Chapter 4
Communities

Liebig's limit: The single factor in shortest supply relative to demand is the critical determinant in the distribution.

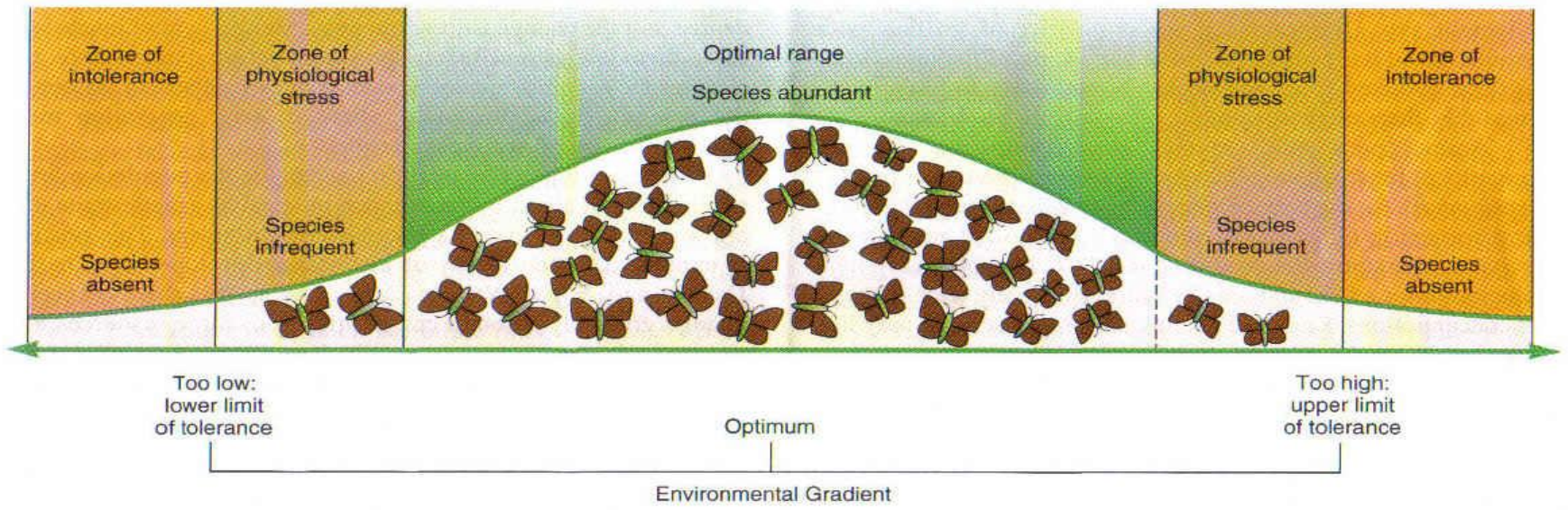


FIGURE 4.2 The principle of tolerance limits states that for every environmental factor, an organism has both maximum and minimum levels beyond which it cannot survive. The greatest abundance of any species along an environmental gradient is around the optimum level of the critical factor most important for that species. Near the tolerance limits, abundance decreases because fewer individuals are able to survive the stresses imposed by limiting factors.

Victor Shelford: Each environmental factor has both minimum & maximum limits beyond which the species can't survive. The single factor closes to these survival limits is the **critical limiting factor.**

Natural Selection- members of a <u>population</u> that are best suited for a particular set of environmental conditions will survive and produce offspring more successfully than their ill-suited competitors.

Factors that cause selective pressure:

1. **Physiological stress due to inappropriate levels of some critical environmental factor.**
2. **Predation, including parasitism and disease**
3. **Competition**
4. **Luck**

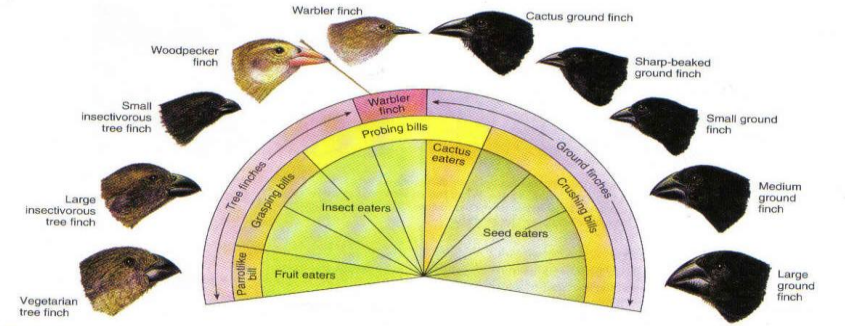


FIGURE 4.5 Some species of Galápagos Island finches. Although all are descendents of a common ancestor, they now differ markedly in appearance, habitat, and feeding behavior. Ground finches (*lower right*) eat cactus leaves; warbler finches (*upper left*) eat insects; others eat seeds or have mixed diets. The woodpecker finch (*upper left*) pecks tree bark as do woodpeckers, but lacks a long tongue. Instead, it uses cactus spines as tools to extract insects.

Habitat – place or set of environmental conditions in which a particular organism lives.
Niche – description of either the role played by a species in a biological community or the total set of environmental factors that determine species distribution.
(How a species obtains food, what relationships it has with other species, and the services it provides in the community).

The Aye-aye is a lemur, a strepsirrhine primate native to Madagascar that combines rodent-like teeth a special thin middle finger to fill the same ecological niche as a woodpecker. The Aye-aye is the world's largest nocturnal primate, and is characterized by its unusual method of finding food; it taps on trees to find grubs, then gnaws holes in the wood and inserts its narrow middle finger to pull the grubs out. The only other animal species known to find food in this way is the Striped Possum. From an ecological point of view the Aye-aye fills the niche of a woodpecker as it is capable of penetrating wood to extract the invertebrates within.

The Law of competitive exclusion: No two species will occupy the same **niche** (The role played by the species- how it obtains food, relationships with other species, & services it provides the community.) & compete for exactly the same resources in the same habitat for very long.

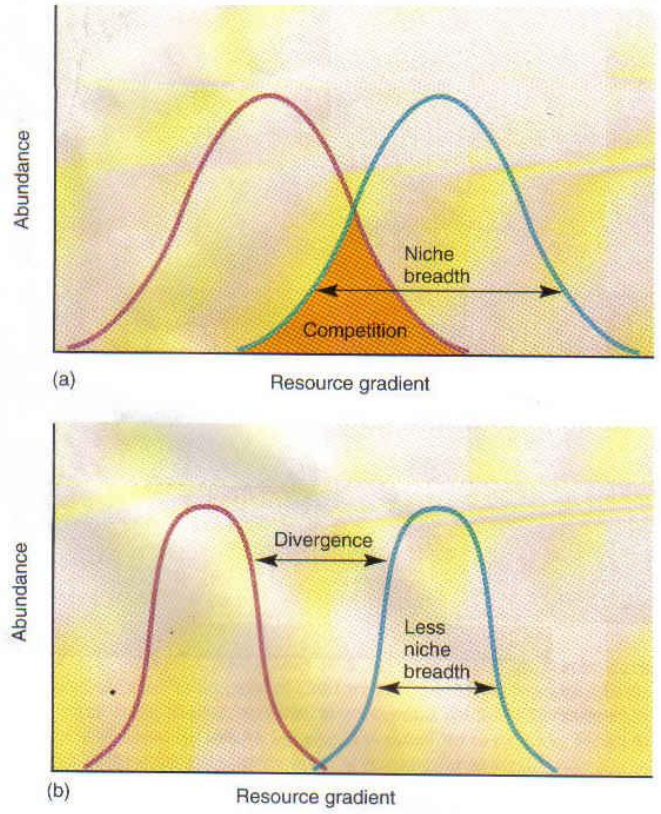


FIGURE 4.7 Resource partitioning and niche specialization caused by competition. Where niches of two species overlap along a resource gradient, competition occurs (shaded area in (*a*)). Individuals occupying this part of the niche are less successful in reproduction so that characteristics of the population diverge to produce more specialization, narrower niche breadth, and less competition between species (*b*).

Resource partitioning- One will migrate, become extinct or change its behavior or physiology to minimize competition.

+ and – relationships

Relationship			
Ammensalism	_	0	
Commensalism	+	_	
Competition	-	_	
Mutualism	+	+	
Parasitism	+	_	
Predation	+	_	
Saprophism	+	Neutral	

Symbiosis is increasingly recognized as an important selective force behind evolution, with many species having a long history of interdependent co-evolution.

BIOTIC RELATIONSHIPS:

SYMBIOSIS: close and often long-term interaction between different biological species.

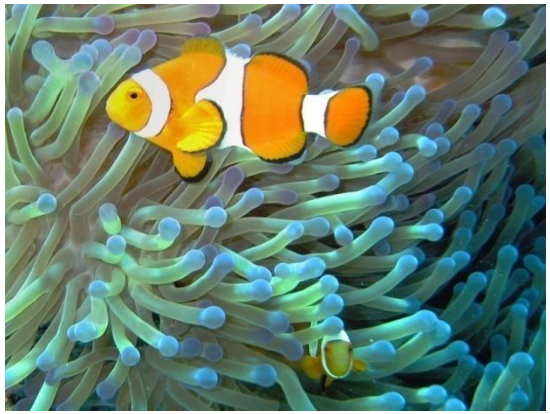
Ammensalism: One species suffers & the other is not affected.

EX. **Alleopathy** – one species releases a chemical substance to inhibit the growth of another.

Mutualism: Both benefit

Symbiotic obligate – physical interaction but either species cannot live without the other. (Lichens)

Nonsymbiotic – no physical interactions but either species cannot live without the other. (Insect pollinators & flowers)



In a symbiotic mutualism, the clownfish feeds on small invertebrates which otherwise potentially could harm the sea anemone, and the fecal matter from the clownfish provides nutrients to the sea anemone. The clownfish is additionally protected from predators by the anemone's stinging cells, to which the clownfish is immune.

CO-EVOLUTION

Symbiosis played a major role in the co-evolution of flowering plants and the animals that pollinate them. Many plants that are pollinated by insects ,bats, or birds have highly specialized flowers modified to promote pollination by a specific pollinator that is also correspondingly adapted.

Neutralism: An interspecific interaction whereby neither population really affects the other. Grizzly bear & butterfly.

Parasitism: One species obtains food at the expense of their host.

Predation: Species obtain food at the expense of their prey.

Saprophytism: one species, especially fungi or bacteria grow on & derive their nutrients from dead or decaying organic matter.

Symbiogenesis

The biologist Lynn Margulis, famous for her work on endosymbiosis, contends that symbiosis is a major driving force behind evolution. She considers Darwins notion of evolution, driven by competition, to be incomplete and claims that evolution is strongly based on cooperation, interaction, and mutual dependence among organisms. According to Margulis and Dorion Sagan, "Life did not take over the globe by combat, but by networking".

Competition

Intraspecific competition: Between members of the same species, over mates, resources or habitat. EX: Territoriality

Interspecific competition: Between members of different species.

Exploitation –Indirect effects reduce resources. (One eats more; no aggression is involved.)

Interference – One organism prevents physical establishment of another by poisoning or other exclusionary techniques.(aggression)

COMMUNITY PROPERTIES:

Primary productivity: rate of biomass production which indicates the rate of solar energy conversion to chemical energy. Regulated by light levels, temp., moisture & nutrient level.

Only 0.1 to 0.2% of the light absorbed by leaves is converted to carbohydrates.

Distribution calculated using relative frequency = frequency of a given species/frequency of all species.

0 – 30% = clumped

31 – 80% randomly distributed

81 – 100% ordered or uniform

Clumped distribution

In clumped distribution, species are clumped together across an area, such as wolves in packs. This is the most common type of distribution.

Uniform distribution

In uniform distribution, each member of a species has its own personal space, with members a certain distance apart. Penguins often exhibit this type of species distribution.

Random distribution

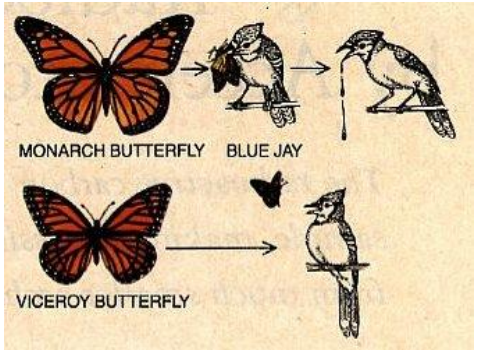
In random distribution, the members of the species are put in seemingly random locations with no observable placing scheme. When dandelion seeds are dispersed, random distribution will often occur as the seedlings land in random places.

Population –
the same species sharing a gene pool.
Community-
all of the populations in a food web.
Ecosystem –
the community + all the abiotic factors.

Defensive mechanisms:

Toxic chemicals, body armor, thorns or spines, noxious odors, poisonous secretions.

Batesian mimicry- a harmless species that looks like one that is harmful. (Good for the prey!)



Mullerian mimicry: Two species that look similar & both are harmful. (Good for the predator!)

Ectones – boundaries between adjacent communities.

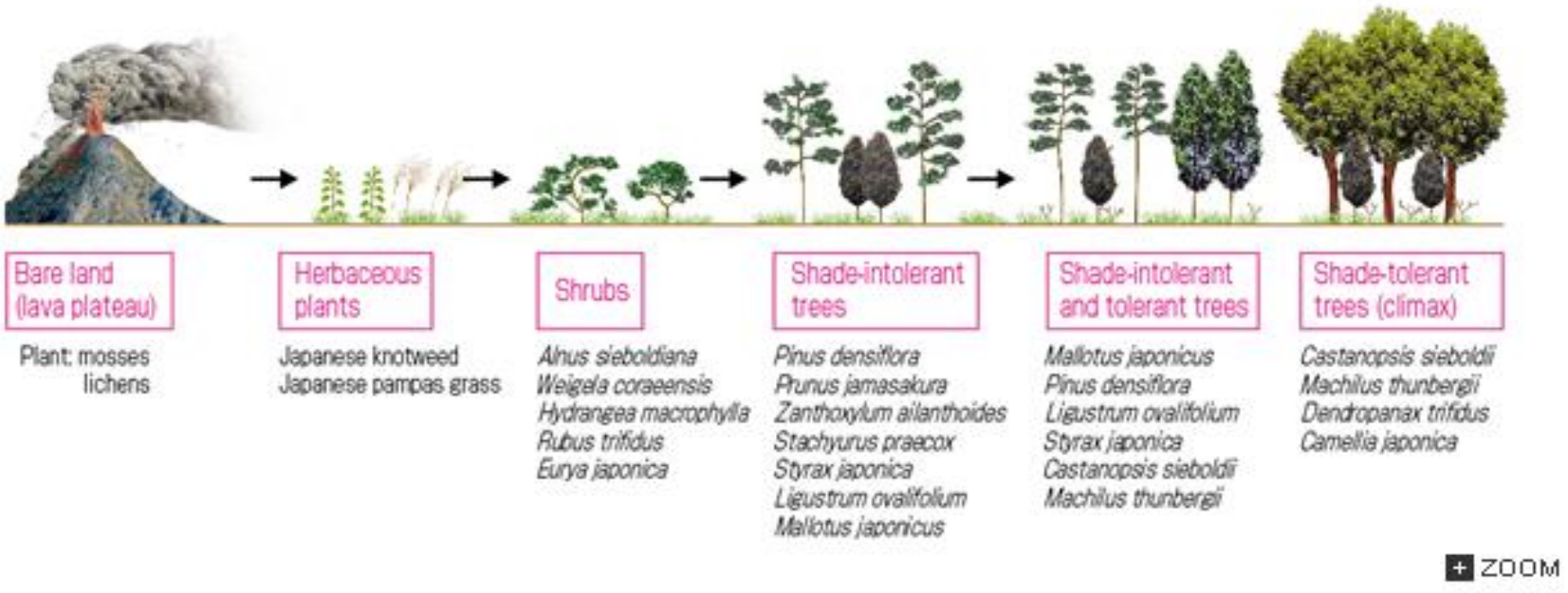
1. abundance – total # of organisms
2. diversity - # of different species, # trophic levels, & heterozygosity within the gene pool.
3. primary productivity – rate of biomass produced (light, temp, moisture, nutrients)

“R” selected - Short life, rapid growth, early maturity, many small offspring, little parental care or protection, little investment in individual offspring, adapted to unstable environments, pioneers, colonizers, niche generalists, prey, regulated mainly by extrinsic factors, low tropic level.

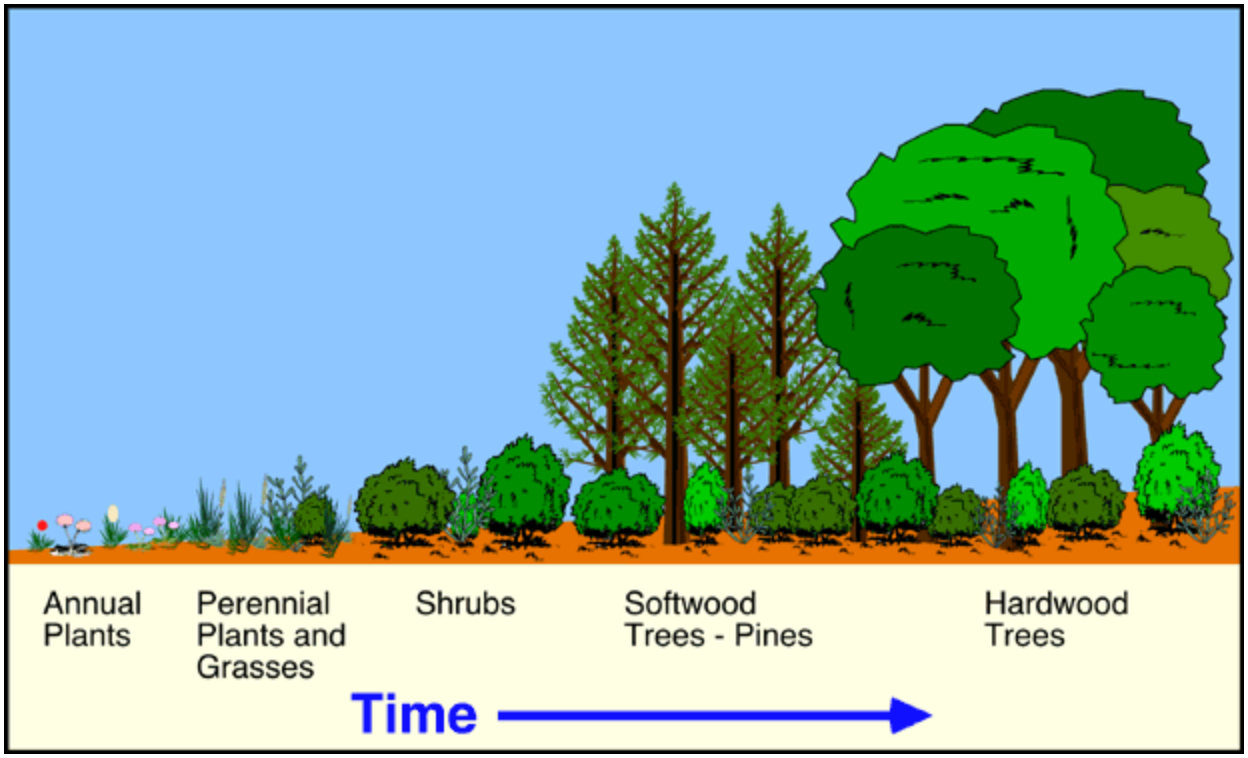
<u>"K" selected</u> – Long life, slower growth, late maturity, fewer large offspring, high parental care & protection, high investment in individual offspring, adapted to stable environment, later states of succession, niche specialists, predators, regulated mainly by intrinsic factors, high tropic levels.

SUCCESSION: Overall change in the community.

1. Primary succession: begins with soil formation or when the area has never been occupied by other living things. Begins with lichens.



2. Secondary succession: Reestablishment of an ecosystem. (Soil is present in terrestrial systems.) Pioneer species are the 1st occupants and are generally “R” selected.



Wildfires are an essential feature of ecosystems; both plants and animals are well adapted to fires and benefit from fire. Fire is an agent of change performing a variety of functions and producing a range of effects.

1) **Fire Dependence**: This concept applies to species of plants that rely on the effects of fire to make the environment more hospitable for their regeneration and growth.

2) **Fire History**: This concept describes how often fires occur in a geographical area. Fire scars, or a layer of charcoal remaining on a living tree as it adds a layer of cells annually, provide a record that can be used to determine when in history a fire occurred.

3) **Fire Adaptation**: This concept applies to species of plants that have evolved with special traits contributing to successful abilities to survive fires at various stages in their life cycles. For example, serotinous cones, fire resistant bark, fire resistant foliage, or rapid growth and development enable various kinds of plants to survive and thrive in a fire prone environment.
One major effect of fire is a change in soil nutrients and soil temperature. Fire may be a chief factor maintaining productivity in colder soils where the lack of nutrients is a major factor limiting plant growth. Fires release nitrogen and other nutrients from woody vegetation back into the soil in the form of mineral-rich ash, which makes them readily available for new plant growth.