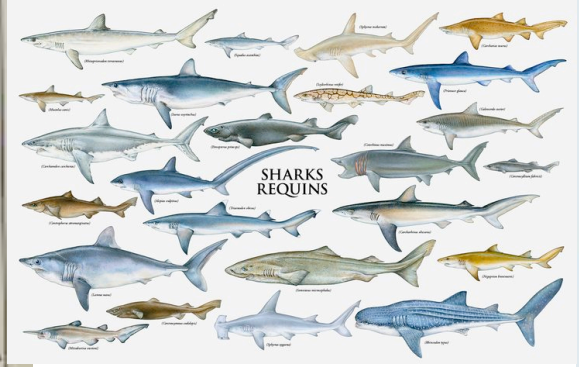
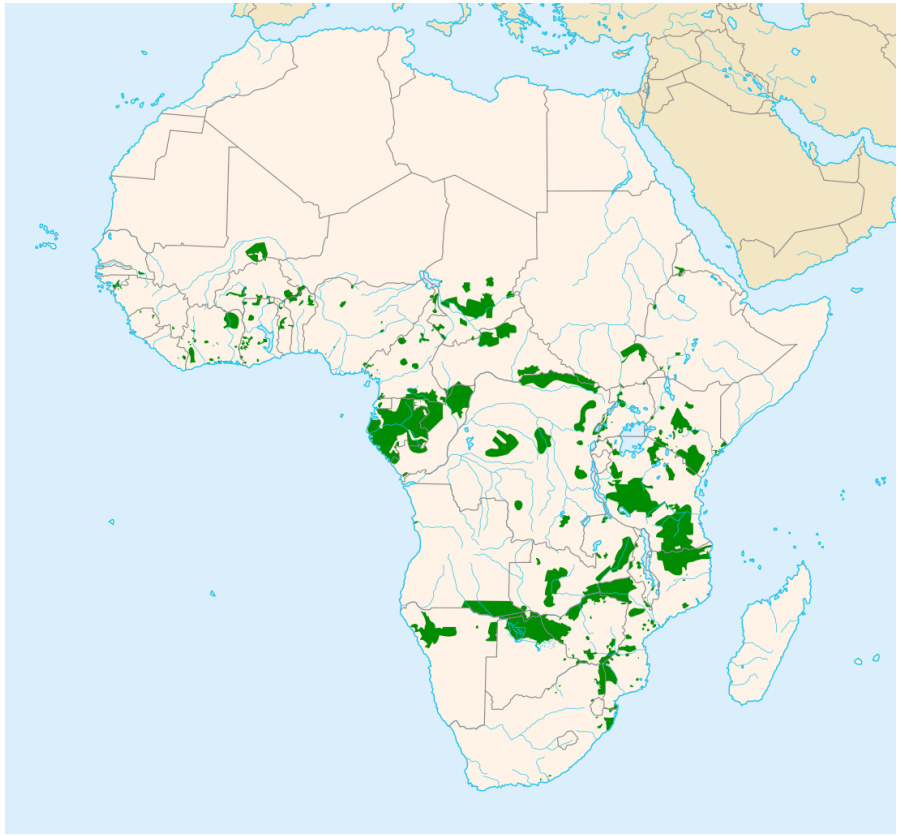
IB Biology Topic 4

Ecology

Species – Easy to define?



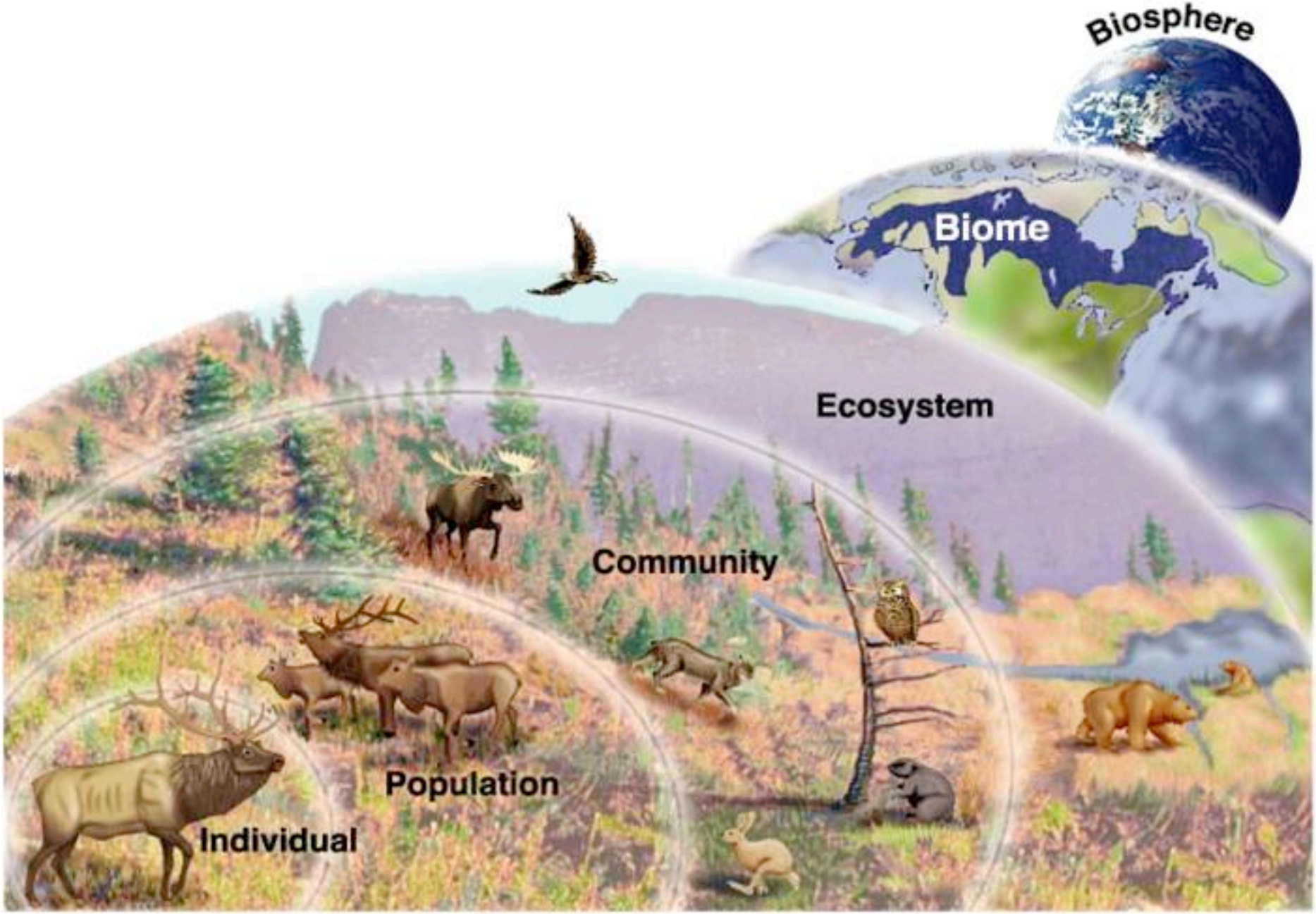
Population



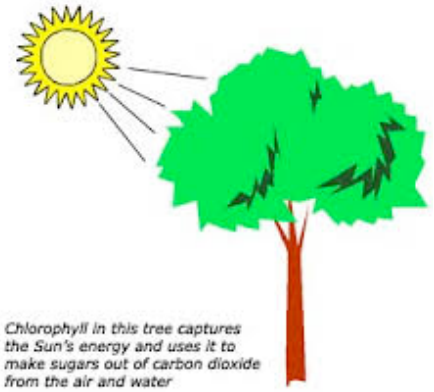
- Elephant distribution in Africa. Are they the same species?
- A Population – individuals that live in the same place at the same time.

Community

- Interacting populations


Biosphere
Biome
Ecosystem
Community
Population
Individual

How do I get my energy?



Autotroph – I capture it myself and make organic molecules to store energy for later use.

Heterotroph – I steal it from another living thing because I cannot capture energy myself.

I capture my own energy….

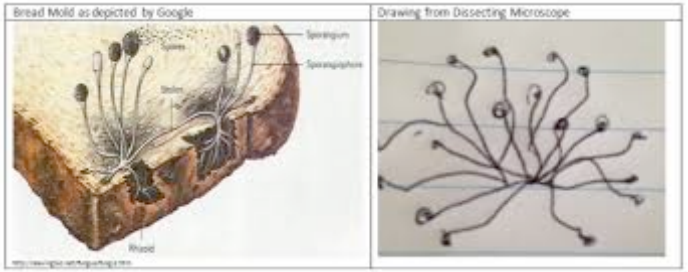
- Autotrophs can be split into two categories
  - PHOTOautotrophs – What is their energy source? Who are PHOTOautotrophs? How do they capture energy?
  - CHEMOautotrophs – What is their energy source? Who are CHEMOautotrophs? How do they capture energy?
  - Answer these questions….You have 10 minutes.

I steal my energy from others….

- Heterotrophs – “consume” others to get energy.
  - Consumers –

  - Detritivores –

  - Saprotrophs -



What are these?

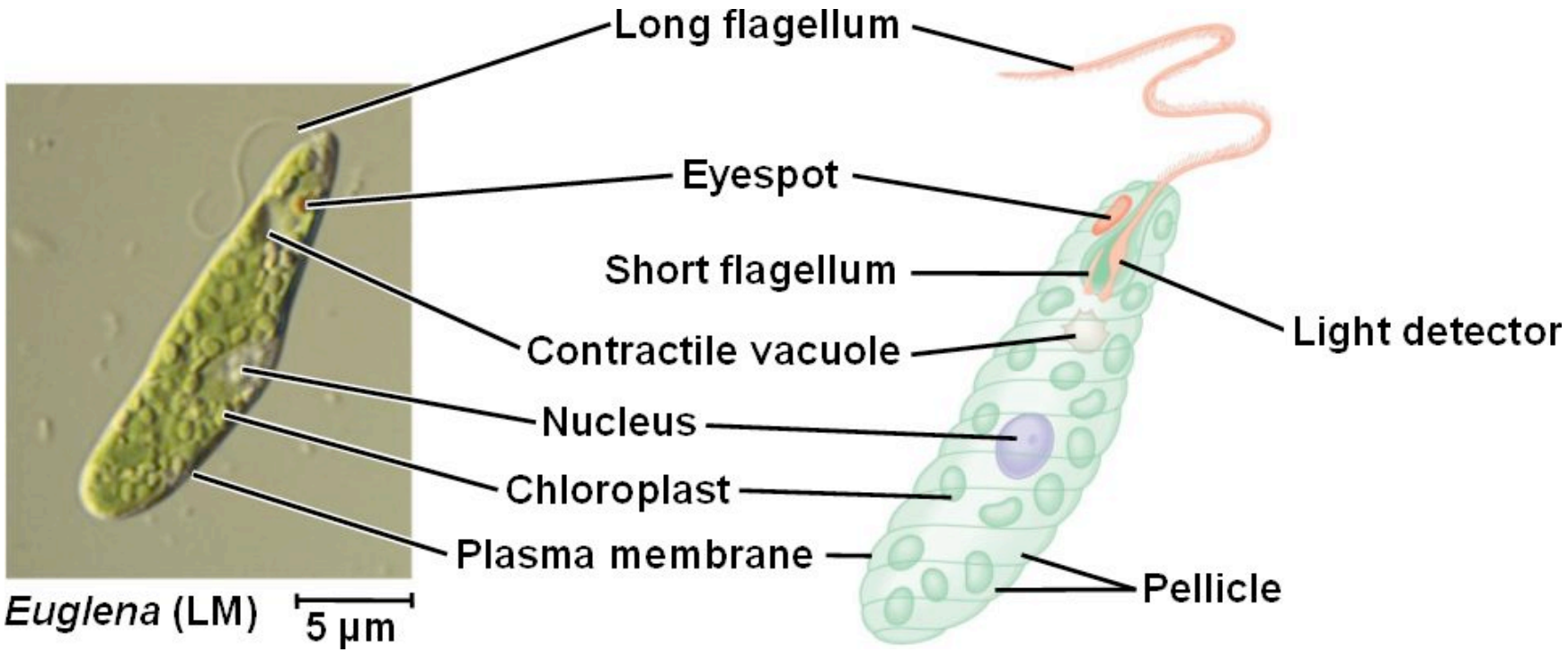
- 1. Ghost orchid: grows underground in woodland, feeding off dead organic matter, occasionally growing a stem with flowers above ground.

What are these?

- 2. Venus Fly Trap - Grows in swamps, with green leaves that carry out photosynthesis and also catch and digest insects, to provide supply of nitrogen .

What are these?

- 3. Euglena - Unicell that lives in ponds, using its chloroplasts for photosynthesis, but also ingesting dead organic matter by endocytosis .



What are these?

- 4. Dodder- grows parasitically on gorse bushes, uses small root-like structures to obtain sugars, amino acids and other substances it requires from the gorse.

What are these?

- 5. Sacoglossan sea slugs – These sea slugs feed on alga cells, digesting everything except the chloroplasts. The chloroplasts are incorporated into the lining of slug's digestive tract. Are they "solar-powered" sea slugs?

Community/Ecosystem Studies

- Field Work – Associations between species
- Quatrats, line transects, sampling

Option C.1 – Species and Communities

What are the key themes in ecology?

- A theme is a recurring idea that shows up regardless of how we study ecology.

Key Themes

- **No organism is isolated**
- All organisms interact with other organisms and the non-living parts of their environment.

Key Themes

- **All organisms are <u>interdependent</u>**
- An organisms <u>survival</u> depends on the interactions it maintains

Key Themes

- **Disturbances spread**
- Because all organisms are interconnected, any disturbance or change can spread through these interactions.
- These disturbances can have widespread and unexpected impacts on many organisms.

Ecology of Organisms

What are some basic questions to ask about an organism?

- Where does it live?
- Why does it live there?

How do we find answers to these questions?

Where should I live?

- Habitat – physical location where an organism lives.
- An organism's choice of habitat is influenced by both biotic and abiotic factors.

Where should I live?

- Biotic and Abiotic factors are dynamic (that means they change).
- Today's choice of habitat might not be a good one tomorrow.
- Organisms must re-evaluate their choice from time to time.

What's the best choice for me?

- Organisms are adapted to function within a normal range of change.

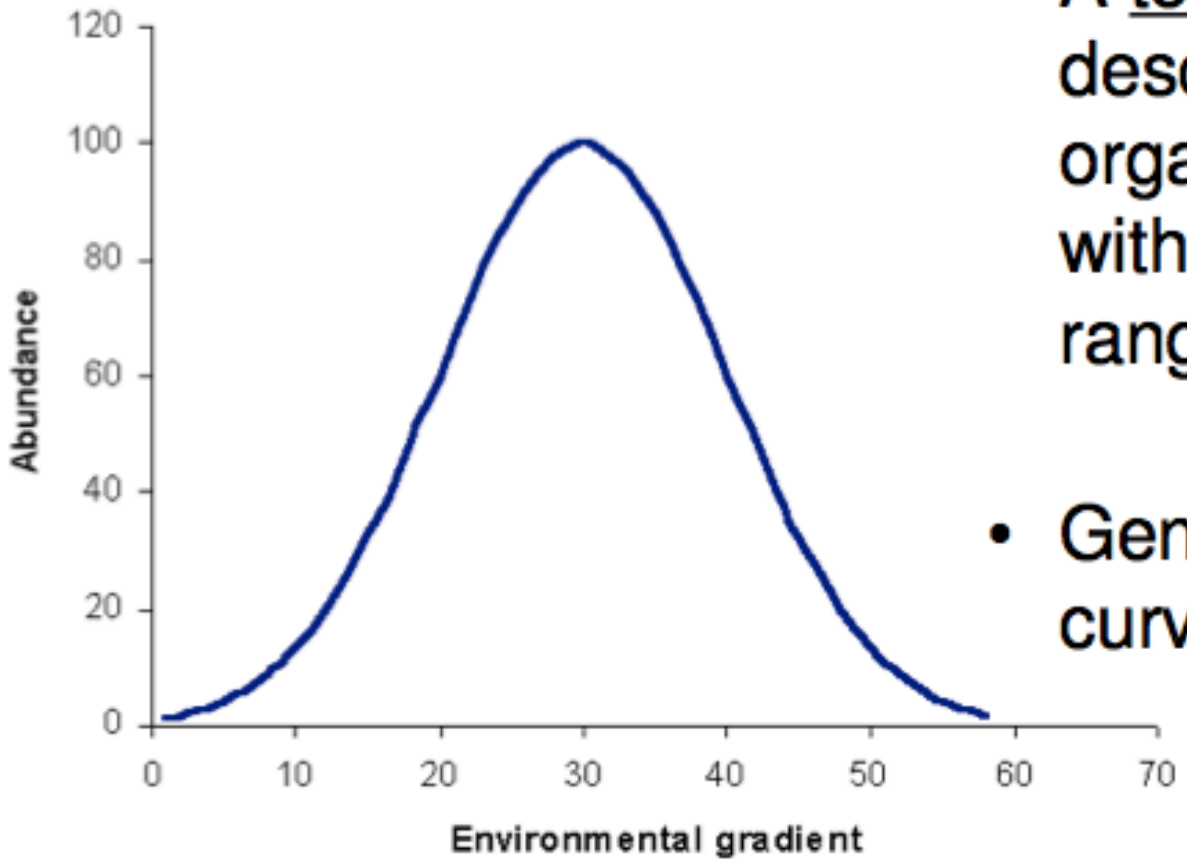
What's normal?

- Habitat choice reflects this acceptable range of conditions under which an organism can survive.

How do we define a normal range?

- Tolerance describes the normal range at which an organism can function.
  - i.e. temperature
  - Hydration
  - salinity
  - pH
  - Etc.
- Organisms have different tolerances for a variety of variables.

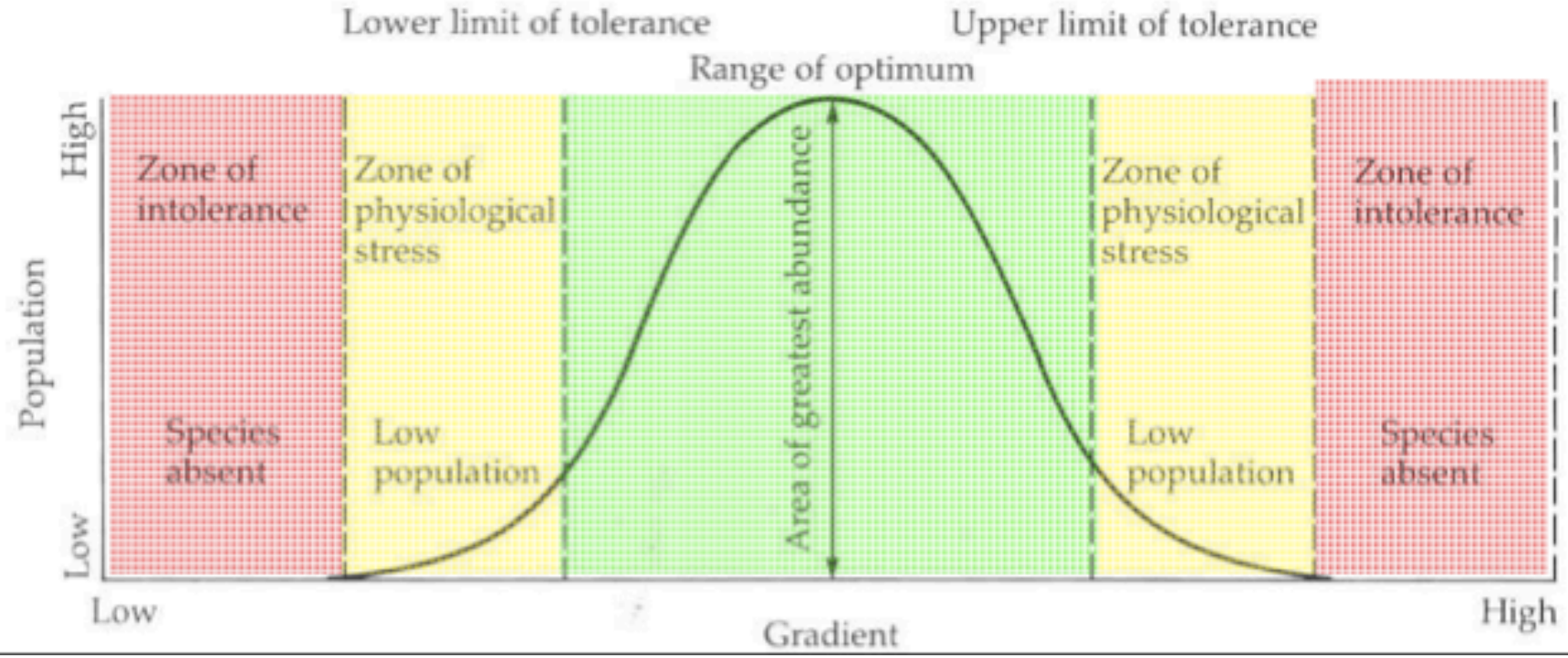
Tolerance Curves



- A tolerance curve describes how well an organism functions within its tolerance range.
- Generally a tolerance curve is bell shaped.

Tolerance Curves

- An organism is said to be **stressed** when environmental conditions move away from ideal.



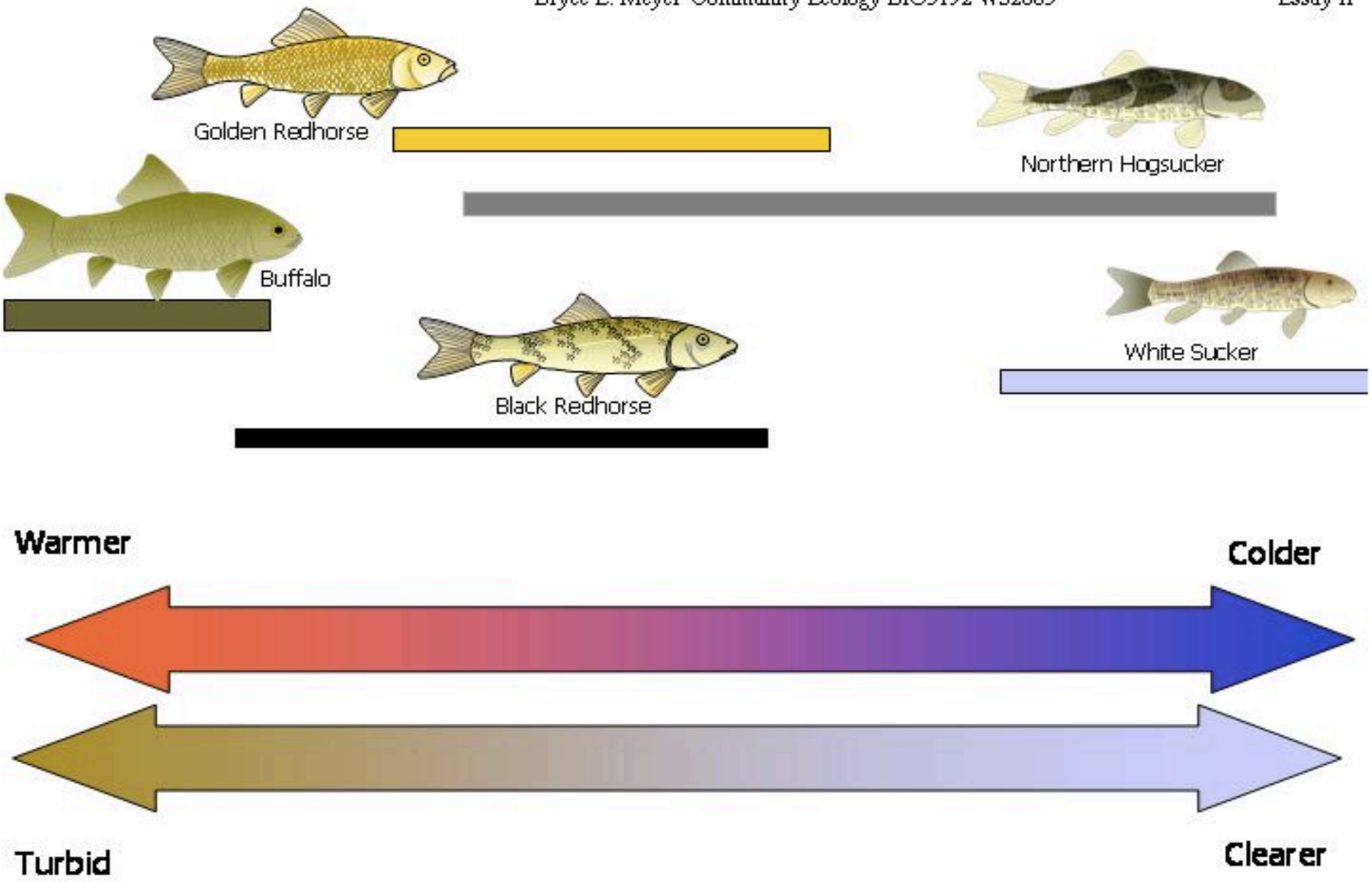
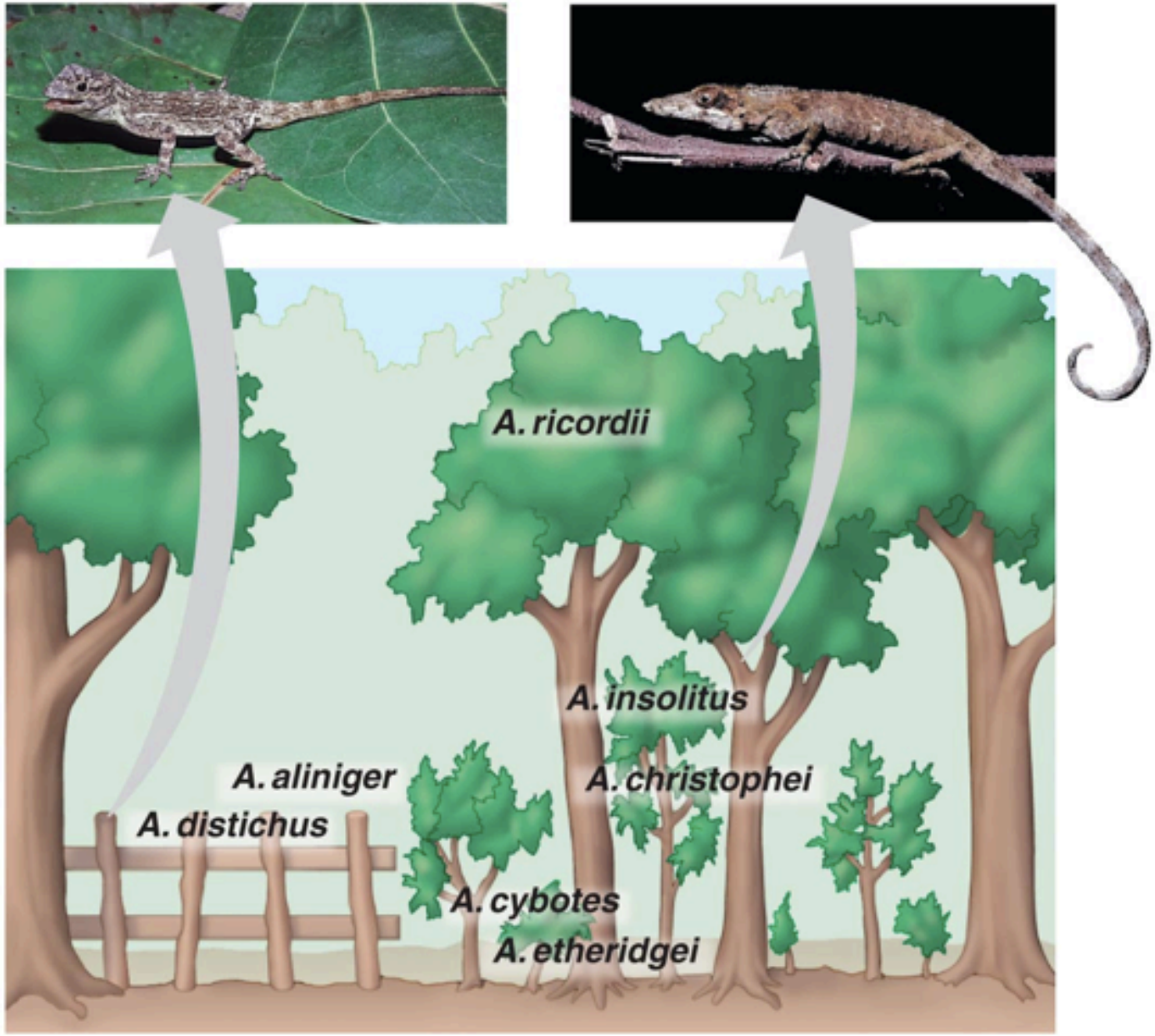


Figure #17: Benthic Large Omnivores: The Sucker Spectrum (bars indicate loosely range of occurrence i.e. Fundamental Niche) p.22

close

A. distichus perches on fence posts and other sunny surfaces.

A. insolitus usually perches on shady branches.



What happens when organisms are under stress due to tolerance limits?

- If conditions exceed the tolerance range an organism will die.

Some organisms can regulate internal conditions.

→ Spend energy to help maintain homeostasis

→ Organisms that can't regulate are called conformers.

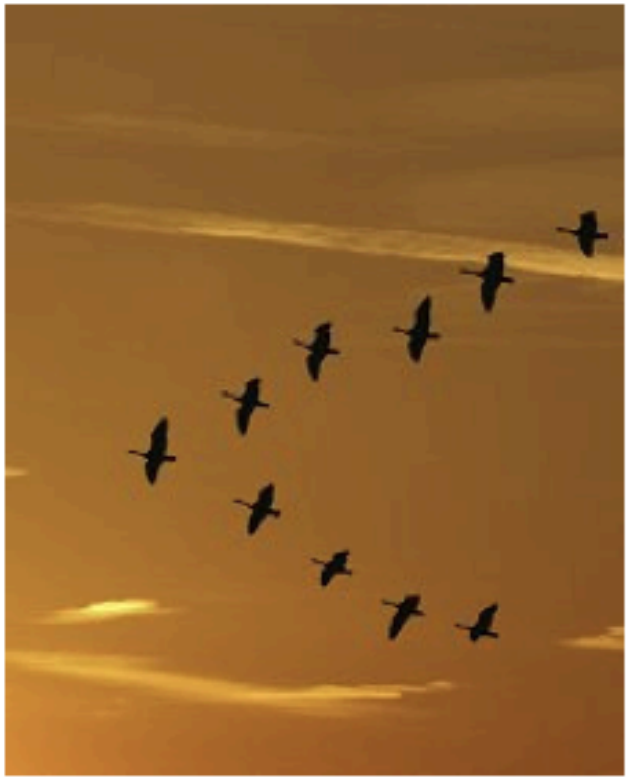
→ Organisms that can are called regulators.

An organism can escape unsuitable conditions by:

- Becoming Dormant

An organism can escape unsuitable conditions by:

- Migrating



Habitat vs. Niche
What's the difference?

- Habitat – the organism's home

- Niche – An organism's habitat + role + tolerance limits to all limiting factors

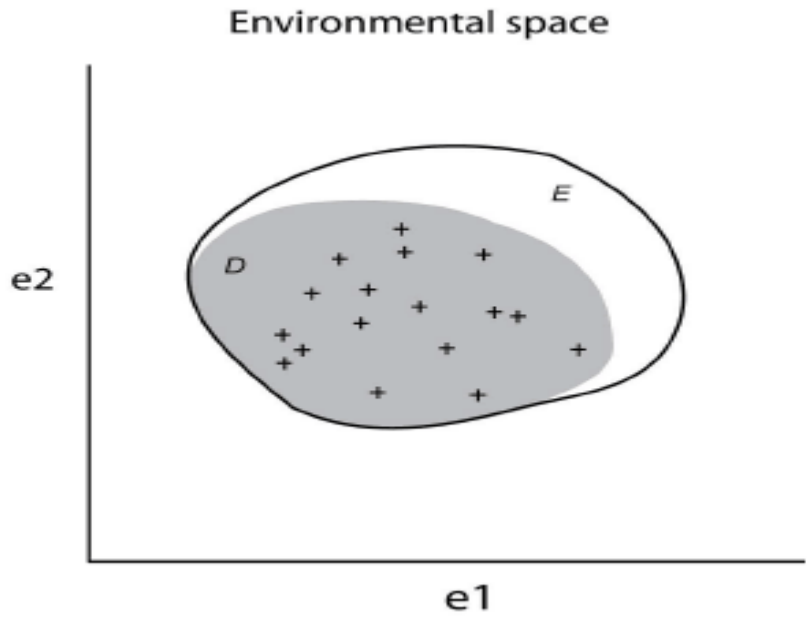
Niche

- The habit at and way of life selected by an organism is its niche.
- “How an organism makes a living”.
- It includes location, methods of hunting, breeding, behavior, active time, etc.

Niche

- **Fundamental Niche** – The **full** range of the places and resources an organism can use.

- **Realized Niche** – The places and resources an organism actually uses (usually smaller because of competition).



Competitive Exclusion Principle

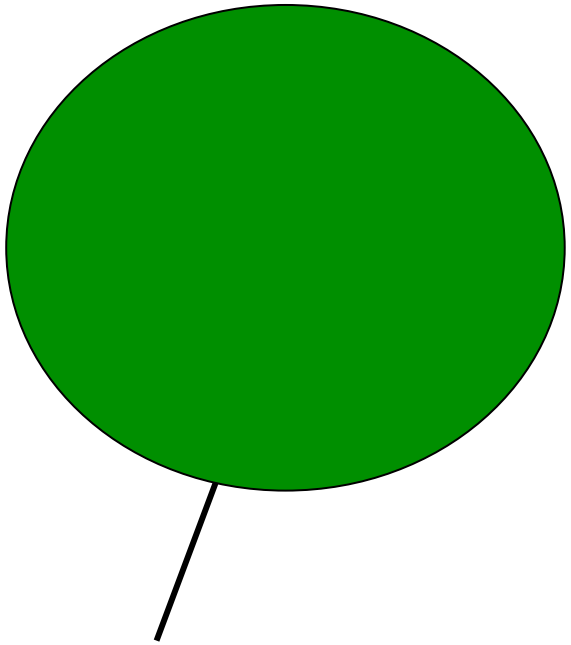
- G.F. Gause (1934)
  If two species, with the same niche, coexist in the same ecosystem, then one will be excluded from the community due to intense competition

Fundamental Vs. Realized Niche

- The actual niche occupied by a a species vs the niche actually occupied by a species because of competition. VIDEO

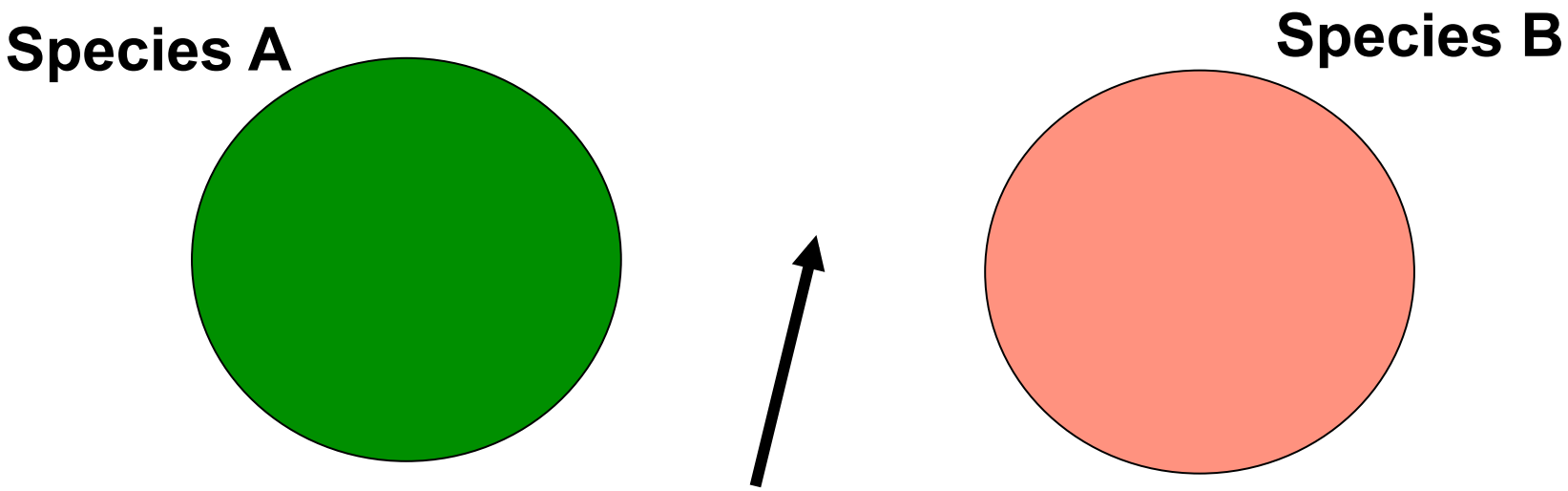
The niche as a two-dimensional shape

Species A



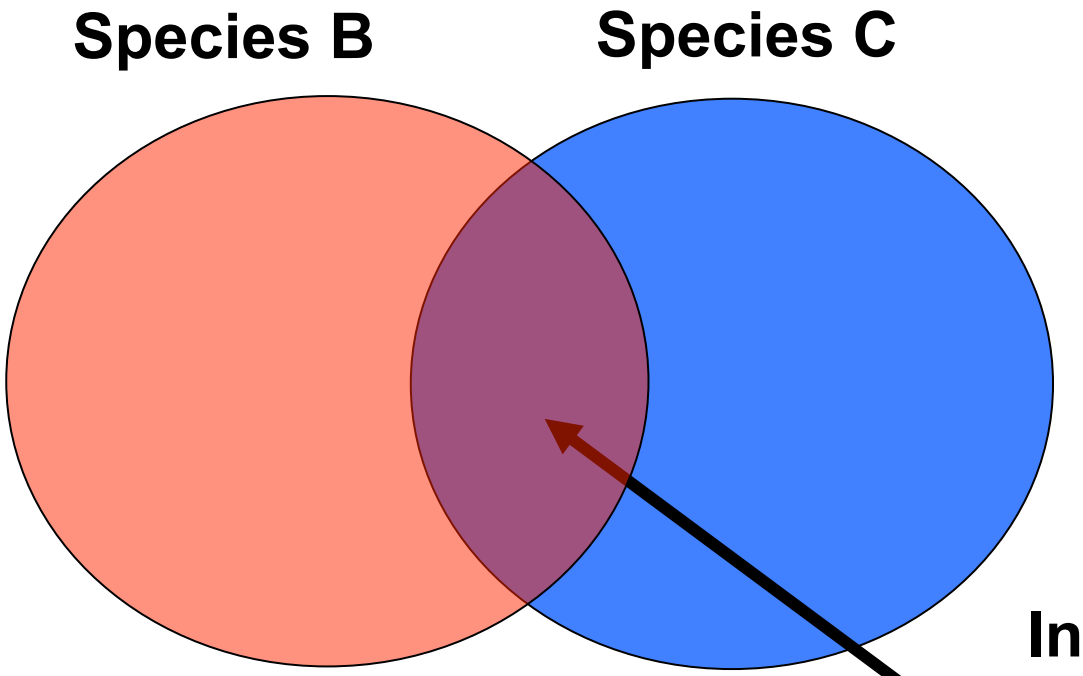
Niche represented by a 2-dimensional area

Separate niches



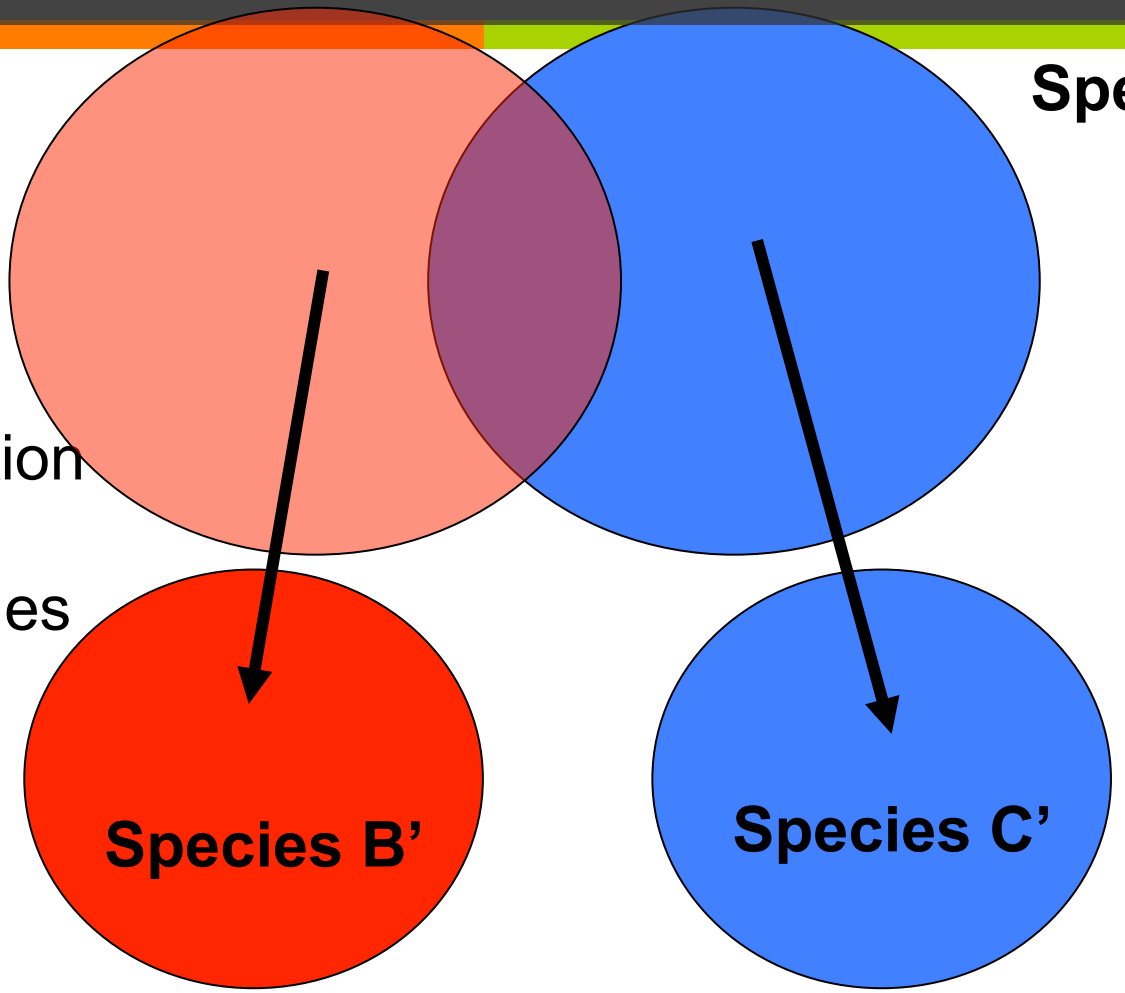
No overlap of niches.
So **coexistence** is possible

Overlapping niches



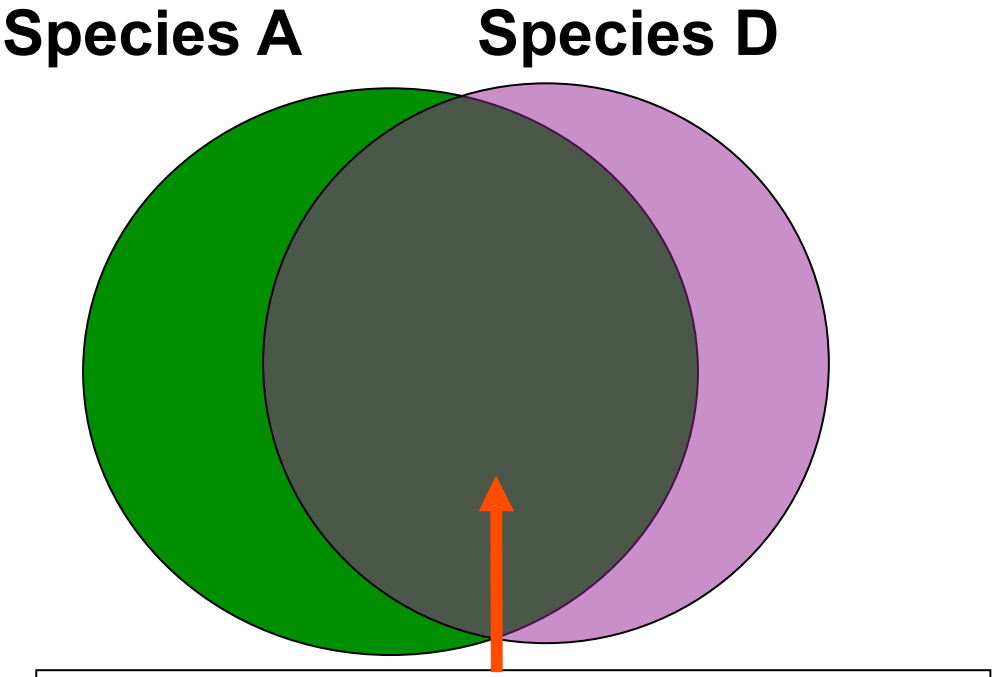
Interspecific competition occurs where the niches overlap

Specialisation avoids competition



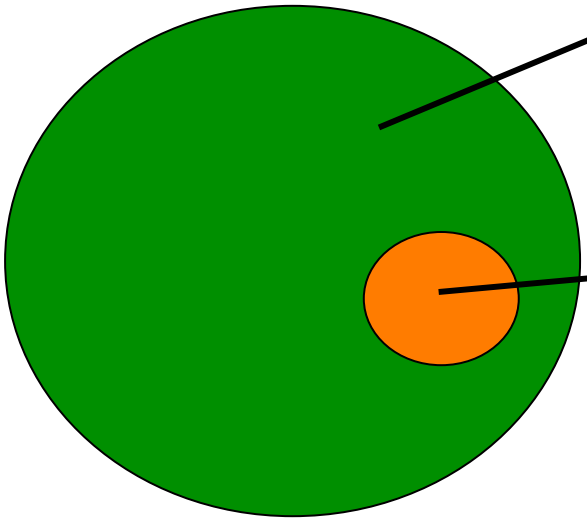
Specialisation into two separate niches

This niche is not big enough for the both of us!



Very heavy competition leads to **competitive exclusion**
One species must go

Total exclusion



Species A has a bigger niche it is more generalist

Species E has a smaller niche it is more specialist Specialists, however, do tend to avoid competition Here it is total swamped by Species A

Example: Squirrels in Britain

The Red Squirrel (*Sciurus vulgaris*) is native to Britain

Its population has declined due to:

- Competitive exclusion
- Disease
- Disappearance of hazel coppices and mature conifer forests in lowland Britain

Isle of Wight Tourist Guide

THE ALIEN

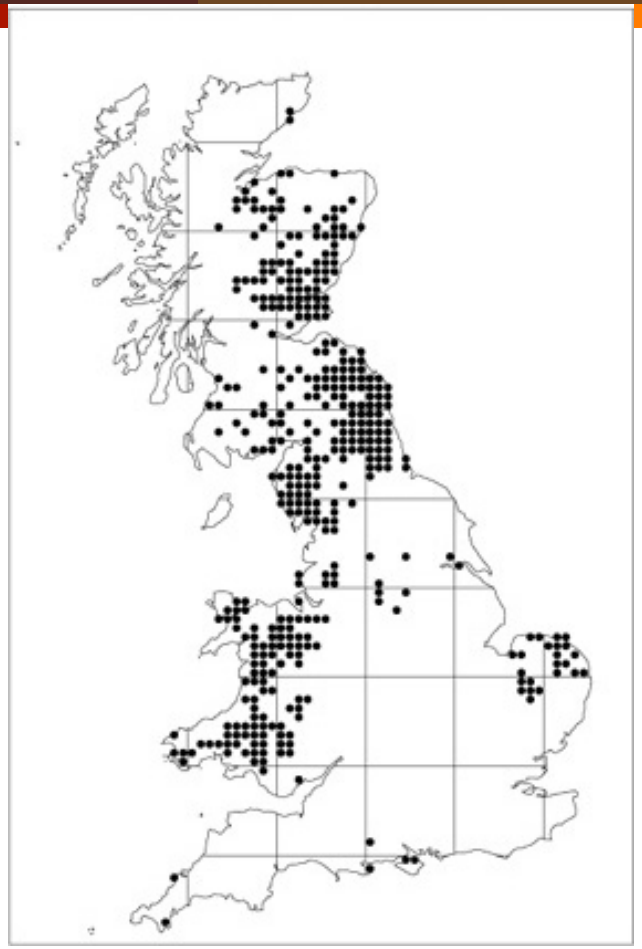
The Grey Squirrel (*Sciurus carolinensis*)
is an alien species

Introduced to Britain in about 30 sites between 1876 and 1929

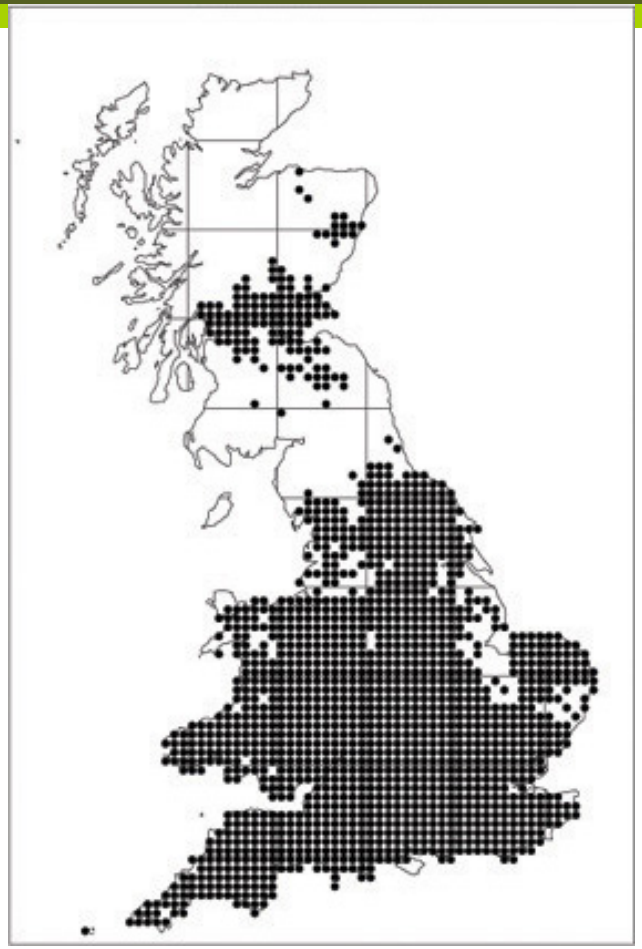
It has easily adapted to parks and gardens replacing the red squirrel

Bananas in the Falklands

Today's distribution



Red squirrel



Grey squirrel

Interspecific Interactions

- All of the following contribute to the niche of an organism
- Identify the interaction as
- O = no impact
- -- = negative impact
- + = positive impact

All of the following contribute to the niche of an organism

Neutralism

- Neutralism is a very common type of interspecific interaction. It includes the situation where neither population directly affects the other. An example of neutralism would be the interaction between salmon and dandelions living in a coastal inlet.

Competition

- **Competition**
- Competition occurs when two or more organisms in the same community seek
- the same resource (e.g., light, food, water, nesting space, ground space), which is in a limited supply.
- If the competition is among members of the same species, it is called intraspecific. Competition among individuals of different species is referred to as interspecific competition.

Competition

Amensalism

- **Amensalism**
- Amensalism is an interaction where one species suffers and the other interacting species experiences no effect. A good example is the antibiotic juglone which is secreted by Black Walnut (Juglans nigra) trees. This substance is known to inhibit the growth of trees, shrubs, grasses, and herbs found growing near Black Walnut trees.

The black walnut secretes a chemical from its roots that harms neighboring plants, an example of amensalism.

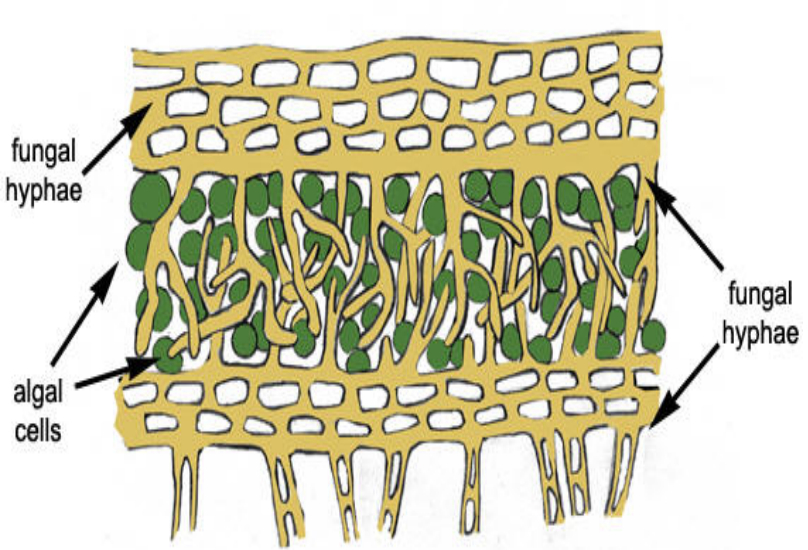
Herbivory

This involves the grazing of herbivores on producers.

Mutualism

- **Mutualism**
- Mutualism is the interaction where both species benefit. The classic example of mutualism is the relationship between fungi and algae which together produce lichens. The fungi provide the framework, moisture and sites for attachment while the algae carry out photosynthesis and thereby provide the food for both itself and the fungi.

Mutualism- Lichens



Predation

Predation involves one species that preys on another, consuming it in the process. Lions preying

Parasitism

- **Parasitism**
- In parasitism, the parasite may live in or on the body of the other organism and gets its nutrients from it. The relationship may be a temporary one as in the case of ticks and fleas or a more permanent one as in tapeworms.

Parasitism- Tapeworm

Commensalism

- **Commensalism**
- Commensalism is a relationship in which one organism benefits and the other is not affected. Orchids can illustrate this. Orchids are epiphytes (plants that grow on other plants). They grow high in the canopy of rainforests on the branches of trees. The orchids benefit in several ways. The main benefit is probably that they can get more sunlight. Orchids do not harm the trees they grow in. Their roots stay on the bark of the tree; they do not take water or nutrients from the tree.

Commensalism-Orchids

Effect on X	Effect on Y	Type of interaction
0	0	Neutralism
0	-	Amensalism
+	0	Commensalism
-	-	Competition
+	+	Mutualism
+	-	Predation or Parasitism

Some types of relationships listed by the effect they have on each partner. '0' is no effect, '-' is detrimental, and '+' is beneficial.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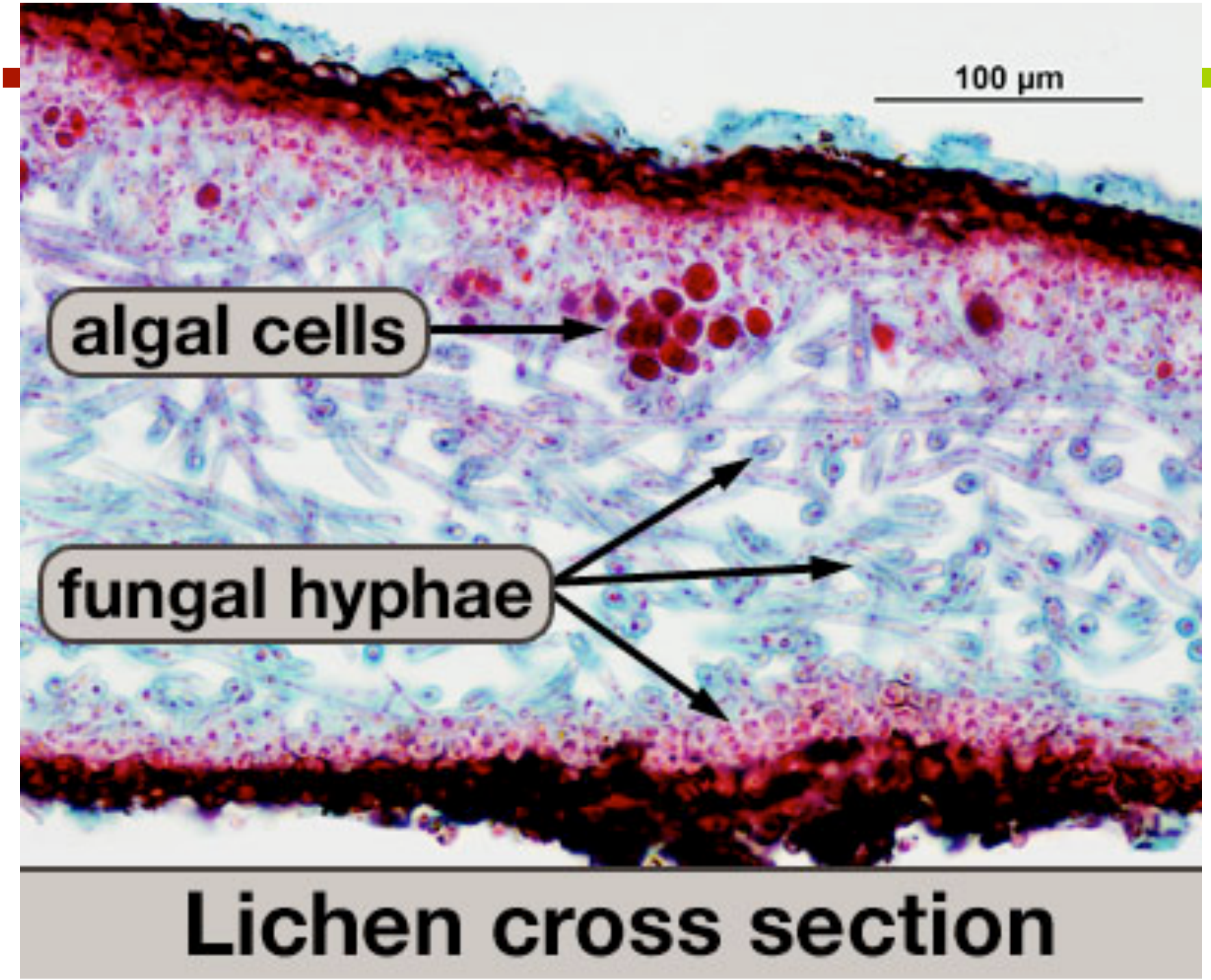
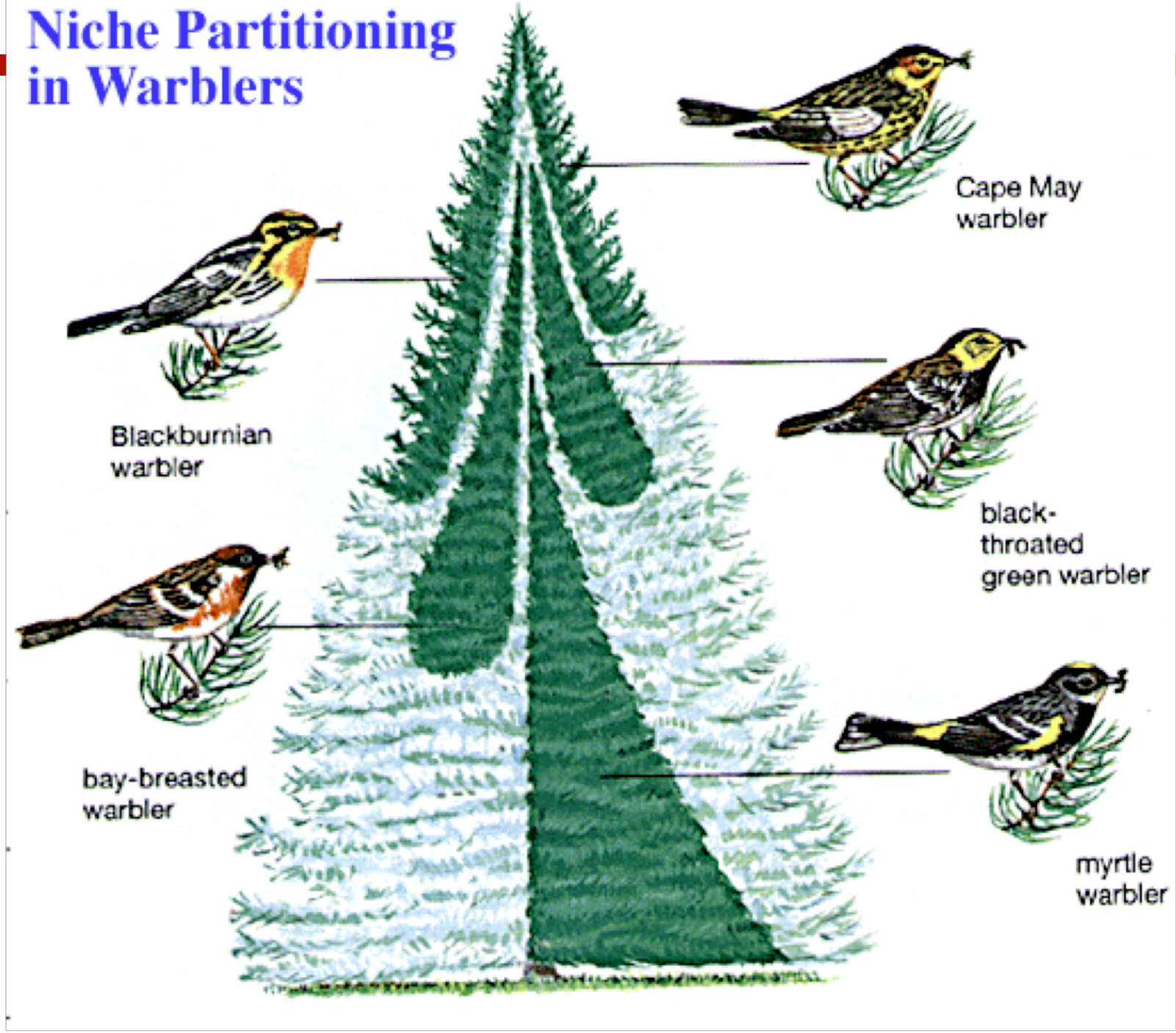

100 µm
algal cells
fungal hyphae
Lichen cross section

Niche Partitioning in Warblers



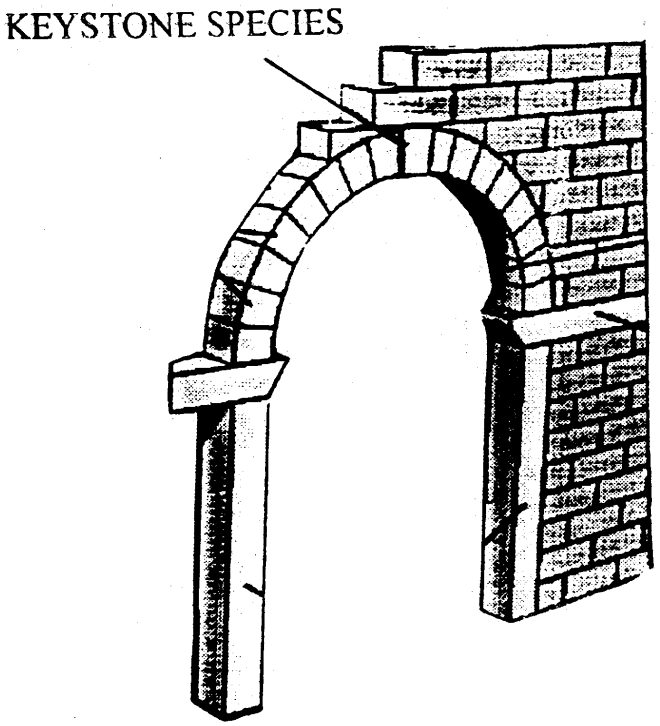




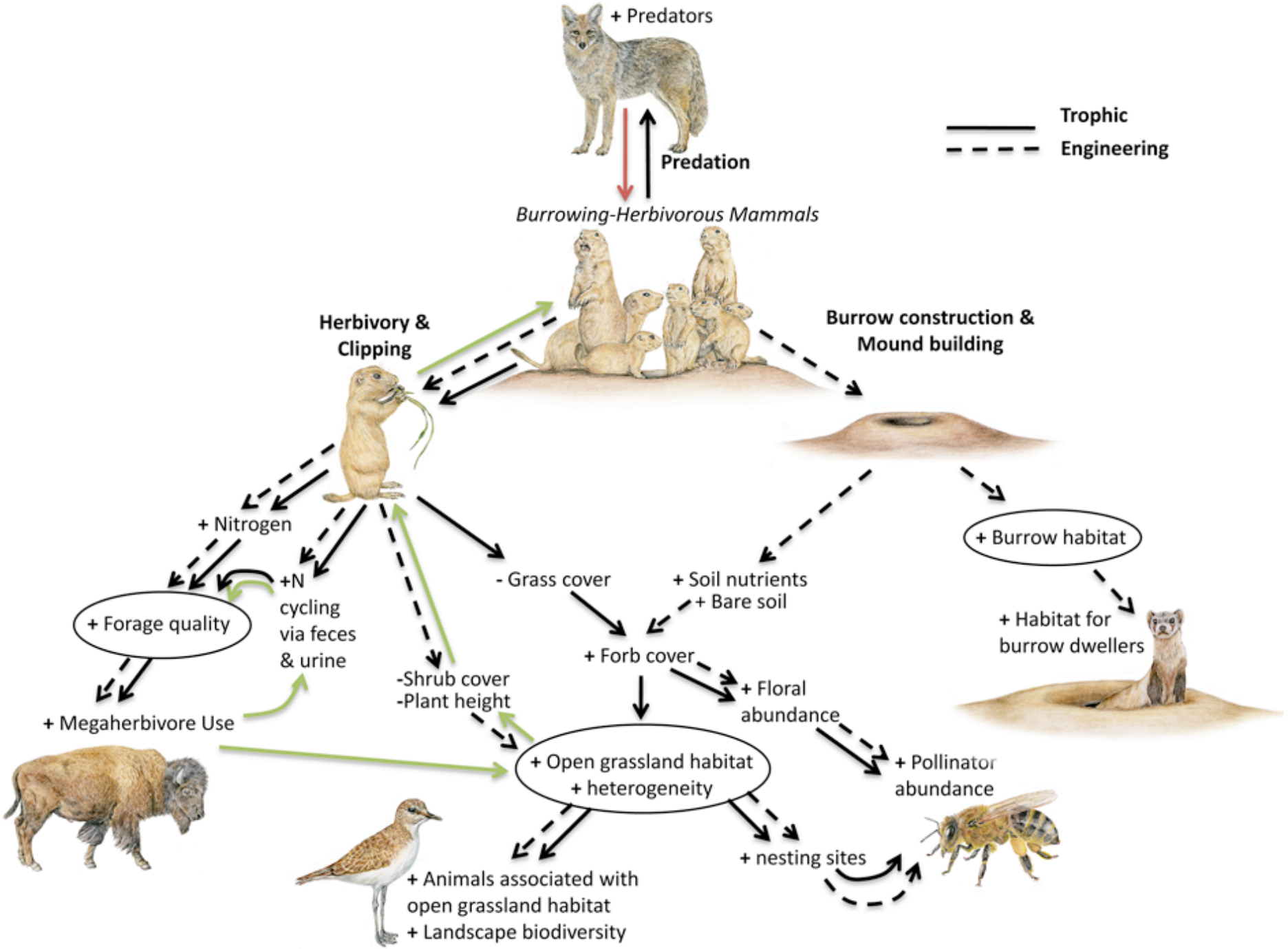


KEYSTONE SPECIES

A plant or animal that plays a unique and crucial role in the way an ecosystem functions. Without keystone species, the ecosystem would be dramatically different or cease to exist altogether. All species in an ecosystem, or habitat, rely on each other.

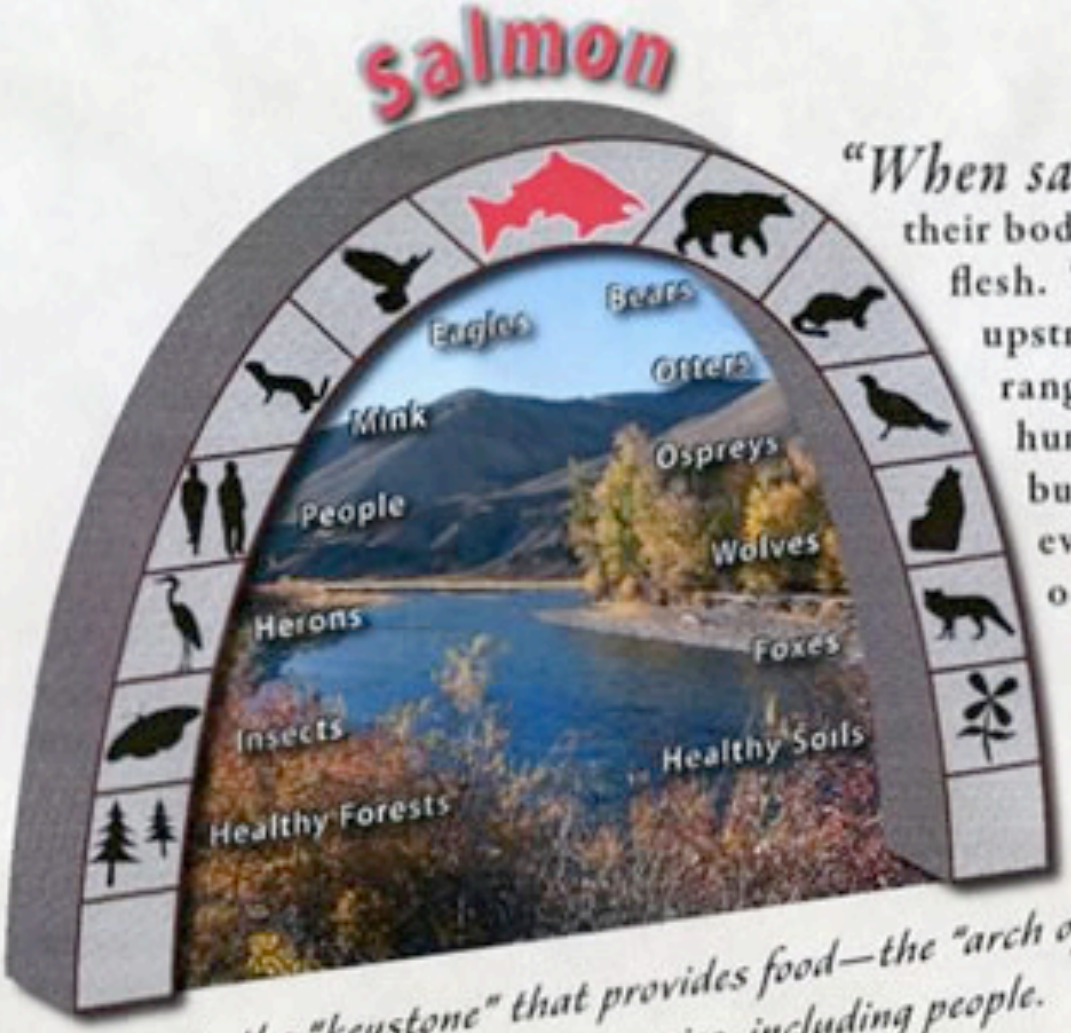


Removal of the keystone in the arch will cause the structure to collapse.


+ Predators
Predation
Trophic
Engineering
Burrowing-Herbivorous Mammals
Herbivory & Clipping
Burrow construction & Mound building
+ Nitrogen
+N cycling via feces & urine
+ Forage quality
+ Megaherbivore Use
- Grass cover
+ Soil nutrients
+ Bare soil
+ Forb cover
-Shrub cover
-Plant height
+ Floral abundance
+ Open grassland habitat
+ heterogeneity
+ Pollinator abundance
+ nesting sites
+ Animals associated with open grassland habitat
+ Landscape biodiversity
+ Burrow habitat
+ Habitat for burrow dwellers


Beaver

Keystone Species



Salmon is the "keystone" that provides food—the "arch of life" to nourish more than 100 species, including people.

"*When salmon return* from the sea, their bodies are the ocean – made into flesh. Their tails propel ocean nutrients upstream and into forests, rivers, and rangelands where they benefit hundreds of other species. Trees, bushes, animals and plants – everything you see here – contains ocean nutrients from salmon."

Dr. Carl Safina, Biologist & Author