

## Chapt. 53 – Community Ecology

**Community** – the populations that co-occur in a given place at a given time [Fig. 53.11]

Important **static properties** of a community:

**Species richness** = the number of species

**Relative abundance** = relative commonness vs. rarity of species

**Species diversity** = an integrated measurement of species richness plus relative abundance

**Community Ecologists** study communities by asking:

What ecological and evolutionary processes organize and structure communities (*e.g.*, what types of species are present and what types of interactions exist among species)?

Why do communities vary in species composition, species diversity, and other aspects of community organization and structure?

### Individualistic vs. Integrated Structure

A debate raged in the early 20th century between **Gleason's "individualistic" hypothesis** vs. **Clements' "integrated" hypothesis** [Fig. 53.29]

#### Gleason's "individualistic" hypothesis:

Species occur in a given area because they share similar abiotic (*e.g.*, habitat) requirements

#### Clements' "integrated" hypothesis:

Species are locked into communities through mandatory biotic interactions  
Communities viewed as "superorganisms"

**Gleason's "individualistic" hypothesis** for community organization has received the most support from field-based studies

Nevertheless, species interactions are important components of community dynamics

## INTERSPECIFIC INTERACTIONS [See Table on pg. 5 of the chapter outline]

**Mutualism (+/+)** *E.g.*, ant-acacias and acacia-ants

Traits of species often evolve as a result of **interspecific interactions**

One species may evolve traits that benefit that species in its interactions with another species

**Coevolution** occurs when two species reciprocally evolve in response to one another

**Pollination (+/+)** (Usually a type of mutualism)

**Frugivory & Seed Dispersal (+/+)** (Usually a type of mutualism)

**Predation (+/-)** Striking adaptations often characterize predators and their prey

**Crypsis** Predators may evolve cryptic morphology; prey may evolve cryptic morphology

**Aposematism** Prey may evolve **aposematic (warning)** morphology

**Mimicry** Organisms may evolve to look like other organisms

**Batesian mimicry** – innocuous **mimic** evolves to look like harmful **model**

*E.g.*, monarch and viceroy

**Mullerian mimicry** – two harmful mimics evolve convergently toward a common morphology, *e.g.*, cuckoo bee and yellow jacket

**Herbivory (+/-)** Feeding (sometimes predation) by animals on plants

**Parasitism (+/-)**

**Parasites** derive nourishment from their **hosts**, whether they live inside their **hosts** (**endoparasites**, *e.g.*, tapeworm) or feed from the external surfaces of their **hosts** (**ectoparasites**, *e.g.*, tick)

**Parasitoidism (+/-)**

**Parasitoids** lay eggs on living hosts and their larvae eventually kill the host

**Commensalism (+/0)** *E.g.*, mites hitching a ride on a beetle

**Amensalism (-/0)**

Common, but not considered an important process structuring communities; *e.g.*, elephant stepping on ants

**Neutralism (0/0)**

Common, but not considered an important process structuring communities; *e.g.*, hummingbirds and earthworms (they never interact with one another)

**Competition (-/-)** Organisms often compete for limiting resources

*E.g.*, smaller plants are shaded by larger plants

*E.g.*, barnacles compete for space on rocky intertidal shores [Fig. 53.2]

**Fundamental niche** – an organism’s “address” (**habitat**) and “occupation” in the absence of biotic enemies

**Realized niche** – an organism’s “address” (**habitat**) and “occupation” in the presence of biotic enemies

**Competitive Exclusion Principle**

Two species cannot coexist if they occupy the same niche

“Close competitors cannot coexist”; *e.g.*, the barnacles [Fig. 53.2] do not coexist where their fundamental niches overlap

**Competition** between two species with identical niches results either in **competitive exclusion** or the evolution of **resource partitioning**

**Resource partitioning** may result from **character displacement** [Fig. 53.3 & 53.4]

### Food Chains

Species interact through **trophic (food) chains** [Fig. 53.12]

"So, the naturalists observe, the flea,  
Hath smaller fleas that on him prey;  
And these have smaller still to bite 'em;  
And so proceed, *ad infinitum*"  
Jonathan Swift (1667-1745)

"Great fleas have little fleas  
Upon their backs to bite 'em  
And little fleas have lesser fleas,  
And so *ad infinitum*"  
DeMorgan (1915)

The length of food chains is rarely > 4 or 5 trophic levels long [Fig. 53.15]  
The main reason follows from the Laws of Thermodynamics:  
Energy transfer between trophic levels is only ~10% efficient

### Food Webs

**Food chains** combine into **food webs** [Fig. 53.13]: Who eats whom in a community?

### Relative Abundance, Dominance, and Keystone Species

**Relative abundance** = relative **commonness** vs. **rarity**

**Dominance** = relative contribution to the **biomass** of a community

Sometimes **exotic species** become deleteriously dominant

**Keystone species** influence community composition more than expected by their relative abundance or biomass

Removing a keystone species has a much greater effect on community structure than expected by its relative abundance or biomass [Fig. 53.16]

### Top-Down vs. Bottom-Up Control

Debates continue regarding the relative importance of top-down vs. bottom-up control on community organization [Fig. 53.12]

Both are important influences in most communities

### Disturbance

A discrete event that damages or kills resident organisms

*e.g.*, **non-catastrophic** treefall gap

*e.g.*, **catastrophic** volcanic eruption

*e.g.*, fire [Figs. 53.21 & 53.22]

*e.g.*, anthropogenic habitat destruction

### Ecological Succession

Changes in species composition following a disturbance in which organisms good at dispersing and growing quickly are replaced by organisms good at surviving under crowded (competitive) conditions

### Primary Succession

Begins from a virtually lifeless starting point (a **catastrophic disturbance**)

## Secondary Succession

Follows a **non-catastrophic disturbance**

Example of primary succession: retreating glaciers in Alaska [Figs 53.23 & 53.24]

Early species may **inhibit** later species; *e.g.*, plant toxins

Early species may **facilitate** later species; *e.g.*, nitrogen-fixing plants

Early species may **tolerate** later species; *i.e.*, the early species neither help nor hinder the colonization of later species

Species diversity generally increases as ecological succession proceeds

Successional stage differences give rise to differences in species diversity from place-to-place

## Intermediate Disturbance Hypothesis (IDH)

Another reason for species diversity differences from place-to-place is the disturbance regime

IDH postulates highest levels of diversity in places with intermediate levels of disturbance

## Species-Area Relationship

The larger the geographic area sampled, the more species found; primarily because larger areas offer a greater diversity of **habitats** and **microhabitats** [Fig. 53.26]

Characterizes **island archipelagos** [Fig. 53.28]

Characterizes **habitat “islands”**

The influence of both **area** and **isolation** on species richness

Larger area = more species

Less isolation = more species

## Island Biogeography Theory E. O. Wilson & Robert MacArthur (1967) [Fig. 53.27]

The **immigration-extinction balance** on islands contributes to the species-area relationship  
Smaller islands have fewer species than larger islands, since immigration rates are lower, and extinction rates are higher on smaller islands

More isolated islands have fewer species than less isolated islands, since immigration rates are lower on more isolated islands

## Diversity Gradients

Species diversity generally increases as one moves from the poles towards the equator

Historical explanations concern latitudinal gradients in biogeographic history

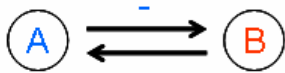
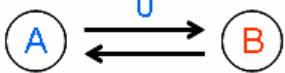
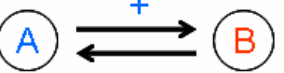






Current-day process explanations concern latitudinal gradients in ecological processes

## Diversity-Productivity Relationship

Current-day processes that create a latitudinal gradient in energy availability appear to contribute to the latitudinal gradient in diversity [Fig. 53.25]

**INTERSPECIFIC INTERACTIONS**

**Influence of species A**

		- (negative)	0 (neutral/null)	+ (positive)
Influence of Species B	-	 <p>Competition</p>	 <p>Amensalism</p>	 <p>Antagonism (Predation/Parasitism)</p>
	0	 <p>Amensalism</p>	 <p>Neutralism (No interaction)</p>	 <p>Commensalism</p>
	+	 <p>Antagonism (Predation/Parasitism)</p>	 <p>Commensalism</p>	 <p>Mutualism</p>