vNhORnwcQcU>



**As far as is known, the fish is able to produce a special mucus that causes the anemone not to release its stings. It is also believed that the movements of the fish inform the anemone of its identity. In return for the anemone's protection, the fish brings scraps to it, and lures larger fish into the anemone's tentacles.**



# Mutualism



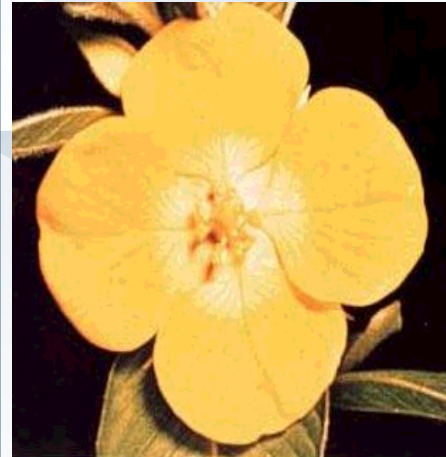
Intentionally placed  
maggots devour  
rotting tissue treating  
diabetes-induced leg  
ulcers

# Mutualism

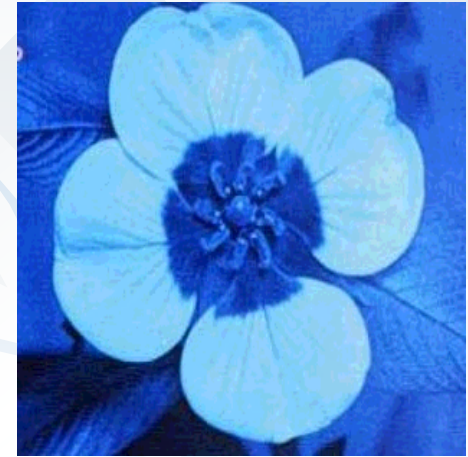


**Honeybee &  
flowering plant**

## Interesting fact!



**How we  
see the flower**



**How a bee  
sees the flower**

They can see into the ultraviolet spectrum which helps them locate flowers and specifically the centers of them for nectar.

# 2. Parasitism

- One species benefits, other is harmed
- Parasite receives nourishment from host
- Parasites don't normally kill host



**Intestinal Roundworm**

# Parasitism



**52.5 Most Parasites Are Smaller Than their Hosts** This Caribbean soldierfish is host to the parasitic isopod attached to its head between its eyes. The fish has no way to remove the isopod, which feeds on its body tissues.

## Parasitic Wasp

<https://www.youtube.com/watch?v=vMG-LWYNcAs>

then there is the...

## Tonguefish

[https://www.youtube.com/watch?v=XBMK7C\\_Hwl4](https://www.youtube.com/watch?v=XBMK7C_Hwl4)

# Lymphatic Filariasis (Elephantiasis)

- The disease is caused by parasitic worms, all transmitted by mosquitoes.



# Parasitism



**Tapeworm reaches maturity in intestine of mammals**



**Heartworm of dogs, whose adults reside in the right side of the heart.**

# 3. Commensalism

**Shark & Ramora  
One benefits.  
Other unaffected.**

**Ramora gets free ride + food**



# 3. Commensalism



## **Shell fish and barnacles**

The barnacles have a substrate...place to live

## **Buffalo and cowbirds**

Birds feed on insects kicked up by buffalo



# Commensalism



**Orchid on tree**

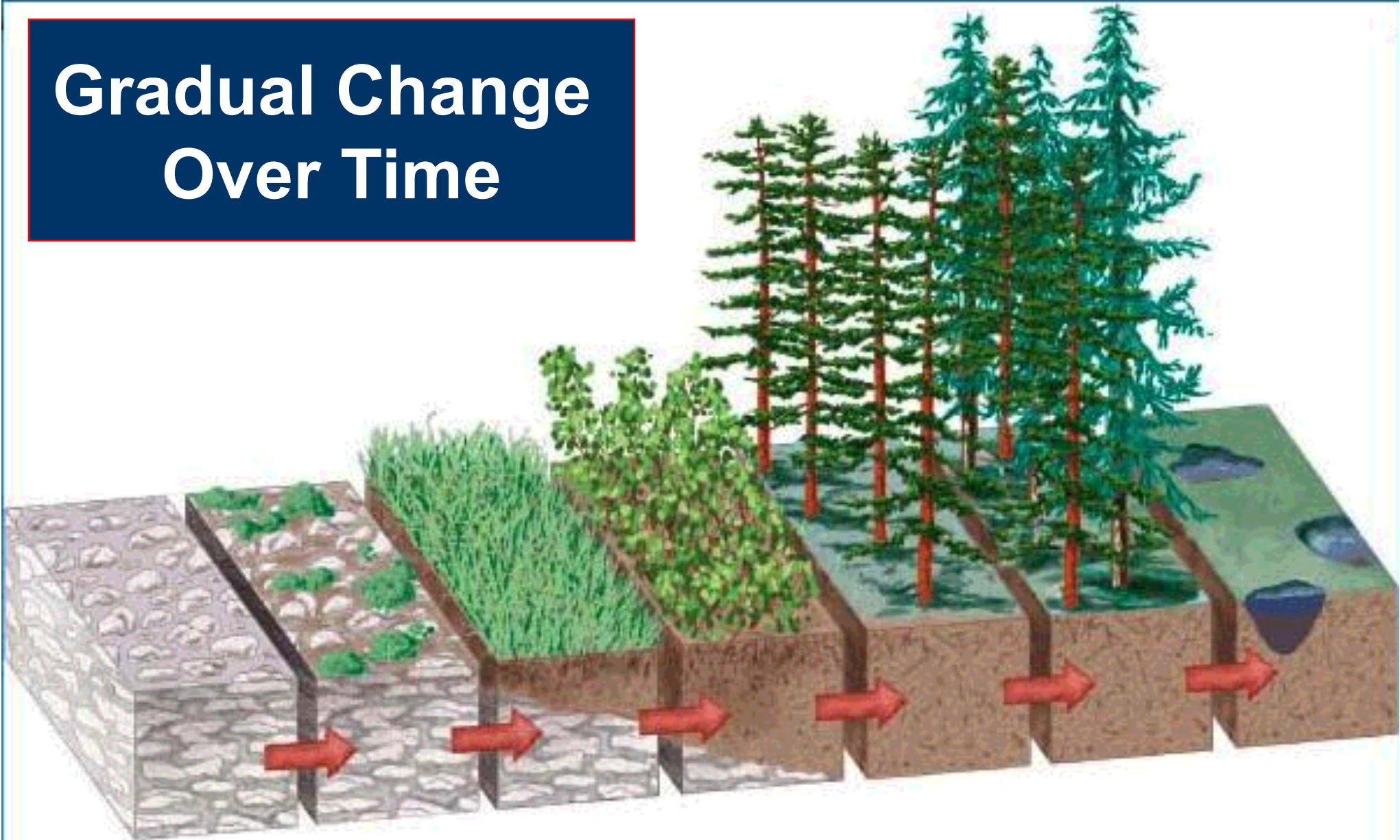


**Nest in tree**



# Ecological Succession

**Gradual Change  
Over Time**



# Succession

- **Gradual process of community replacement**
  - **Succession is the progression through these 3 types of communities**

**Pioneer  
community**



**Seral  
stages**



**Climax  
community**



# Ecological Succession occurs in STAGES

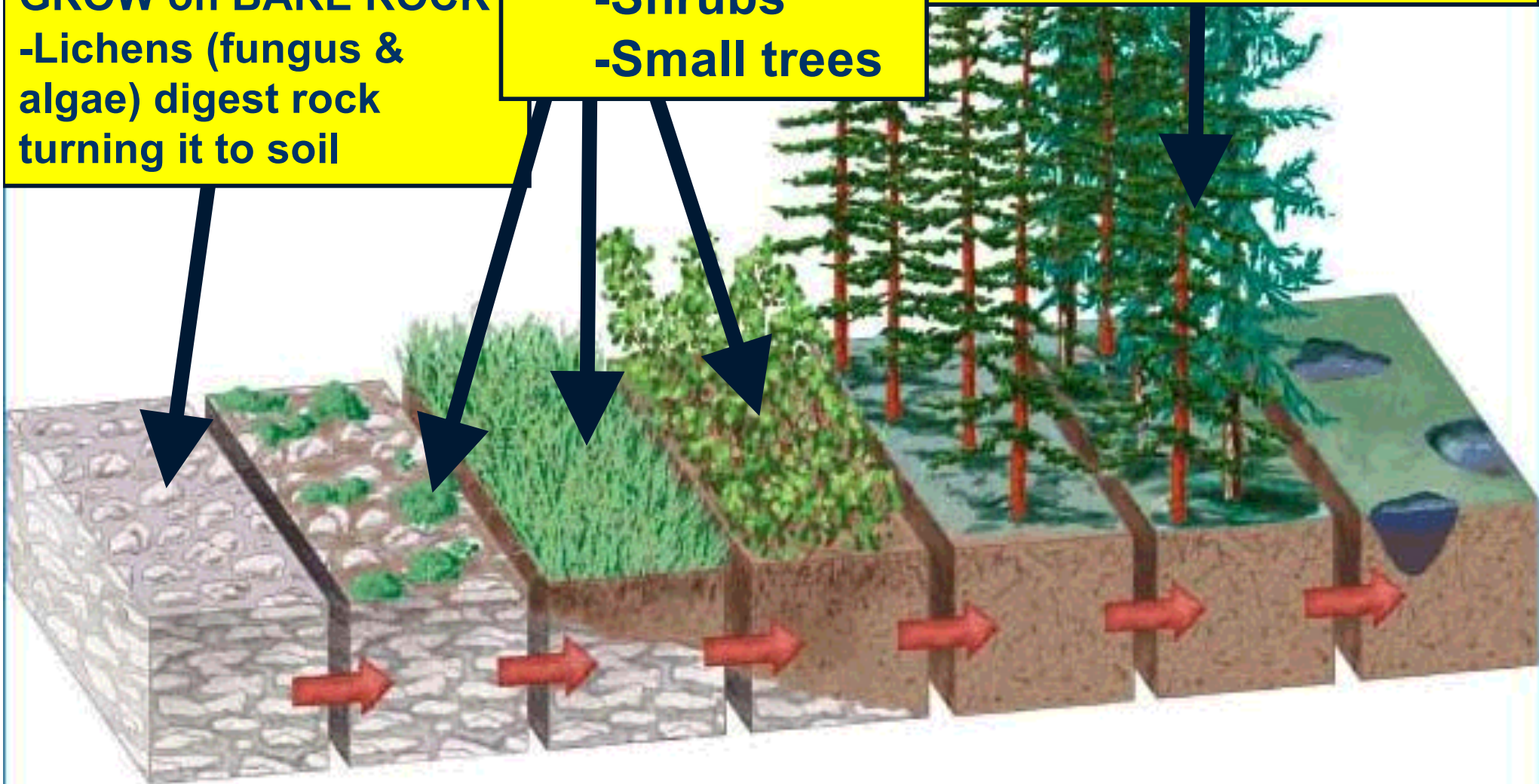
## 1) Pioneer Communities

GROW on BARE ROCK  
-Lichens (fungus & algae) digest rock turning it to soil

## 2) Seral stages

-Grass  
-Shrubs  
-Small trees

3) Climax Communities  
most stable  
most biodiversity  
-conifers (evergreen)  
-maples, oaks, poplars



# CLIMAX COMMUNITY

**CLIMAX COMMUNITY:** Stable or “final” form of the ecosystem

## **-Type of Climax community depends on ecosystem**

- A climax community is one that has reached the **stable stage**.
- Examples are tundra , grassland, desert , and the deciduous, coniferous, and tropical rain forests .



# Types of Succession

## Primary

1. Begins with **bare rock** after a glacier recedes or volcano erupts
  2. Pioneer species invade (Lichens)
  3. Grasses, shrubs, trees (seral stages)
  4. Climax community is reached
- is much slower than secondary succession because soil must be made from bare rock

## Secondary

- **soil is already present**
- Occurs after destruction of climax community
  - Ex. Fire, flood

# Primary Succession

(i)



Begins with  
bare rock



(ii)



Pioneer  
species invade



# Primary Succession



(a) Retreating Glacier



(b) Barren Moraine



(c) Pioneering Mosses



(d) Invading Alders



# Primary Succession in Hawaii after a volcano Eruption



# Primary Succession in Hawaii after a volcano Eruption



# Secondary succession

-trees are colonizing uncultivated fields and meadows.



# Secondary Succession



- 1) Occurs after destruction (flood, fire, avalanche etc.)
  - 2) Does not start with bare rock.
- Soil already present.

# Secondary Succession



Fireweed (pink flowers) are among the first plants to grow after a forest fire in secondary succession.



■ What is the difference between primary and secondary succession?



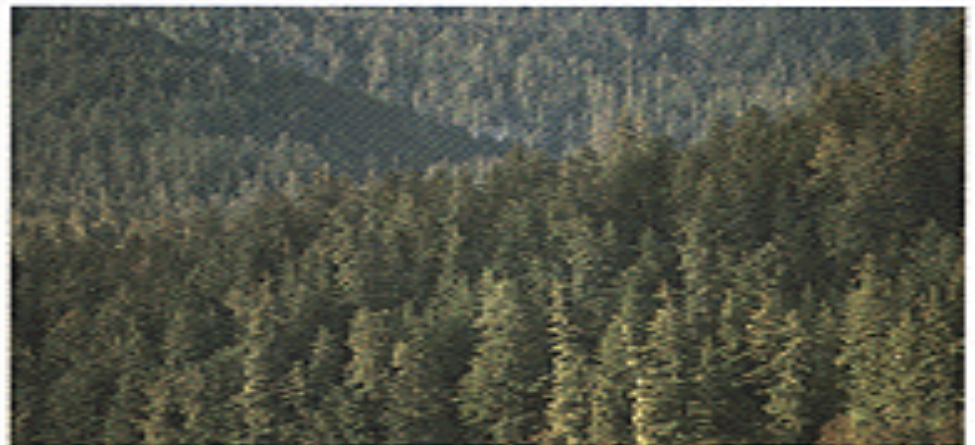
(b)



(d)



(e)



(f)