Chapter 6
Population and Community Ecology

Nature exists at several levels of complexity

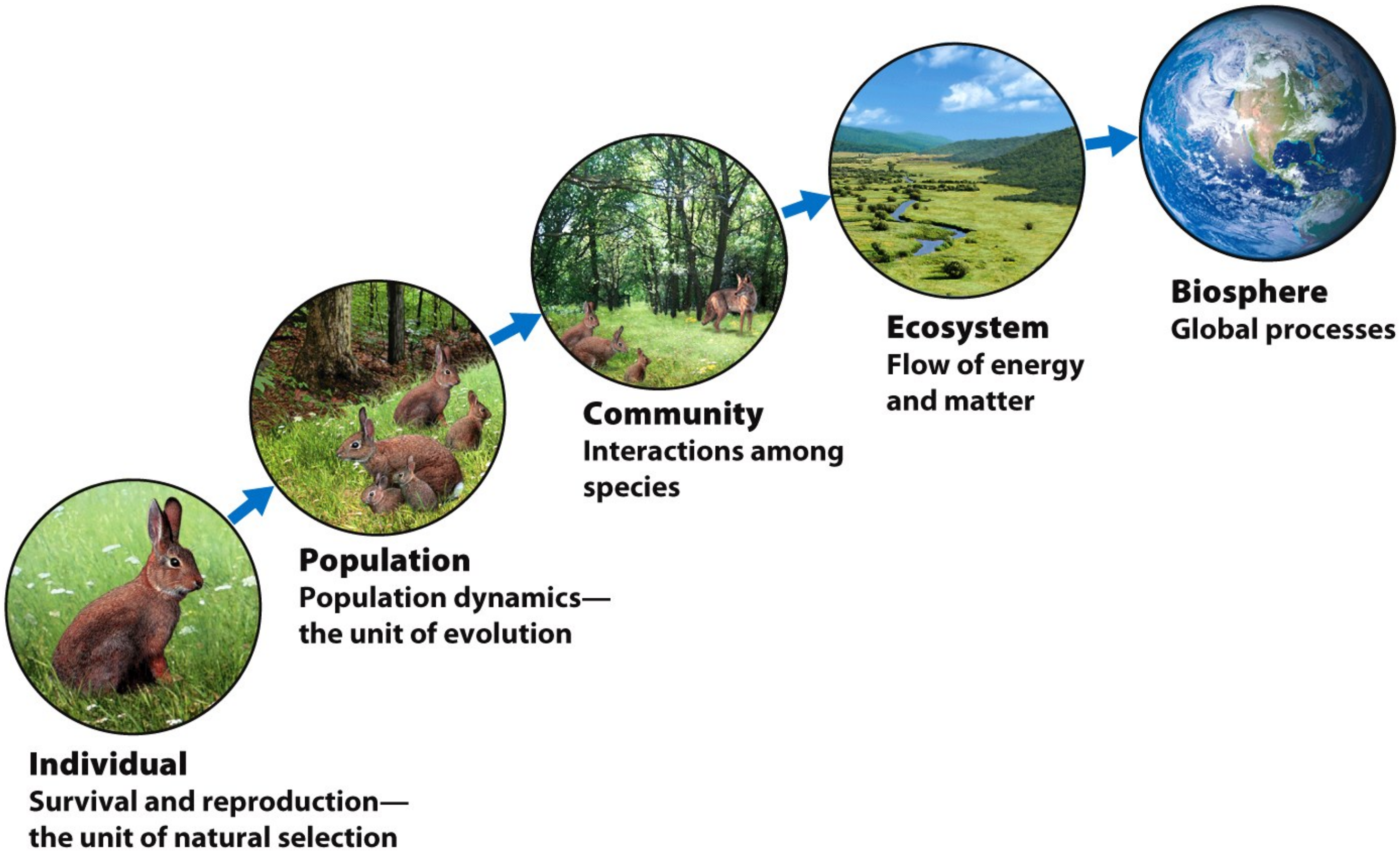

Figure 6.1
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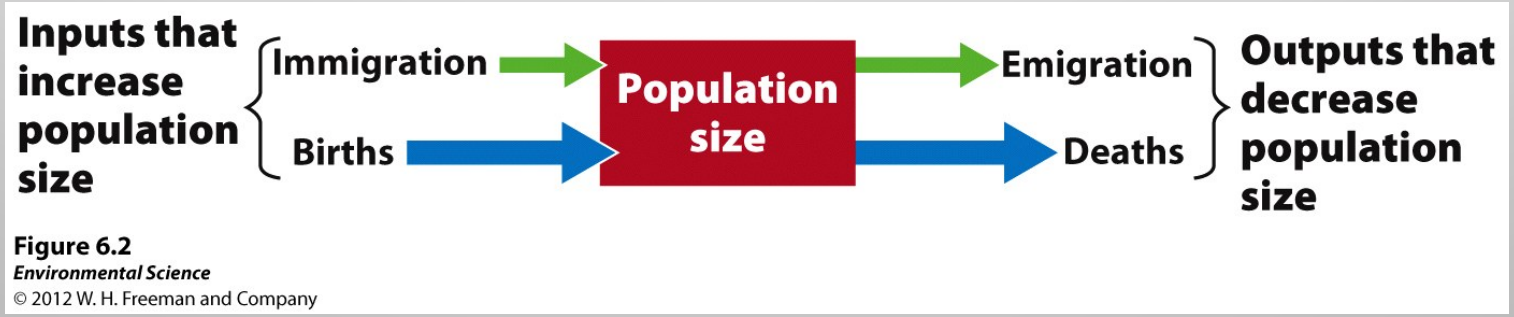
Population Ecology



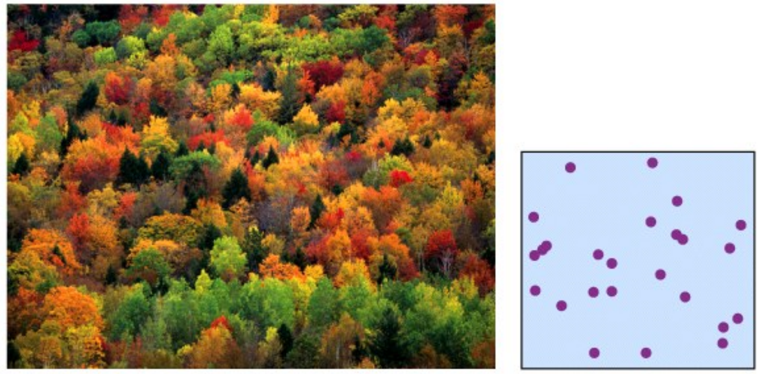
2 Laws of Population Ecology:

a) All populations have potential to grow to infinite numbers.

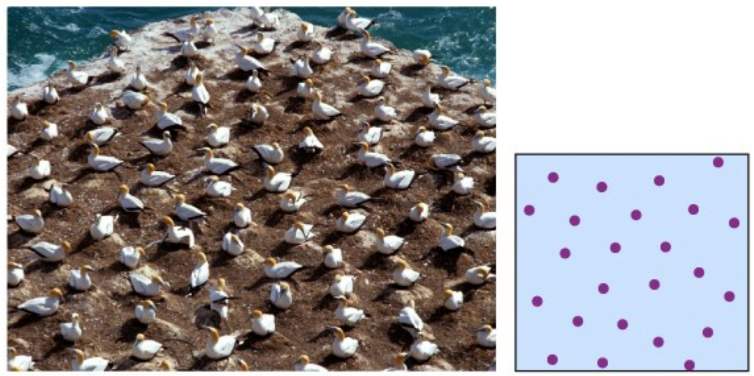
b) None do! Why do you suppose that is true?

Factors that Regulate Population Abundance and Distribution

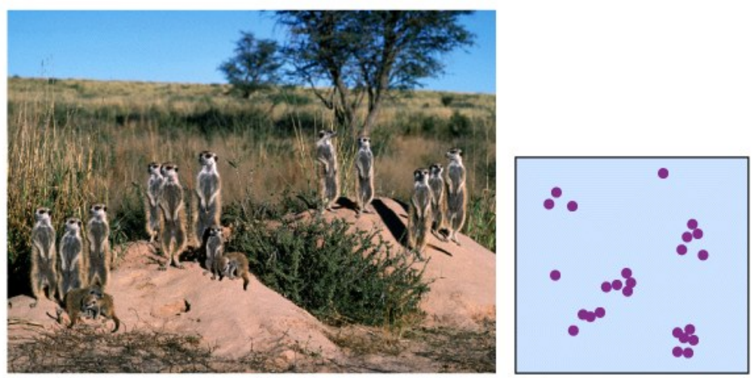
- Population size- the total number of individuals within a defined area at a given time.
- Population density- the number of individuals per unit area at a given time.
- Population distribution- how individuals are distributed with respect to one another.
- Population sex ratio- the ratio of males to females
- Population age structure- how many individuals fit into particular age categories.



(a) Random distribution



(b) Uniform distribution



(c) Clumped distribution

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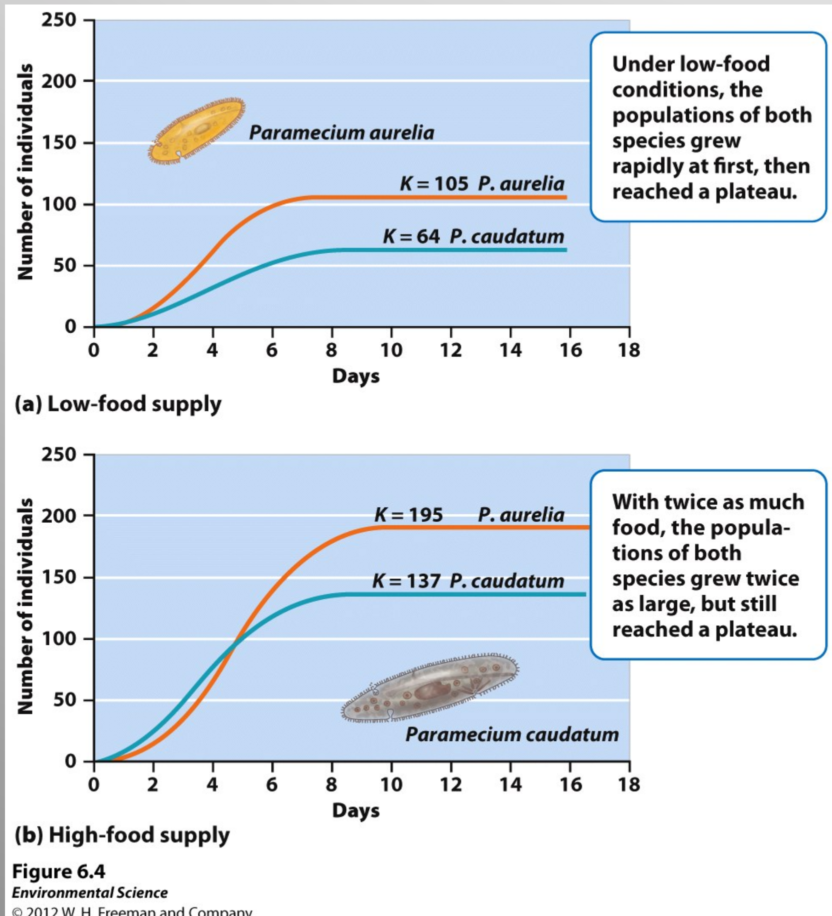
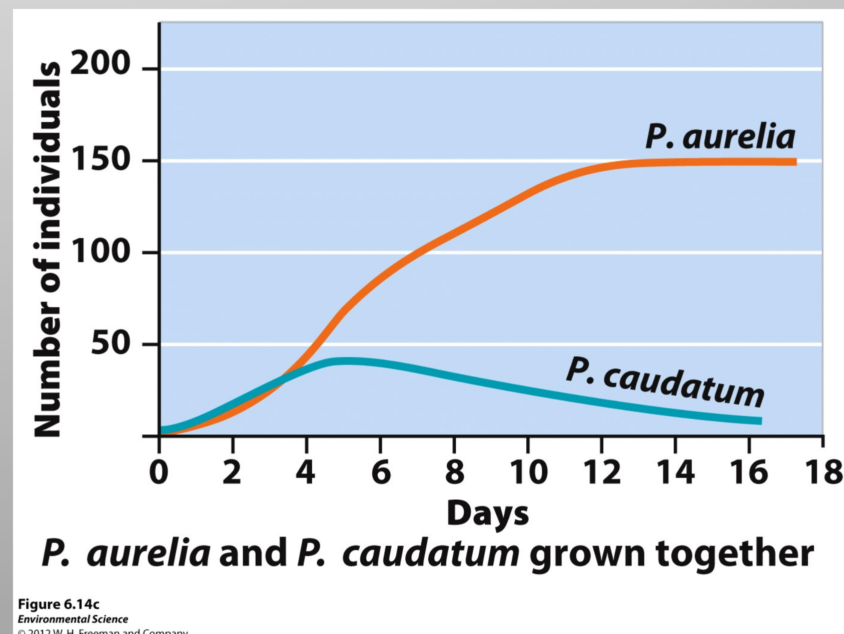
Factors that Influence Population Size

- Density-dependent factors- the size of the population will influence an individual's probability of survival.
- Examples:

Limiting resources (Limiting Factors)





Carrying Capacity

Maximum number of individuals that the environment can sustain indefinitely…

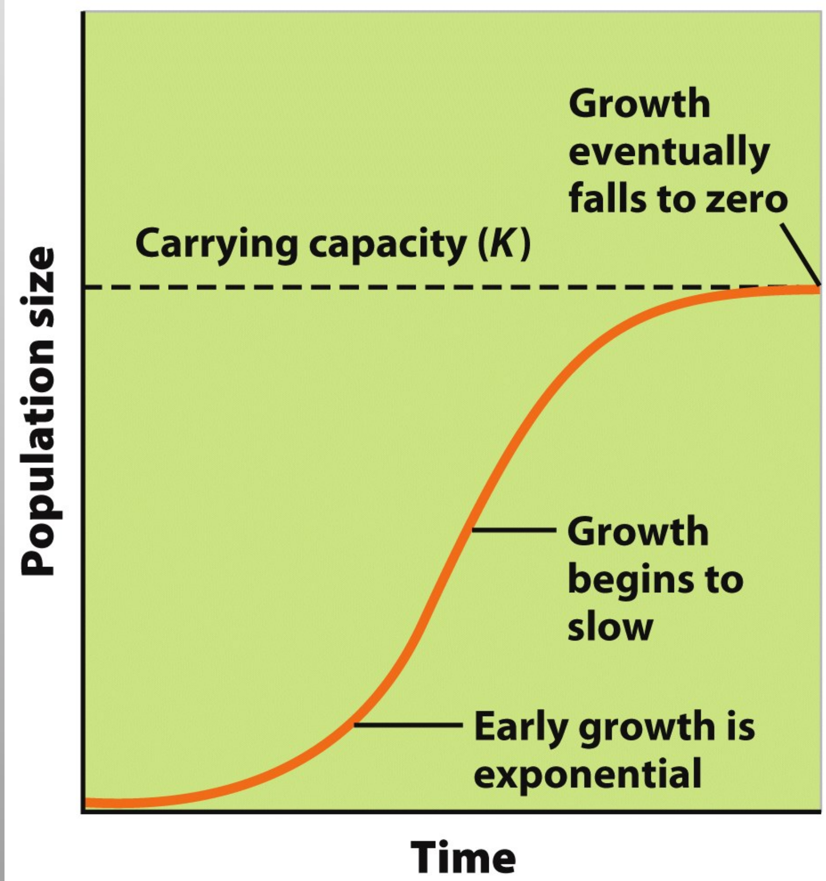


Figure 6.7
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Density-independent factors-

the size of the population has no effect on the individual's probability of survival.

Examples:

Exponential Growth Model

- Growth rate- the number of offspring an individual can produce in a given time period, minus the deaths of the individual or offspring during the same period.
- Intrinsic growth rate- under ideal conditions, with unlimited resources, the maximum potential for growth.

Exponential Growth Model

- J-shaped curve- when graphed the exponential growth model looks like this.

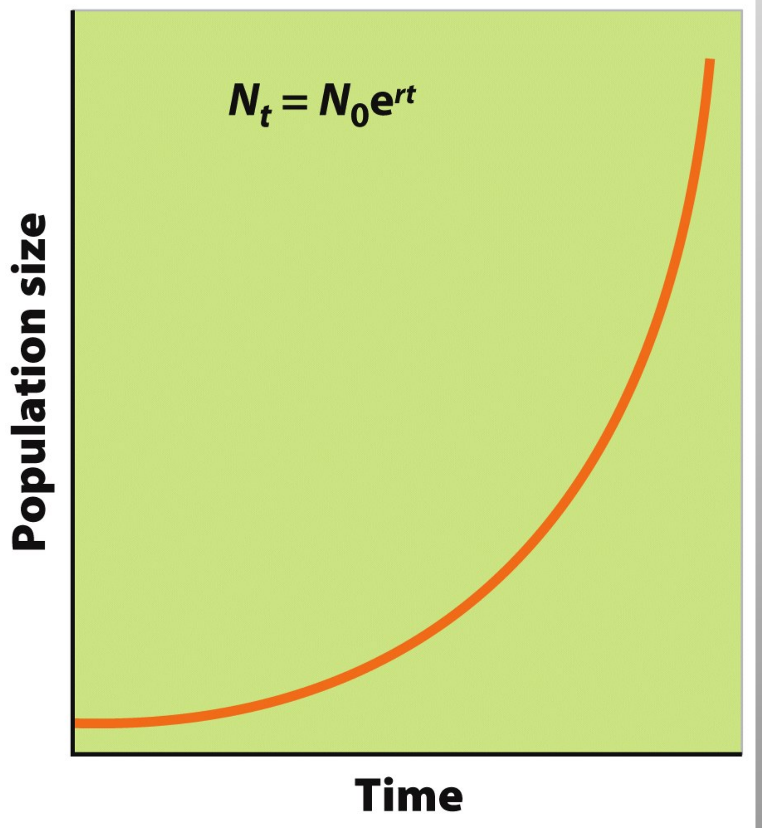

Figure 6.5
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Logistic Growth Model

- Logistic growth- when a population whose growth is initially exponential, but slows as the population approaches the carrying capacity.
- S-shaped curve- when graphed the logistic growth model produces an "S".

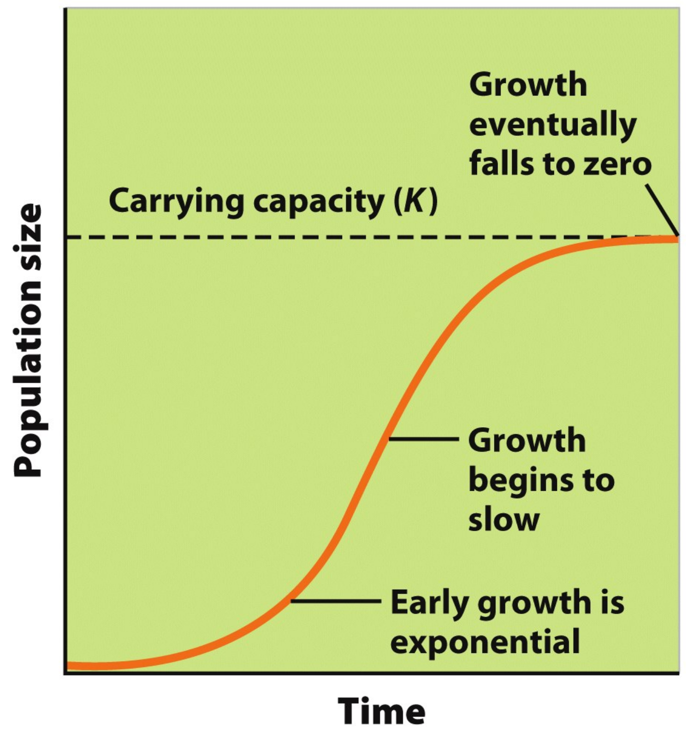

Figure 6.7
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Variations of the Logistic Model

- If food becomes scarce, the population will experience an overshoot by becoming larger than the spring carrying capacity and will result in a die-off, or population crash.

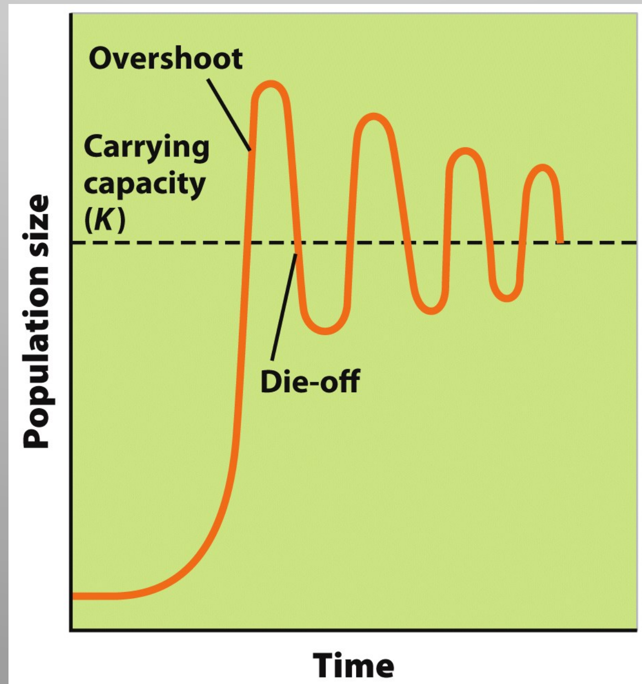

Figure 6.9
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Role of Predators
Predator-Prey Oscillations

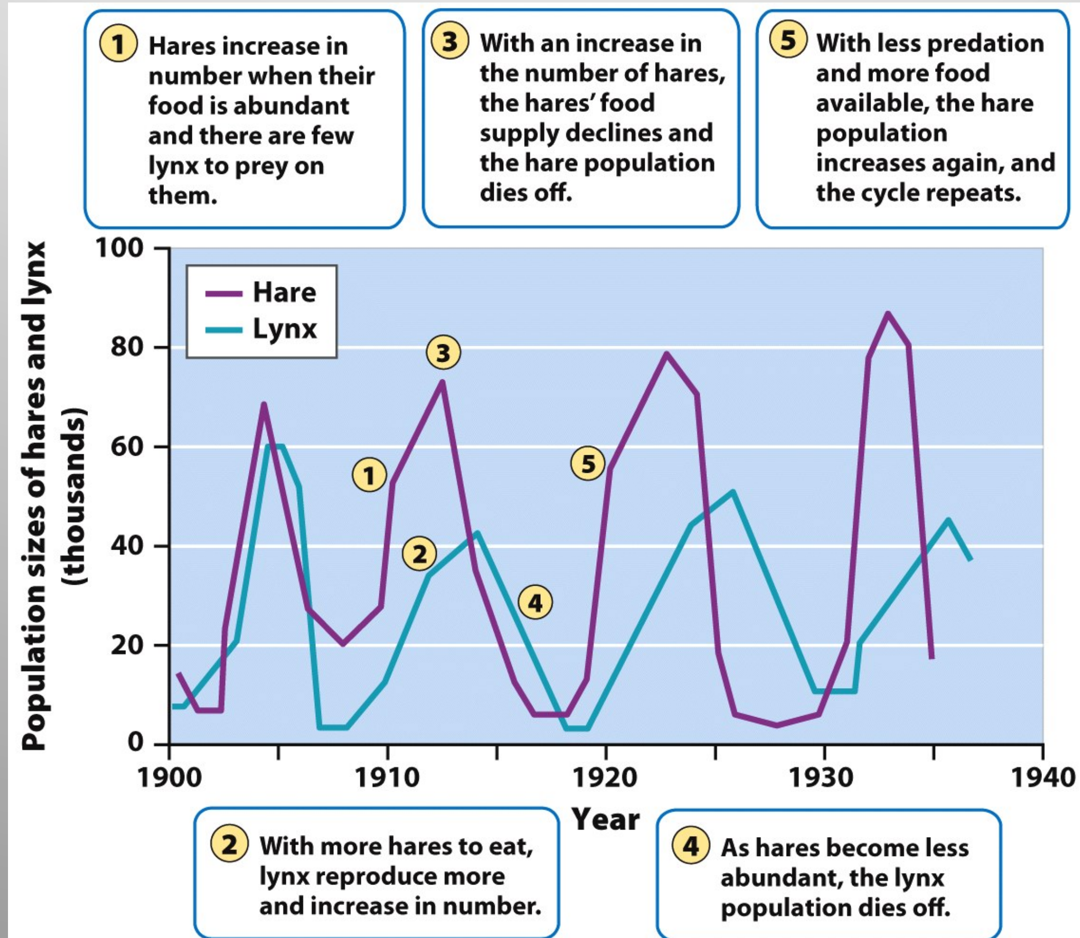

Figure 6.10
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Role of Predators
Predator-Prey Oscillations

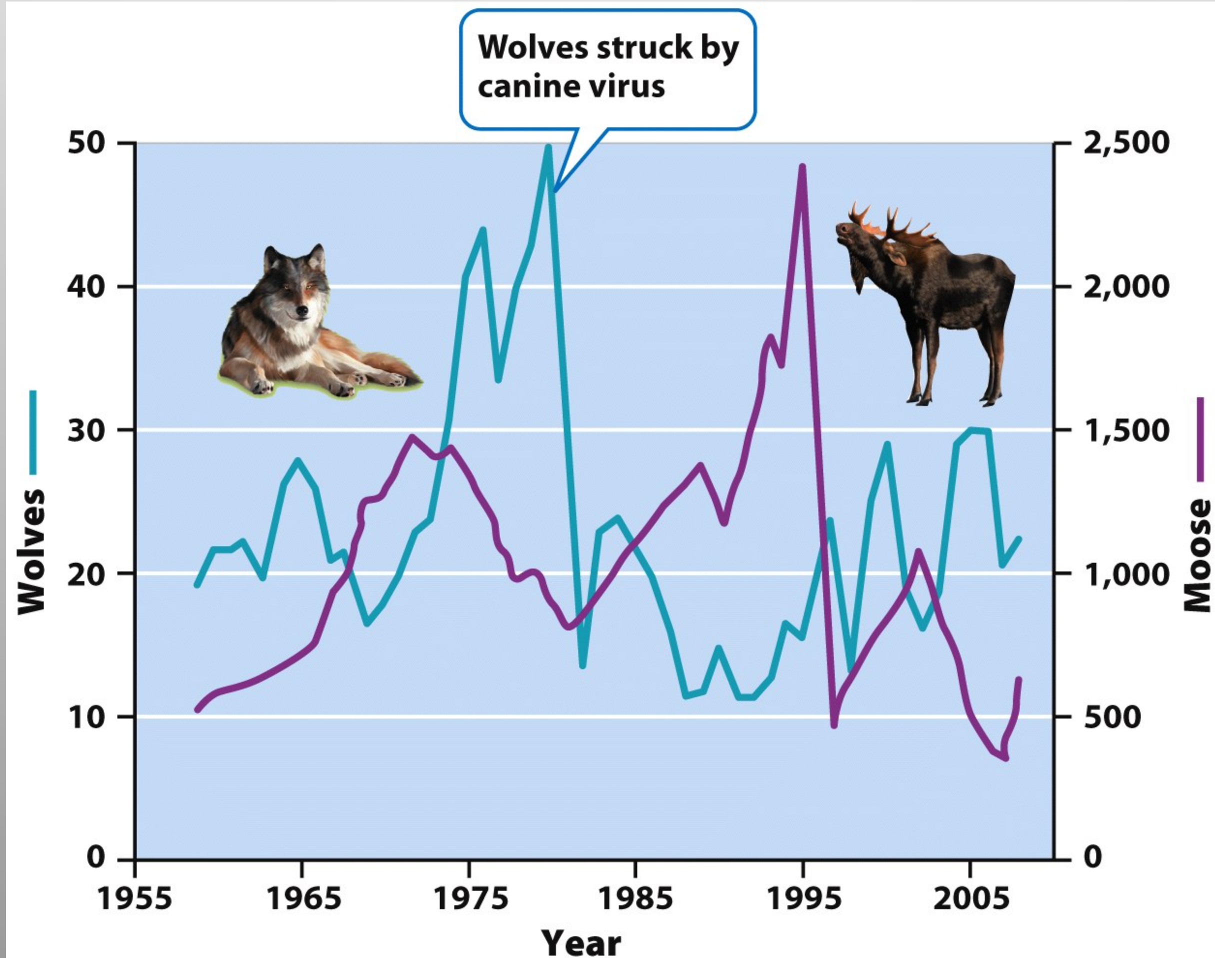

Figure 6.11
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Reproductive Strategies

- **K-selected species-** the population of a species that grows slowly until it reaches the carrying capacity. Ex. elephants, whales, and humans…many threatened species, too.
- **R-selected species-** the population of a species that grows quickly and is often followed by overshoots and die-offs. Ex. mosquitoes and dandelions…many invasive pest species, too.

TABLE 6.1 Traits of *K*-selected and *r*-selected species

Trait	*K*-selected species	*r*-selected species
Life span	Long	Short
Time to reproductive maturity	Long	Short
Number of reproductive events	Few	Many
Number of offspring	Few	Many
Size of offspring	Large	Small
Parental care	Present	Absent
Population growth rate	Slow	Fast
Population regulation independent	Density dependent	Density
Population dynamics	Stable, near carrying capacity	Highly variable

Table 6.1
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Survivorship Curves

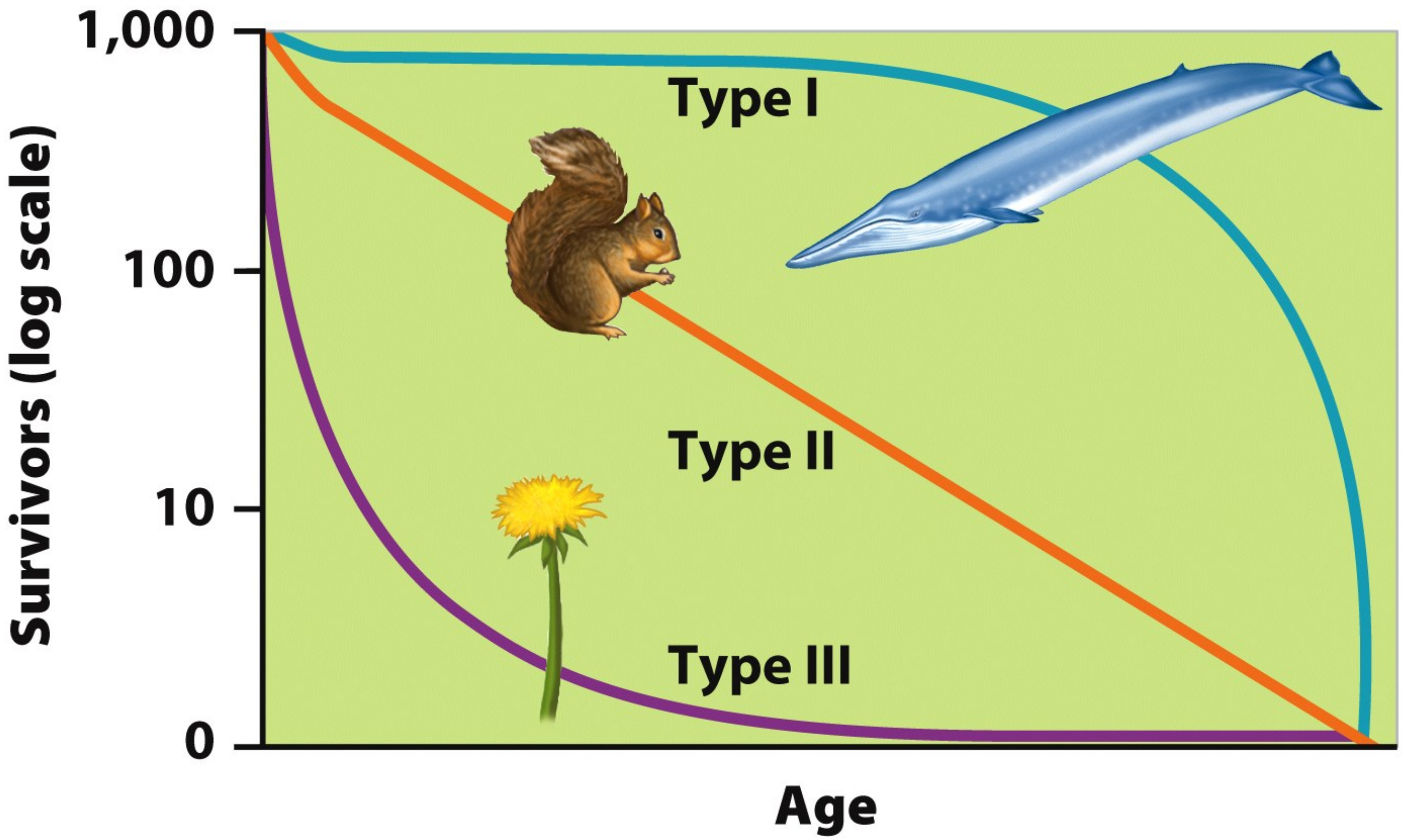

Figure 6.12
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Metapopulations

- Metapopulations- a group of spatially distinct populations that are connected by occasional movements of individuals between them.

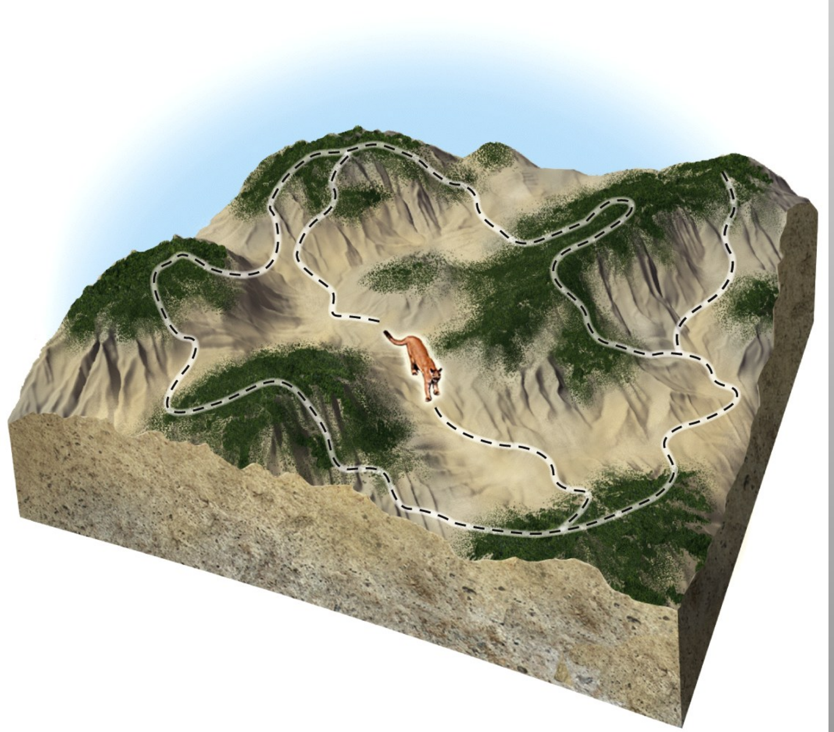

Figure 6.13
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Competition

- Competition- the struggle of individuals to obtain a limiting resource .

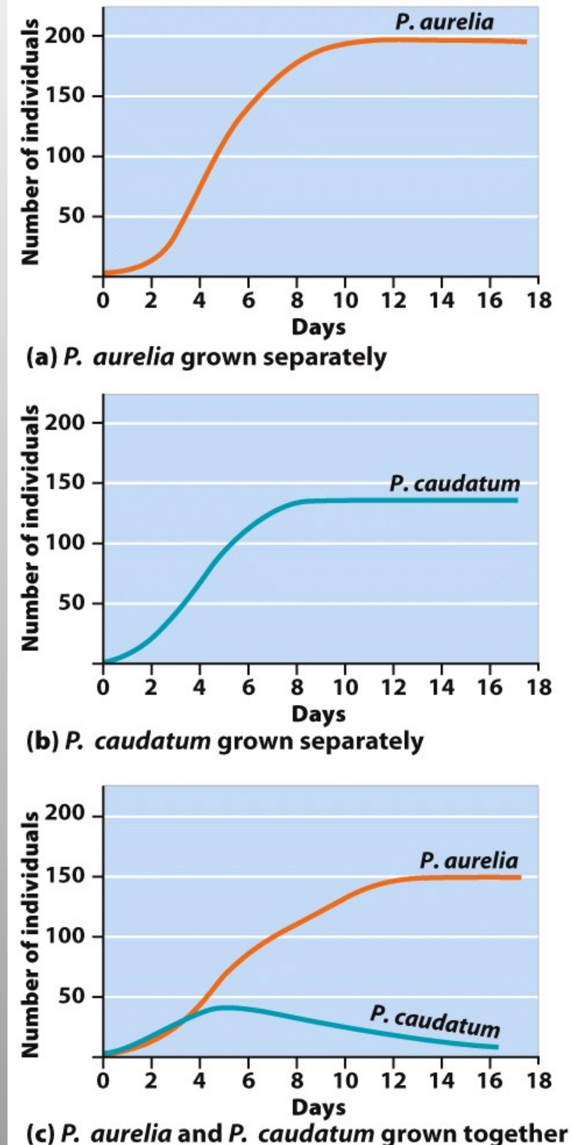

Figure 6.14
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Resource Patitioning

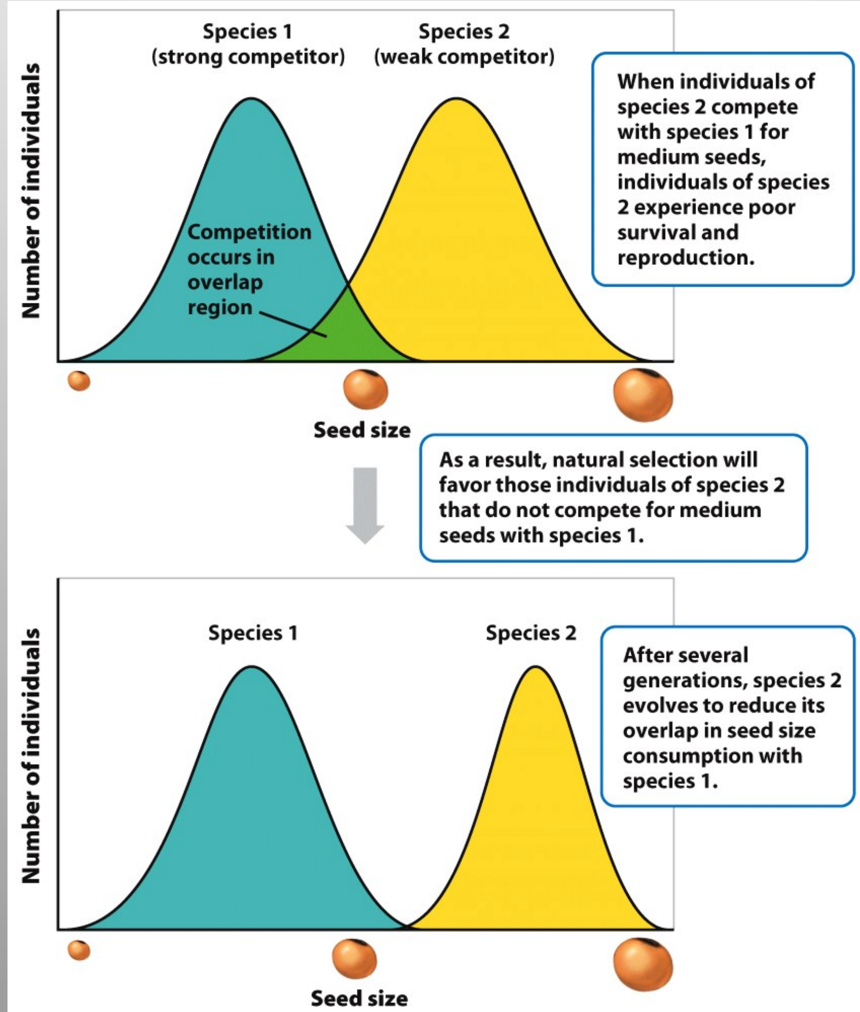

Figure 6.15
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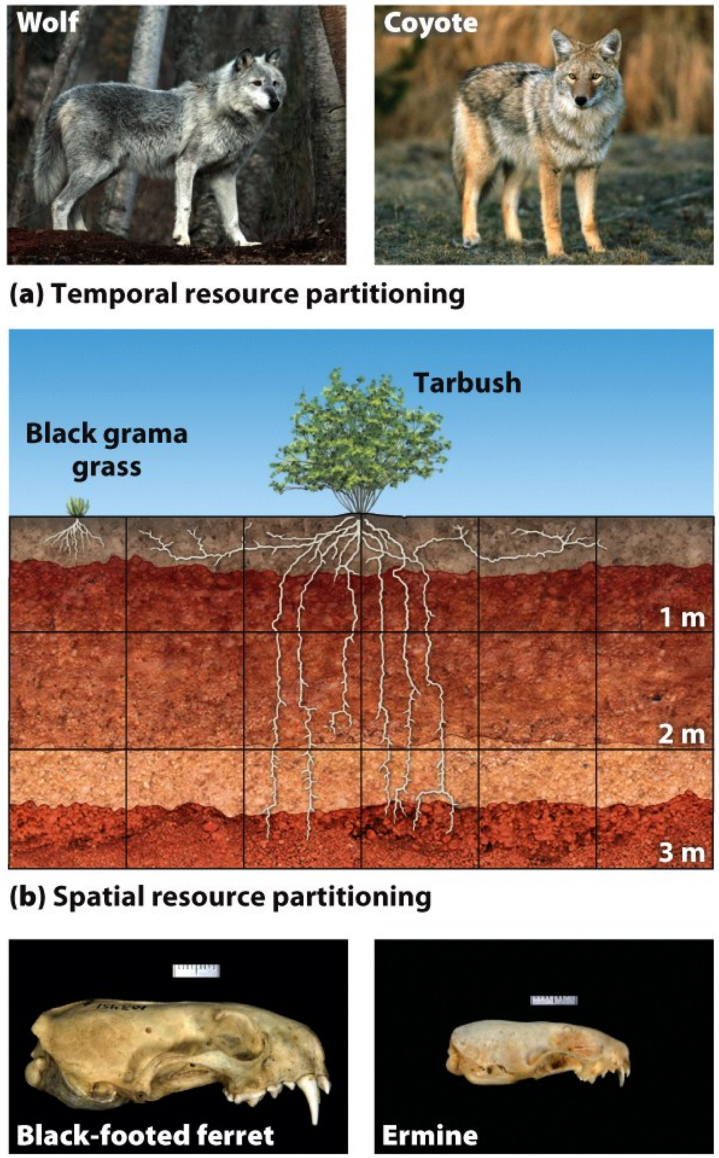

(a) Temporal resource partitioning

(b) Spatial resource partitioning

(c) Morphological resource partitioning

Figure 6.16
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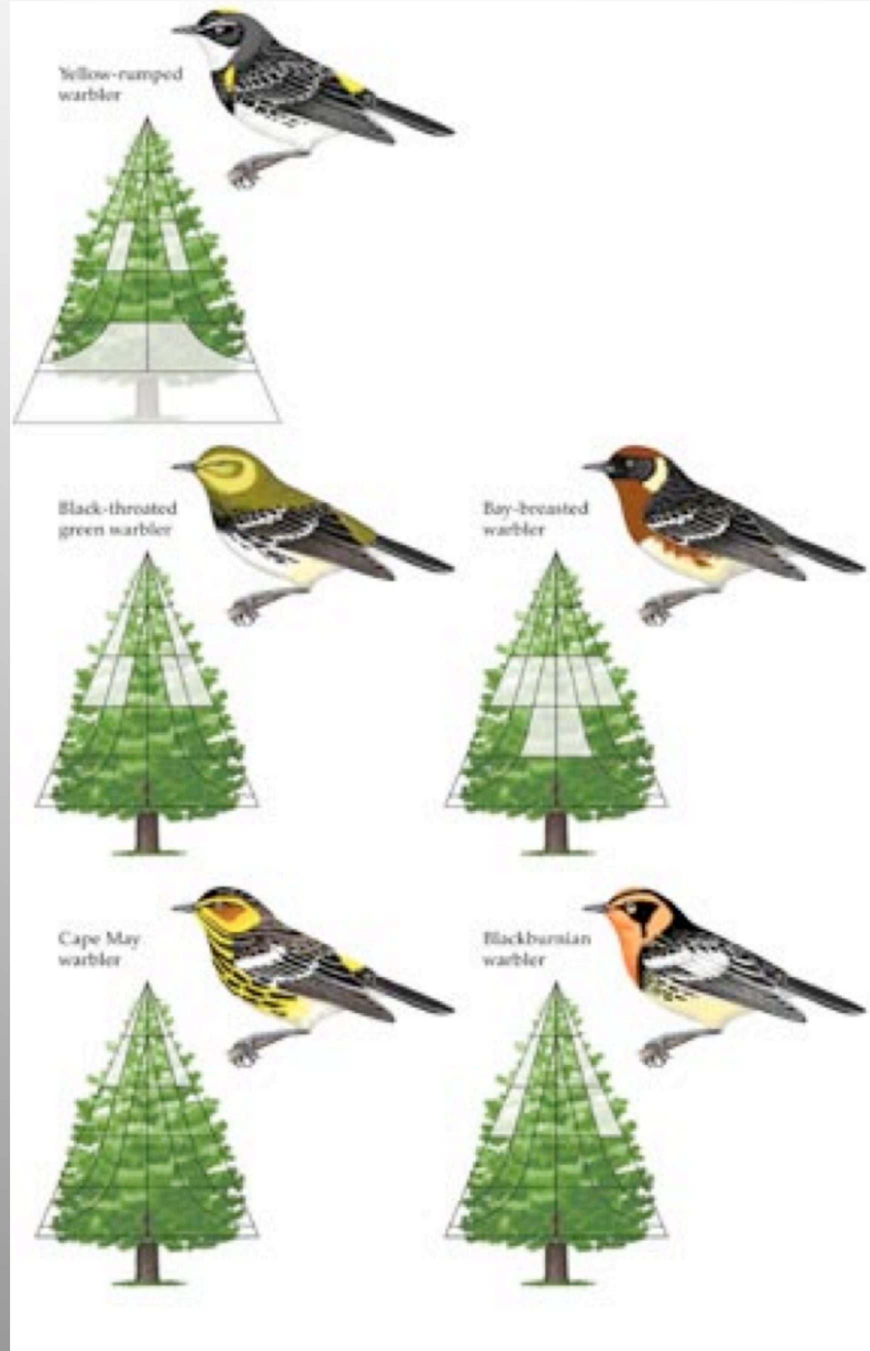

Yellow-rumped warbler
Black-throated green warbler
Bay-breasted warbler
Cape May warbler
Blackburnian warbler

Predation

- **Predation- the use of one species as a resource by another species.**
- **True predators**- kill their prey.
- **Herbivores**- consume plants as prey.
- **Parasites**- live on or in the organism they consume.
- **Parasitoids**- lay eggs inside other organisms.

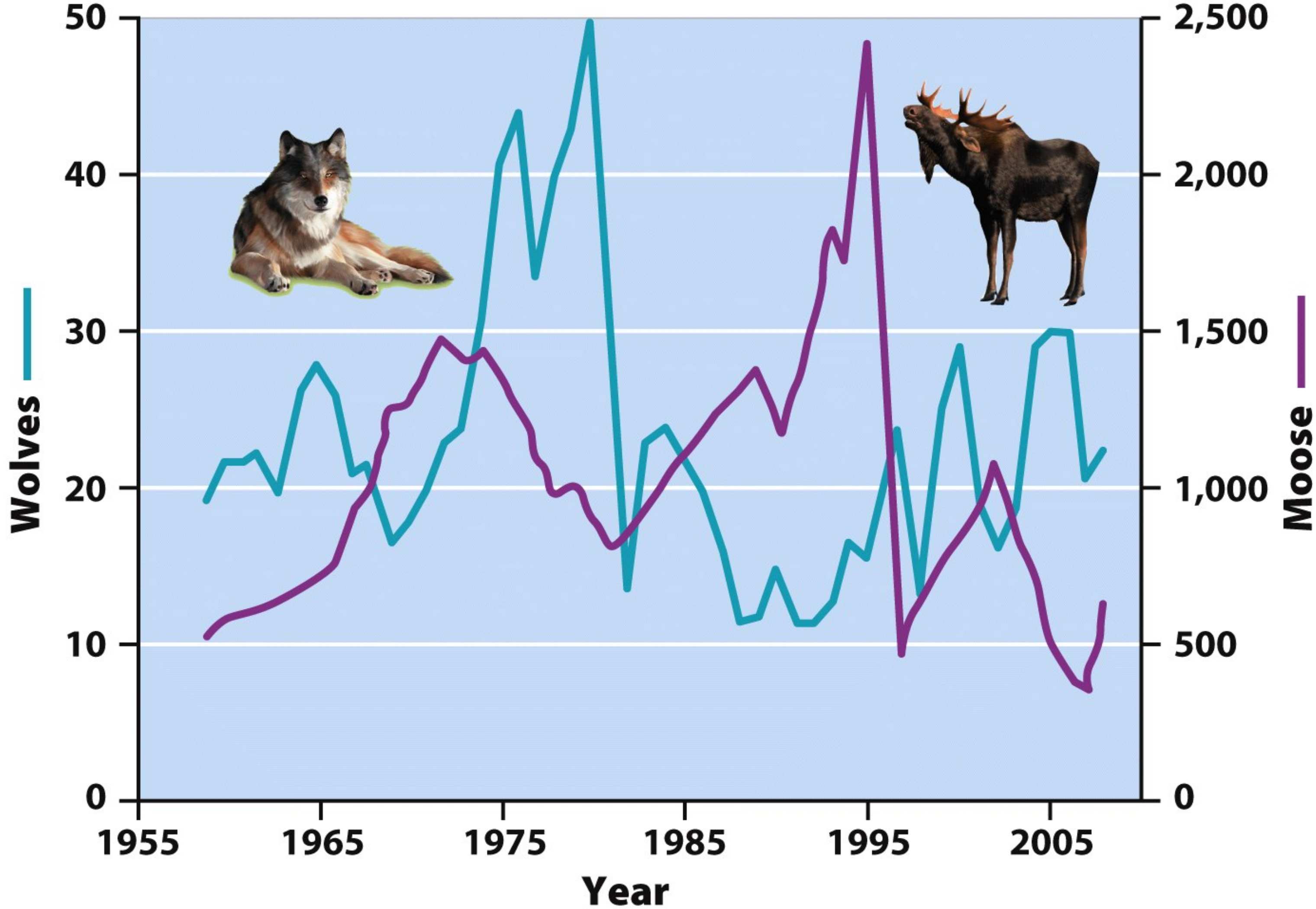

Figure 6.11 part 1
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Symbiosis - Mutualism

- **Mutualism**- A type of interspecific interaction where both species benefit.

Figure 6.18
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Figure 6.18 (inset)
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Symbiosis - Commensalism

- **Commensalism**- a type of relationship in which one species benefits but the other is neither harmed nor helped.

TABLE 6.2 **Interactions between species and their effects**

Type of interaction	Species 1	Species 2
Competition	–	–
Predation	+	–
Mutualism	+	+
Commensalism	+	0

Table 6.2
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Symbiosis - Parasitism

Keystone Species

- **Keystone species-** a species that plays a role in its community that is far more important than its relative abundance might suggest.

Figure 6.22 (inset)
Environmental Science

Figure 6.22
Environmental Science

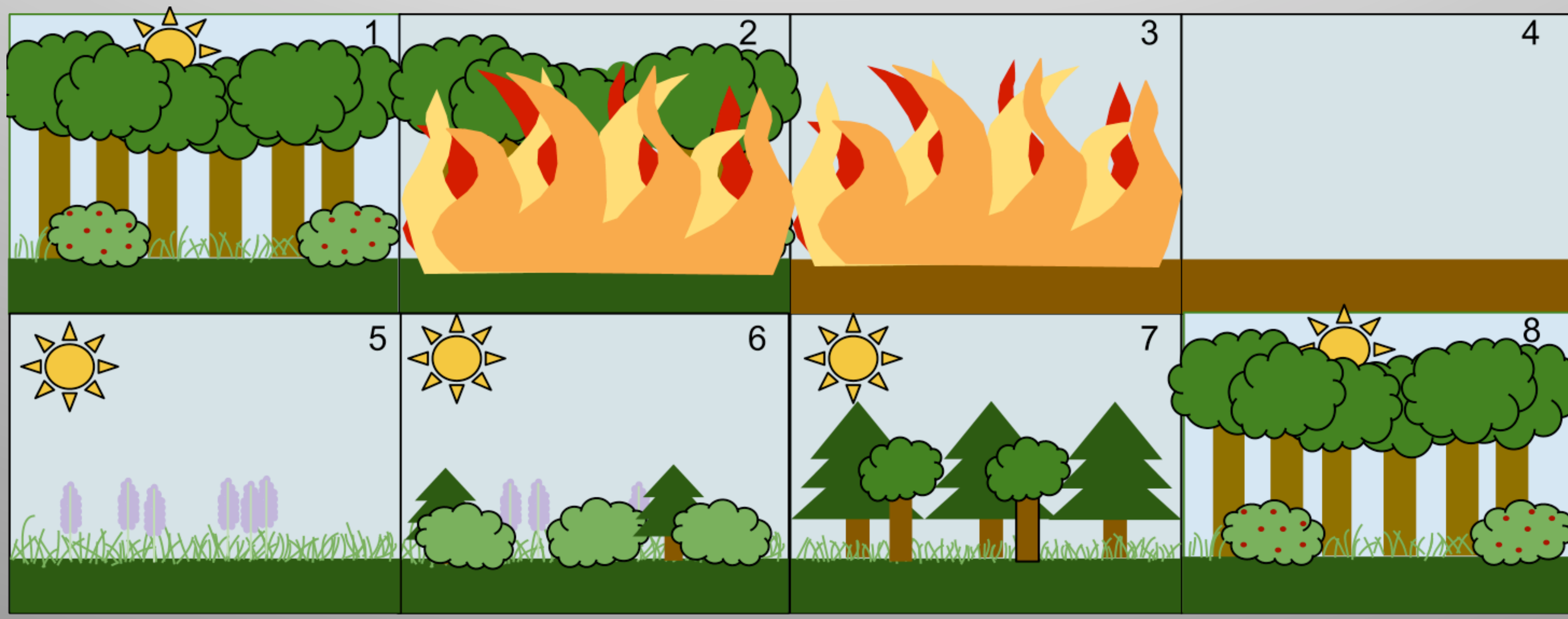
Roles of Keystone Species

Population Control
Pollination
Habitat Modification
Seed Dispersal
Nutrient Cycling
Help plants obtain nutrients/water

Come up with examples for each:

Ecological Succession

Changes in Community Structure Over Time



Primary Succession

- **Primary succession**- occurs on surfaces that are initially devoid of soil.

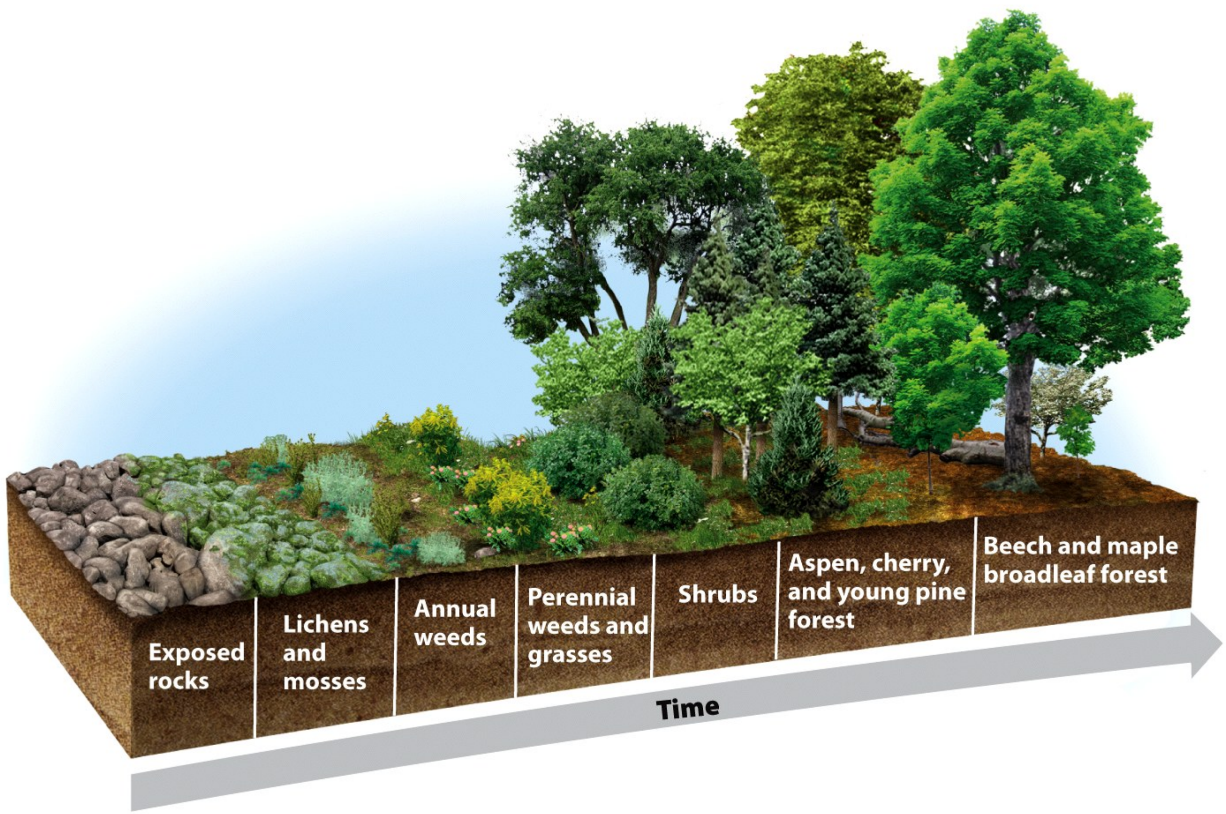


Figure 6.23
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Primary Succession

On newly cooled lava

On bare rock surface

Secondary Succession

- **Secondary succession**- occurs in areas that have been disturbed but have not lost their soil.

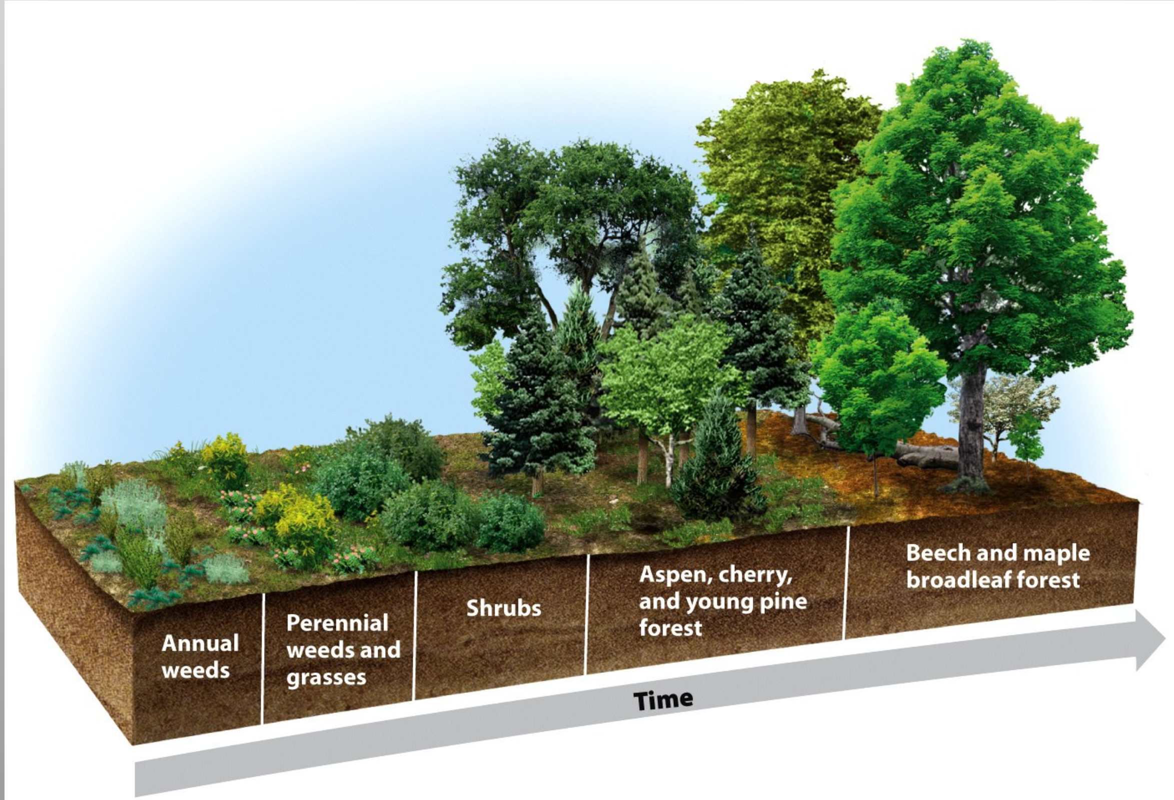

Figure 6.24
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Secondary Succession

After a fire

After deforestation

Secondary Succession on Abandoned Farmland

Aquatic Succession

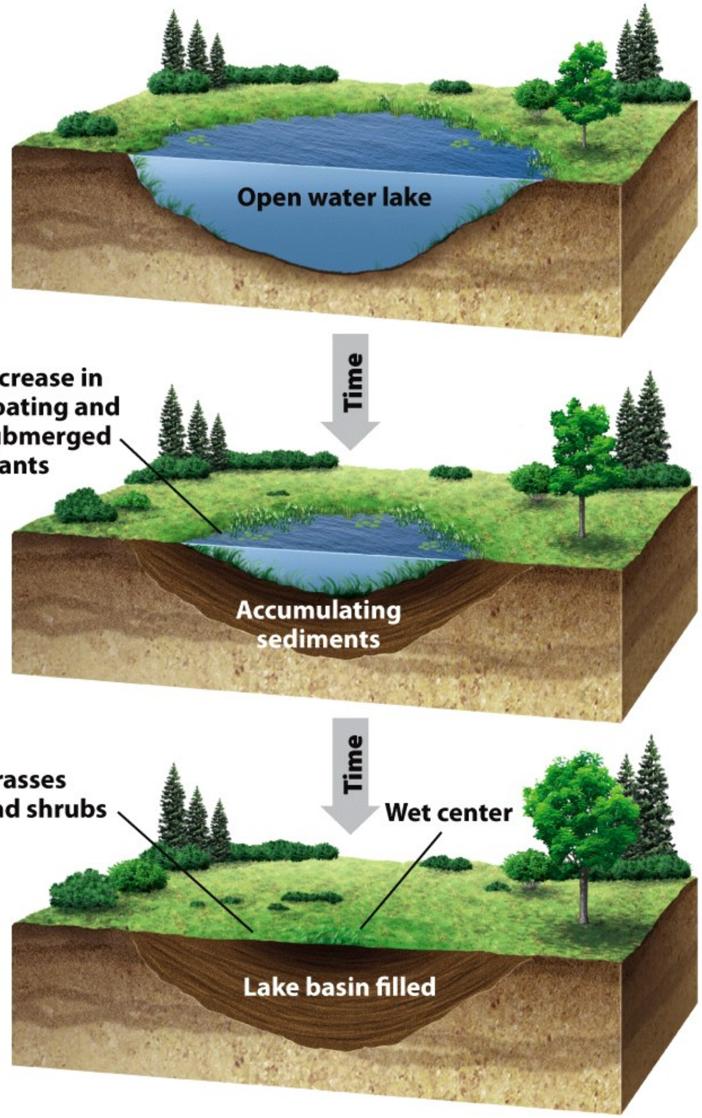

Figure 6.25
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Succession in a Pond

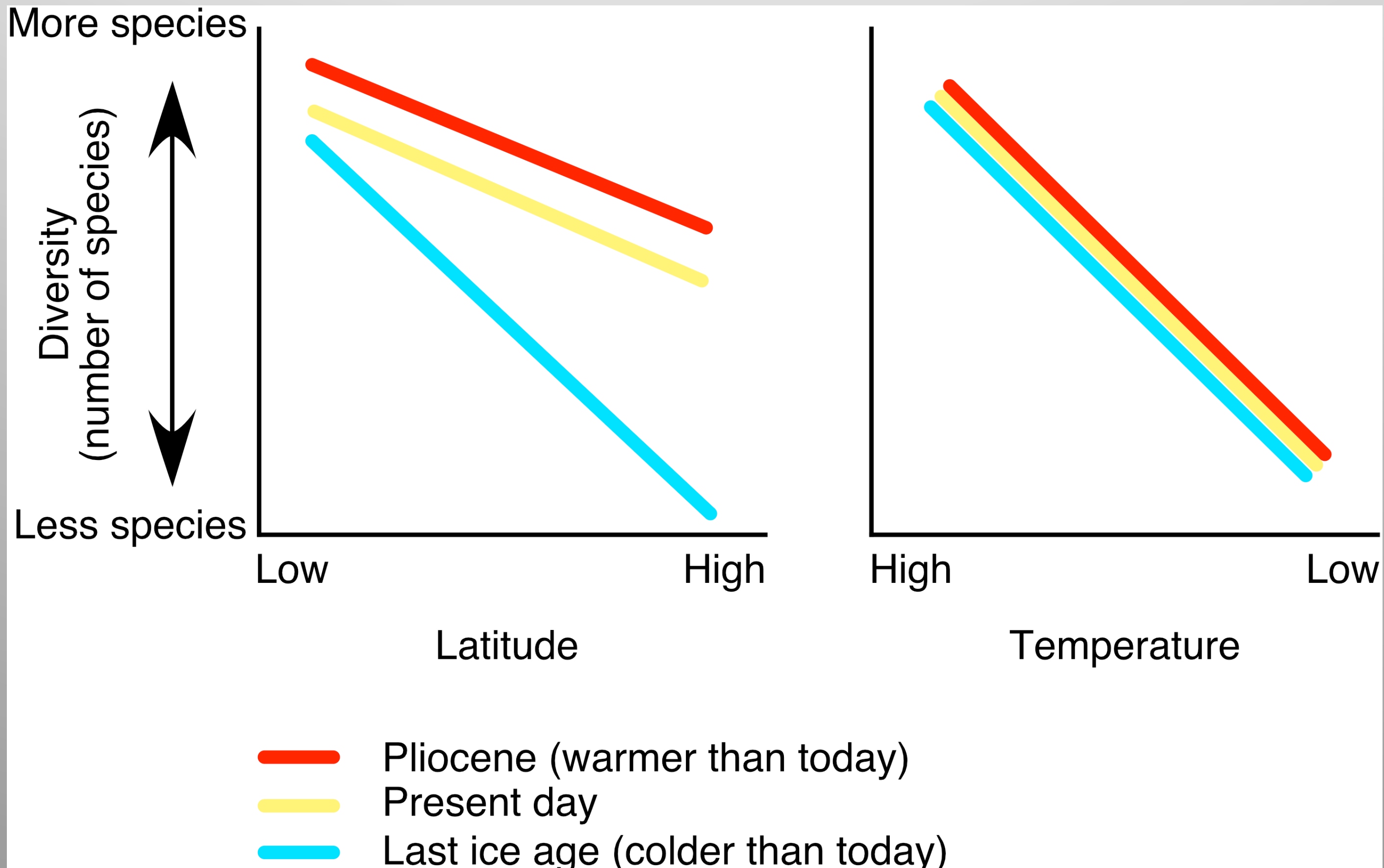
Processes that determine species richness:

Colonization by new species

Speciation events

Extinction in the area

Effect of Latitude on Species Richness

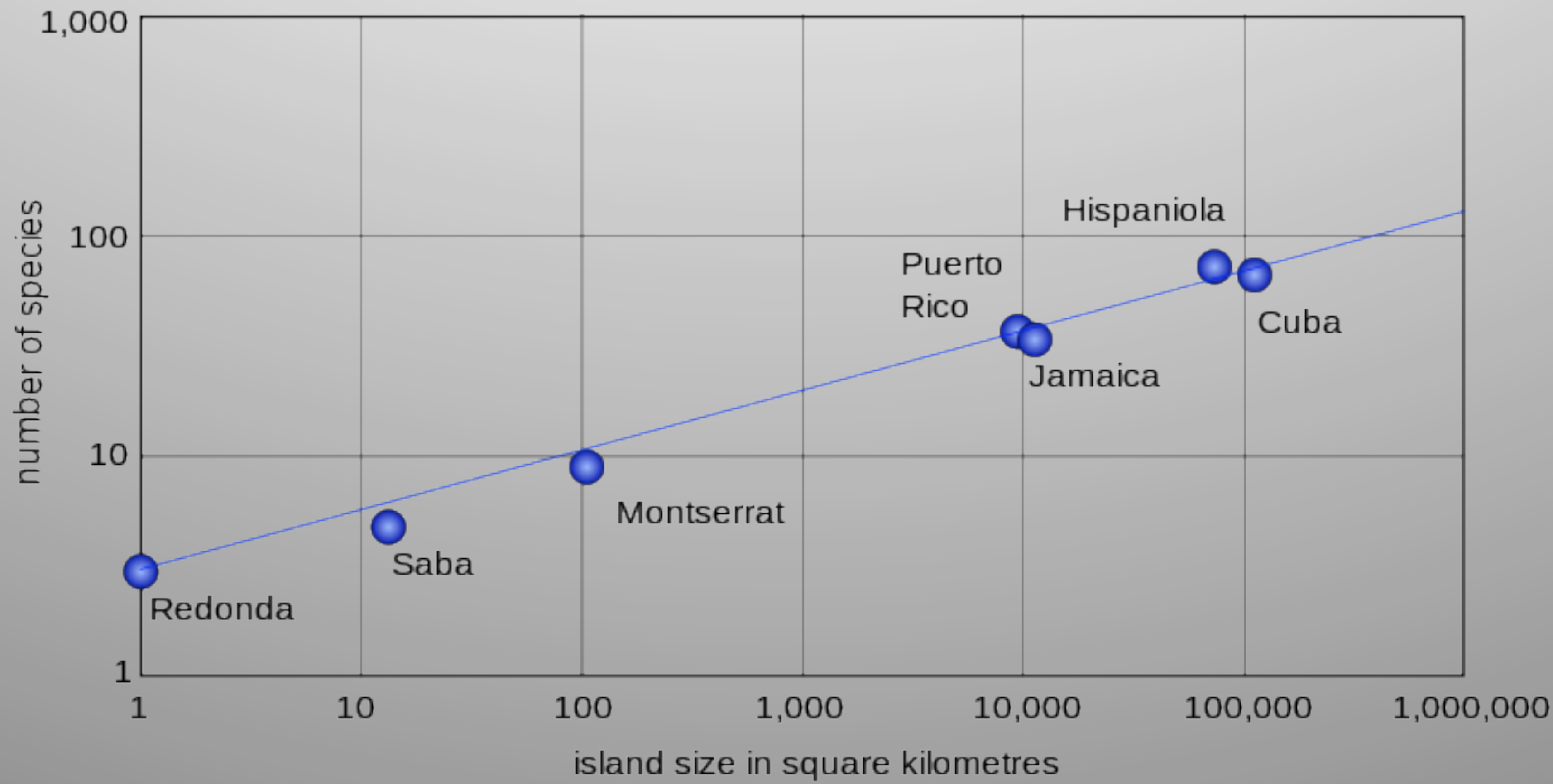


Effect of Time on Species Richness

Lake Baikal
25 million yrs
580 invert. Sp.

Slave Lake, Canada
<100,000 yrs
4 invert. Sp.

Effect of Habitat Size and Distance from Mainland



Theory of Island Biogeography

- Theory of island biogeography- the theory that explains that both habitat size and distance determine species richness.

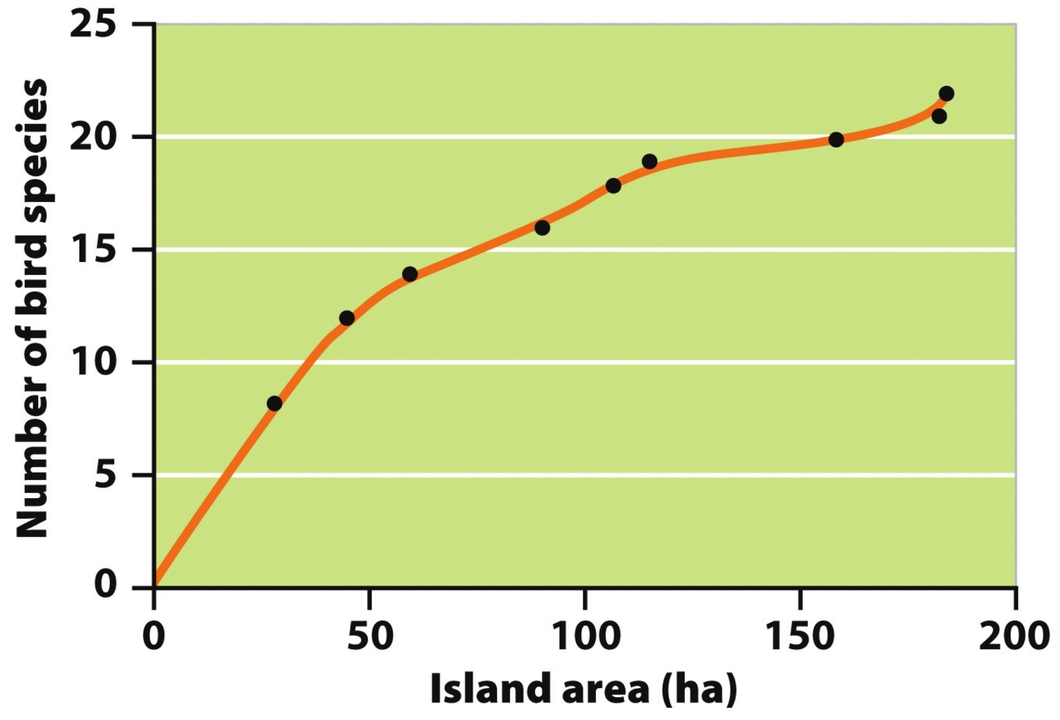


Figure 6.26
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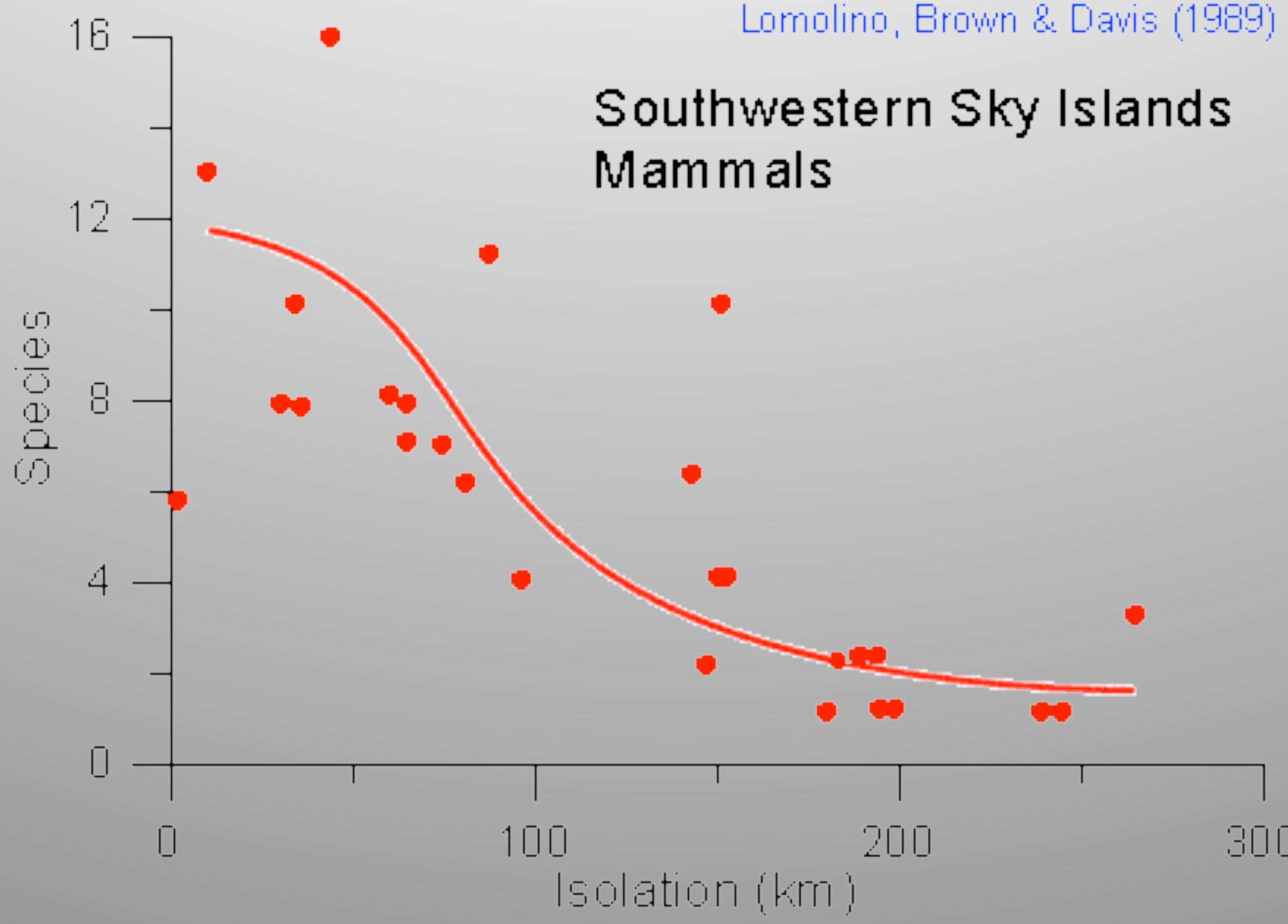
Effect of Habitat Size and Distance from Mainland



Island Biogeography applied to Fragmented Habitat

Island Biogeography applied to Fragmented Habitat

Y2Y Corridor

Sustainability
Bringing back the Black-Footed Ferret

Sustainability…trying to do the right thing

Unintended Consequences

Minimum Viable Population (MVP)