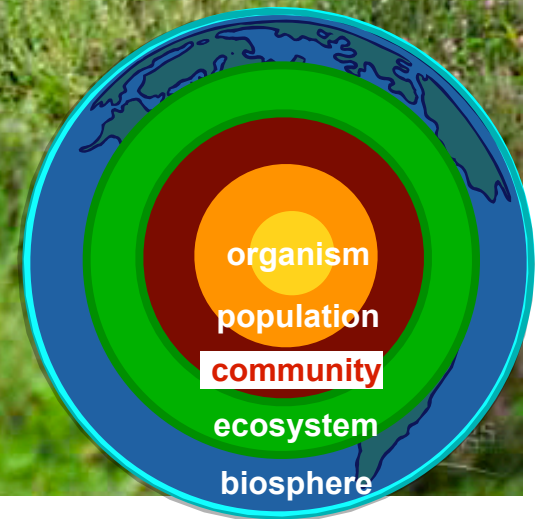




Community Ecology

AP Biology



Community Ecology

■ Community

- ◆ all the organisms (of different species) that live together in a particular region
 - These multiple populations of species engage in interspecific interactions (a.k.a. symbiosis)
 - ◆ Competition
 - ◆ Predation
 - ◆ Herbivory
 - ◆ Parasitism
 - ◆ Mutualism
 - ◆ Commensalism

■ Community Ecology

- ◆ study of interactions among all populations in a common environment

AP Biology

To answer:
In what way do the
populations interact?



Interspecific interactions

■ Symbiosis

- ◆ When organisms of two or more species live in direct and intimate contact and interaction with one another

■ Symbiotic interactions

- ◆ Competition (-/-)
 - Resources are often limited in nature.
Ex: birds compete for nesting sites
- ◆ Predation (+/-)
 - Ex: spider consumes moth
- ◆ Herbivory (+/-)
 - Ex: goat eats leaves
- ◆ Parasitism (+/-)
 - Ex: tick feeds on blood of wolf
- ◆ Mutualism (+/+)
 - Ex: lichen (= algae does photosynthesis, sharing some sugar with fungus, & fungus creates structure to house algae)
- ◆ Commensalism (+/0)
 - Ex: barnacles live attached to whale
- ◆ Amensalism (-/0)
 - Ex: Pine tree kills grass because pine needles droppings make top soil more acidic



Symbiosis Key:

- = species harmed by interaction
- + = species benefited by interaction
- 0 = species unaffected by interaction

Competition



■ Interspecific competition - / -

- ◆ An interaction that occurs when individuals of different species compete for a **limited** resource, the loss thereof limiting their growth, reproduction, and survival.
 - Ex: Weeds in a garden compete for soil nutrients (minerals) and water with other garden plants of its own species and of other species
 - ◆ In contrast, oxygen is usually available in large enough quantities not to be a resource competed over.
- ◆ **BOTH** competing organisms obtain **FEWER** resources, even if one species is better at competing for them than the other!!!



Ecological Niche

- Every organism occupies a **niche** in the ecosystem

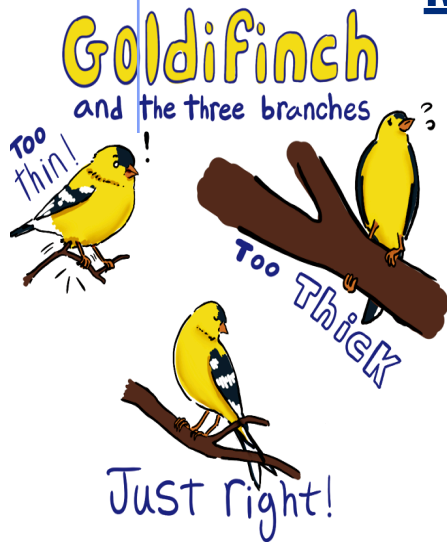
- ◆ An organism's niche is its ecological role

- Refers to the interrelationship of a species with all the biotic and abiotic factors affecting it.

- More specifically, a niche refers to:

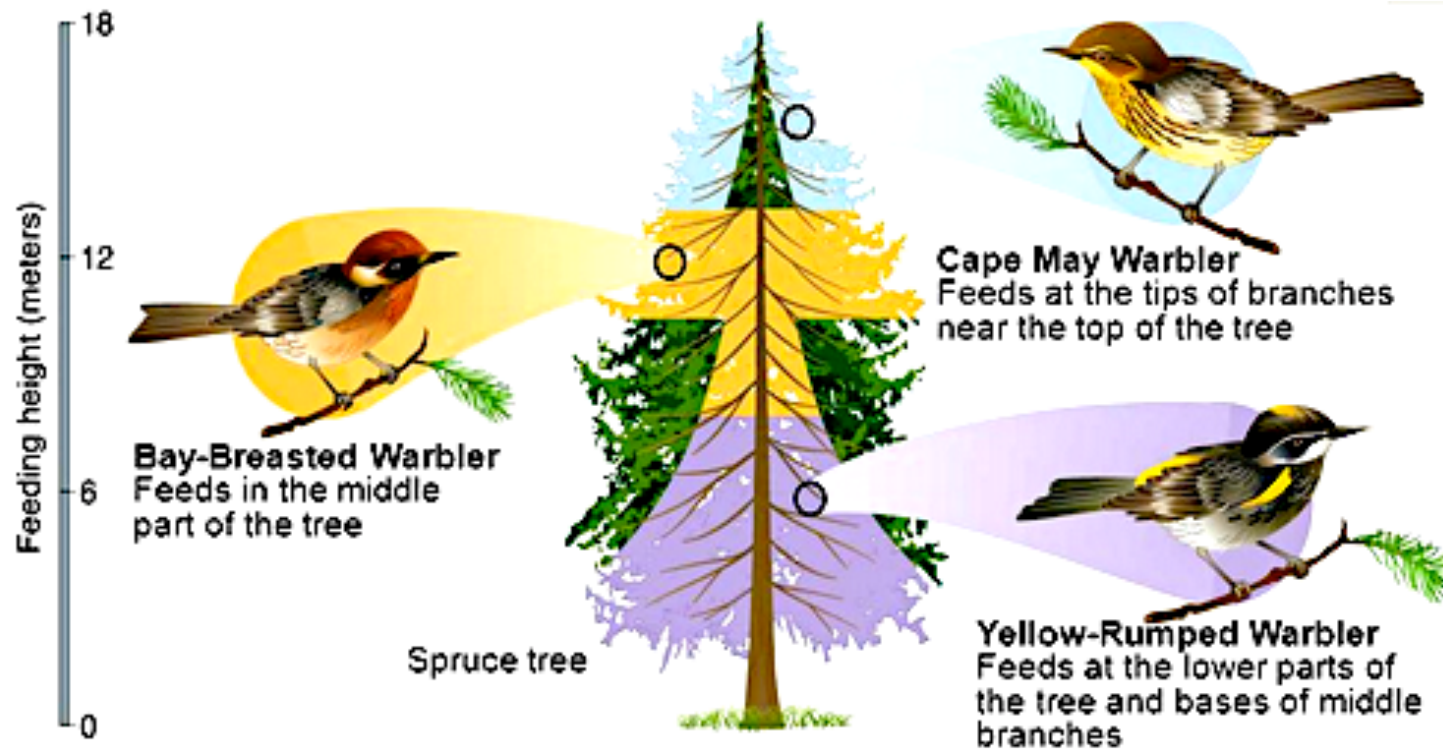
1. the specific location an organism inhabits
2. the role or function of an organism or species in an ecosystem
3. the interrelationship of a species with all the biotic and abiotic factors affecting it

- **habitat** = “address” - the geographical place an organism lives
- **niche** = “job” - how it lives and is able to survive in its environment.



- ◆ Ex: a fish species' **niche** might be defined partly by ranges of salinity (saltiness), pH (acidity), and temperature it can tolerate, as well as the types of food it can eat.

Part of the Ecological Niche of Warblers



Ecological Niche

- A fundamental niche is the niche of a species in the absence of competition.
- A realized niche is the niche a species occupies due to pressures, e.g. the arrival of a competing species to its habitat.
 - ◆ Niche overlap is when two organisms use the same resource or other environmental variable.
 - Often, niches overlap only partially as the resources are shared.
- Importantly:
 - ◆ Two organisms with exactly the same niche **CANNOT** survive in the same habitat longterm
 - They compete for exactly the same resources, so one will drive the other to extinction since one will be slightly at garnering resources than the other
 - ◆ Species whose niches only partly overlap may be able to coexist.
 - Over long periods of time, they may evolve to make use of more different, or less overlapping, sets of resources!

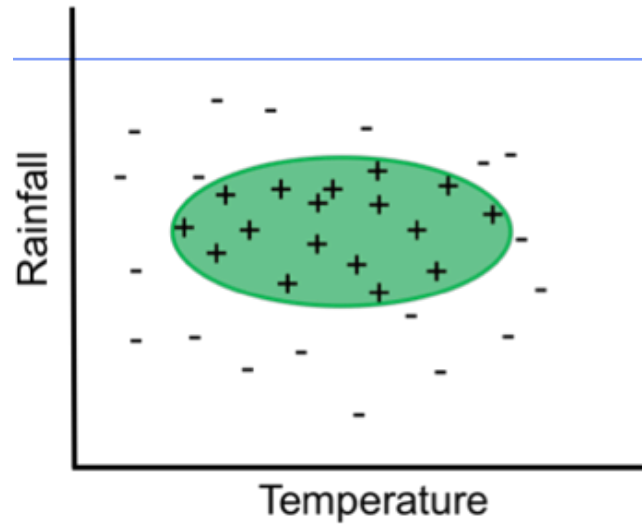


The **fundamental niche** of the species refers to the environmental conditions where a species **can occur**, and assumes that the species only occurs there and nowhere else.

However, a species is not necessarily found in every location that has suitable environmental conditions because the distribution of a species is also influenced by **biotic and abiotic factors** which limit the aspects of their niche used (ex: the presence of a predator or geographical barrier to spreading).

The part of the niche actually occupied by a species is referred to as the **realized niche**.

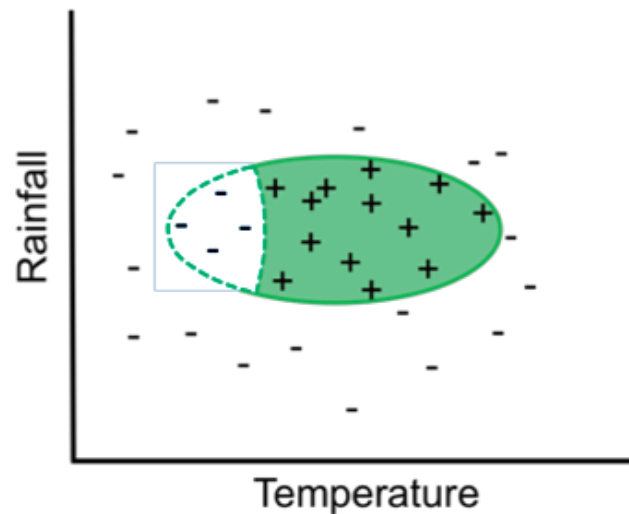
Fundamental niche



Potential distribution



Realized niche



Actual distribution

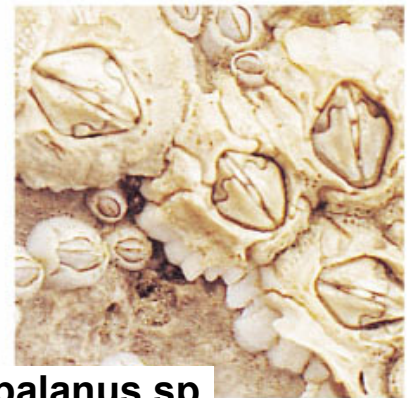
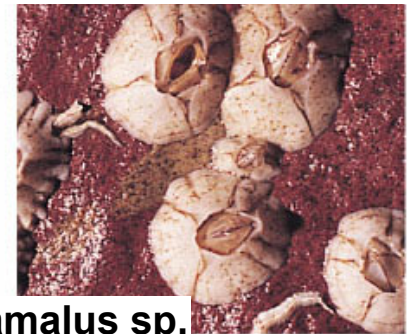
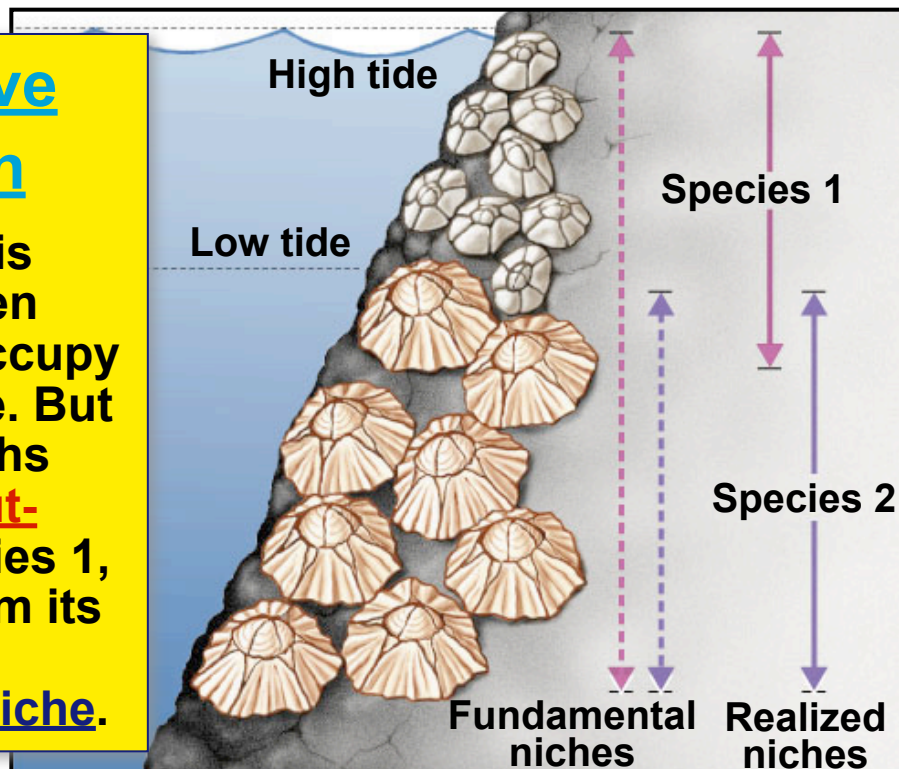


Ecological Niche

- Two species **CANNOT** coexist permanently over time in a community if their niches are identical
 - The competitive exclusion principle tells us that two species can't have exactly the same niche in a habitat and stably coexist.
 - Species with identical niches also have identical needs, which means they would compete for precisely the same resources.

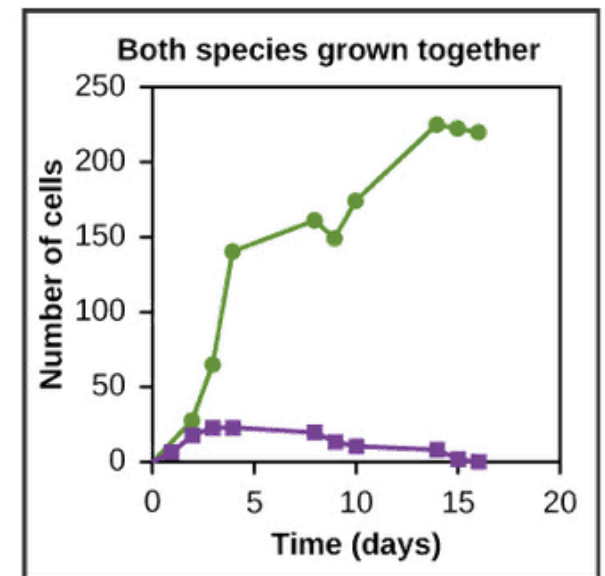
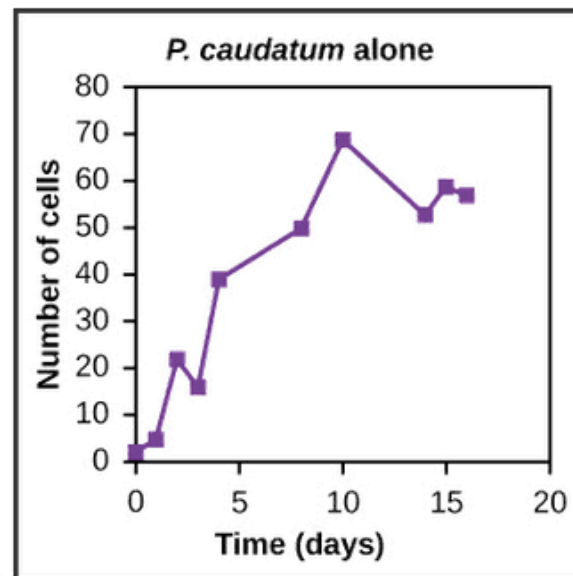
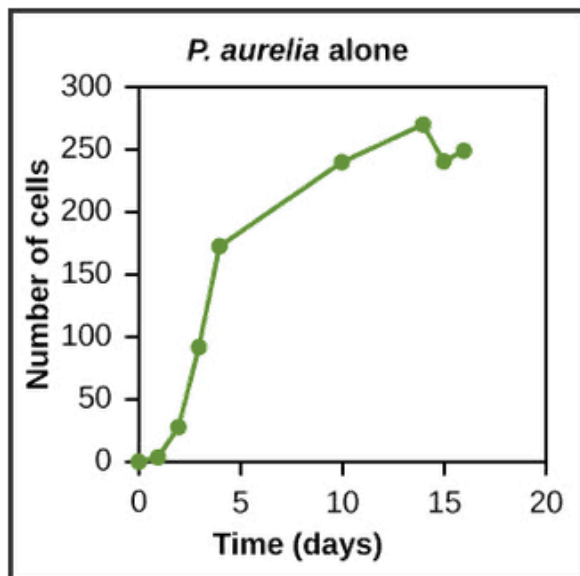
Competitive Exclusion

If Species 2 is removed, then Species 1 will occupy whole tidal zone. But at lower depths Species 2 **out-competes** Species 1, excluding it from its potential (fundamental) niche.



Consequences of Competitive Exclusion

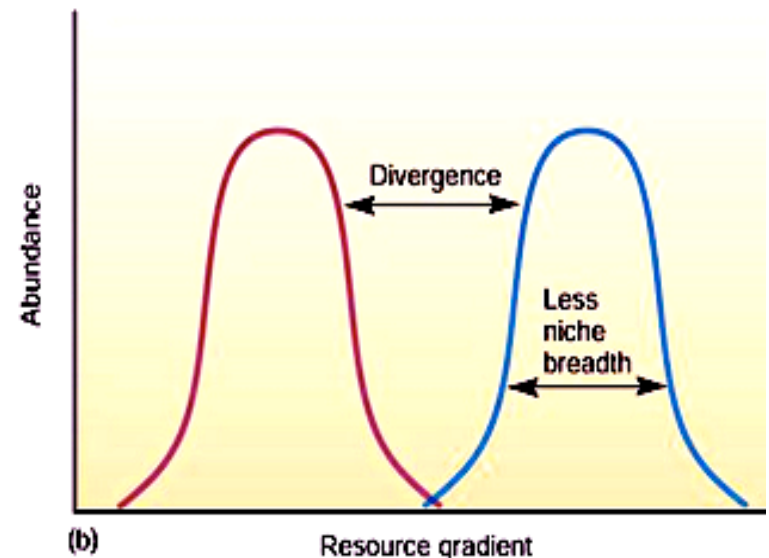
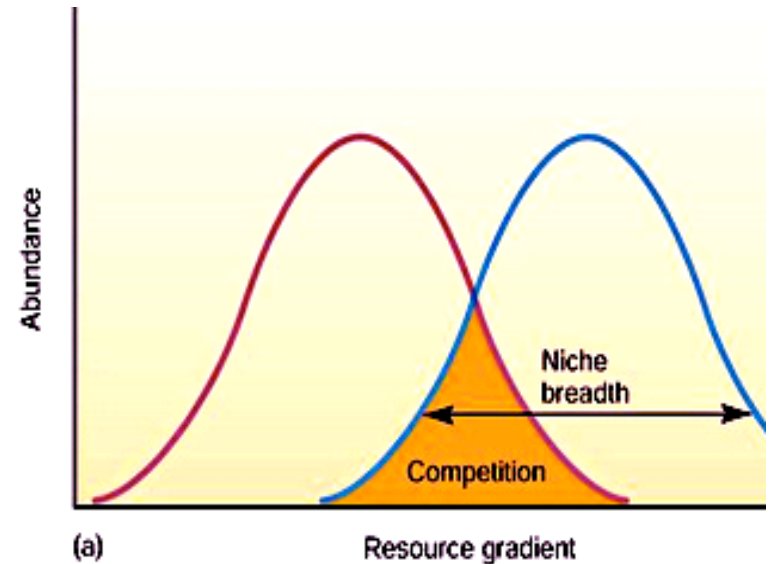
- When grown individually in the lab, both species, *Paramecium aurelia* and *Paramecium caudatum*, thrive.
 - ◆ When they are grown in the same test tube (habitat) with a fixed amount of nutrients, both grow more poorly, and *P. aurelia* eventually outcompetes *P. caudatum* for food, leading to *P. caudatum*'s “extinction.”
 - Competitive exclusion may be avoided if one or both of the competing species is able to evolve to use different sets of resources, occupying a different areas of the habitat, feeding during a different time of day etc...



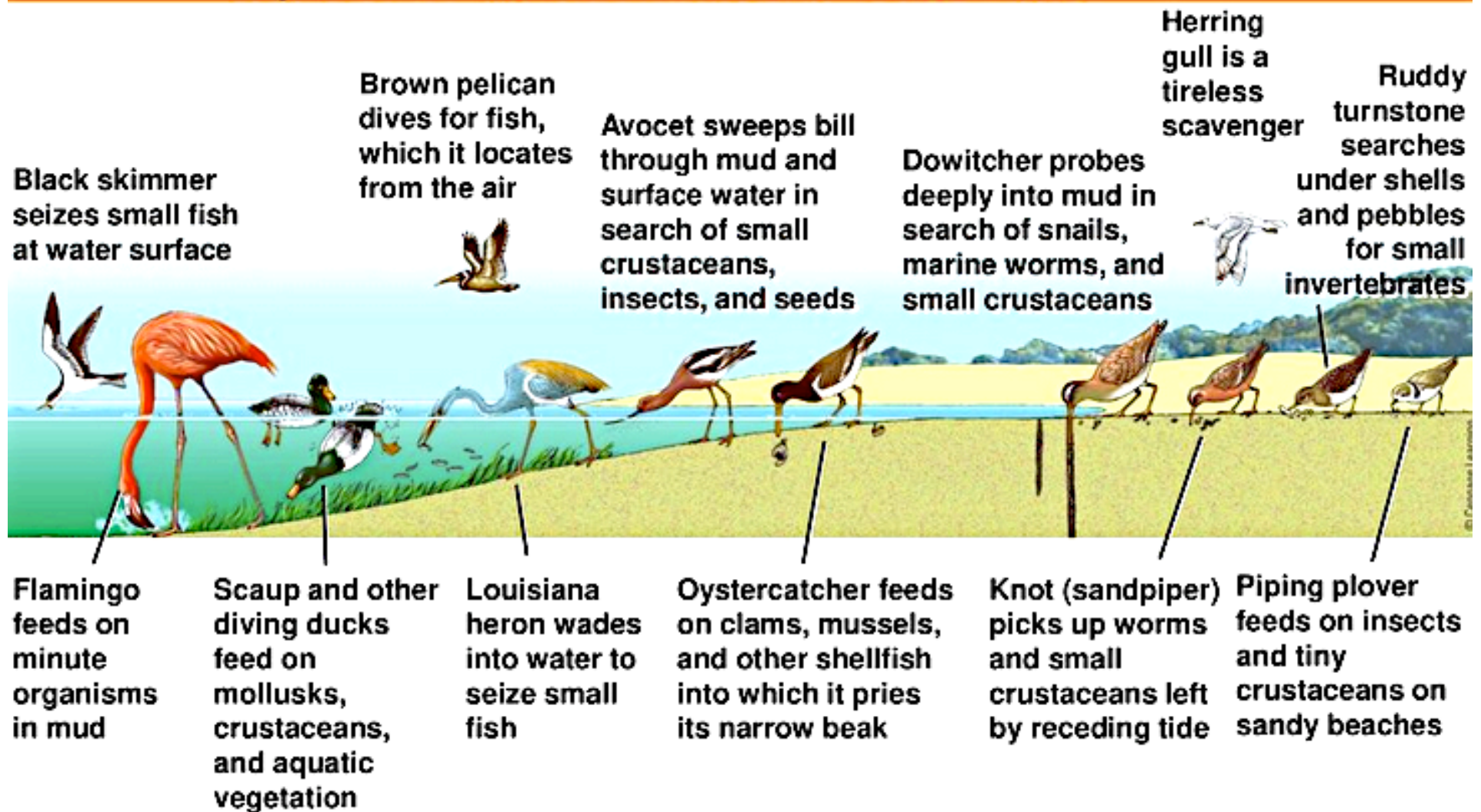
Consequences of Competitive Exclusion Over Generations

If two species' niches overlap partially, but **not** completely, two similar species might be able to evolve to rely more on largely non-overlapping resources and end up, after generations, having different, changed, **non-overlapping niches**.

- ◆ This evolutionary process is called **resource partitioning**, and it helps the two species coexist because there is less direct competition between them over time.
 - The evolution of resource partitioning is the result of natural selection:
 1. positive (natural) selection for the use of non-overlapping areas of their niches
 2. negative selection against the use of overlapping resources.
 - Natural selection causes changes to a species niche to minimize competition



Specialized Feeding Niches of Various Bird Species in a Coastal Wetland



Niche & Outcomes of Competition

■ Competitive Exclusion

- ◆ No two similar species can occupy the same niche at the same time
 - One species either goes extinct or one species' niche becomes modified through natural selection over generations
 - ◆ Species now use a slightly different set of resources



Resource Partitioning

Differentiation of niches that enables similar species to coexist in a community

Resource partitioning

Dominican Republic lizards: Seven species of Anolis lizards live in close proximity, and all feed on insects and other small arthropods. Competition for food is reduced because each lizard species has a different perch, thus occupying a **distinct niche**.

- Two similar species **CAN** coexist in a community if there are one or more significant differences in their niches
 - Reduce competition through occupying **microhabitats**

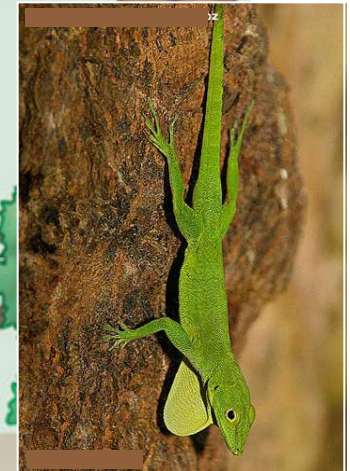
“the ghost of competition past”

A. ricordii



A. insolitus

A. christophei



A. aliniger

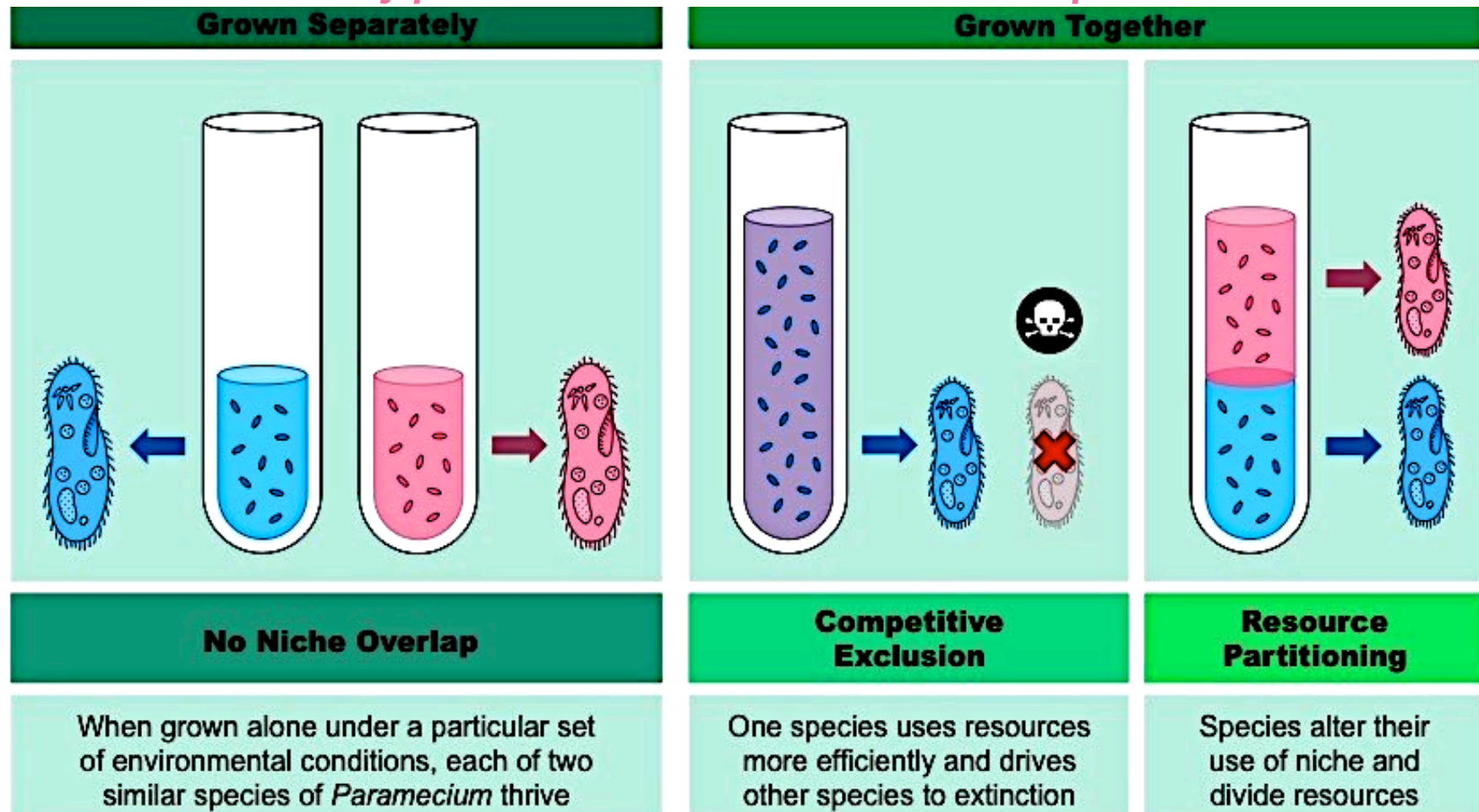
A. distichus

A. cybotes

A. etheridgei



Niche differentiation occurs when 2 species are in the same environment, **competitive exclusion** takes place due to competition for resources, one species being better at securing certain overlapping resources (*= one species will be forced to use only part of its niche as a result of competition with the other*)



Consequences =

1. If niches are identical, one species will **disappear** community
2. If niches only overlap, **resource partitioning** (“niche differentiation”) may evolve as an **ADAPTATION** (*= the two species’ niches may change over many generations due to natural selection so they no longer overlap*)

Character Displacement

- ◆ Phenomenon where differences in phenotype among two similar species, whose distributions overlap geographically, are accentuated in regions where the species co-occur, but are minimized or lost where the species' distributions do not overlap.
 - This pattern results from evolutionary change driven by competition among species for a limited resource (e.g. food).
 - ◆ character displacement occurs because of the competitive exclusion principle, which, in this case, leads to the evolution by natural selection of resource partitioning.
 - Without differentiation in each species's ecological roles, one species will be eliminated through competition for too many of the same resources.

Galapagos Island Finches

