

Ecology

Ecology is the study of relationships between organisms and their environment. When describing ecological relationships we organize information about organisms in different ways. A **population** is a group of individuals of the same species all living together in the same area. A school of manini (convict tang) is a population. A **community** consists of all the organisms living together in an area. The manini, algae, corals, worms, and other invertebrates on the reef make up the community. The **ecosystem** includes all of the organisms in the community as well as the physical or abiotic factors in the area like temperature, climate, salinity, and available nutrients. A tropical coral reef in seawater with salinity of 33 ppt (represents 33 parts sodium chloride per thousand parts water) and average temperature of 25-30° C populated by the organisms described above represents an ecosystem.

There are many complex relationships in an ecosystem. **Biotic** relationships are between living organisms (bio = living). One kind of relationship is **symbiosis**. Symbiosis literally means living together, and describes two different species live together in a close relationship. If two species simply live in the same area it is not symbiosis, but if their survival is affected in some way by living together, and if they have evolved over time together due to the selective pressures placed on both by the relationship, they are considered symbionts. There are several special categories of symbiosis. If both species benefit, the symbiosis is **mutualism**. If one species benefits, but one is unaffected, the symbiosis is **commensal**. If one species benefits and one is harmed, the symbiosis is **parasitic**. Parasites may harm the host in many ways, by taking food, killing young, or draining the host of energy, but very rarely kill it. A special category, called the **parasitoids**, often kill the host, but only after time has gone by. Symbioses can be obligate - the organism must partake in the relationship in order to survive - or facultative - the organism does not need to be in the relationship, but given the opportunity will do so.

A second kind of biotic relationship, probably the one most people think of because it is so commonly depicted on nature programs on television, is **predation**. Predation occurs when an organism kills and consumes another organism. Mahi-mahi that eat flying fish are predators, but so are sea urchins that completely consume kelp and other algae. To be a true predator, an animal must kill and eat its food. Animals like leeches that take their food without killing the host are parasites, not predators. Scavengers like brittlestars that feed on shed or dead plant and animal material are also not predators as they eat food that is already dead and do not have to kill it.

Competition is a biotic relationship that can have a substantial impact on populations of organisms. When a resource is limited, organisms may compete for it in some form. Interspecific competition is competition amongst individuals of the different species. Intraspecific competition is competition amongst individuals of the same species. Organisms can compete for varying resources- food, mates, space, or access to light or chemical nutrients. The more similar the needs of the competitors, the fiercer the competition between them tends to be. **Interference competition** occurs when

organisms actively fight over a resource. **Exploitation competition** occurs when one organism takes up the resource, passively preventing others from gaining access to it.

Fill in the table with examples of biotic interactions (e.g. from the intertidal):

Type of interaction	Example	Beneficial to whom?	Harmful to whom?
Competition (exploitation)			
Competition (interference)			
Parasitism			
Mutualism			
Commensalism			
Predation			

Organisms are greatly influenced by biotic factors like predation, competition, and symbiosis, but they are also influenced by **abiotic** or physical factors, or things that are non-living (a = without; bio = living). In a marine environment, there are many things that influence the populations and communities there. Imagine a small nudibranch that lives in the intertidal zone and must be covered by seawater at all times so that it does not dry out and die. It has gills that get clogged by fine sand, and must avoid very sandy substrates. It requires plenty of dissolved oxygen to breath and hides in small rocky holes to get away from predators. It hunts its chosen prey during daylight hours when it can sense light and dark to help it maneuver. It is very small and not strong, and cannot hold on to rocks very tightly when waves are high, so it remains in its tight crevices when the tide is high or the waves are very rough. When the water is too cold it becomes very sluggish and cannot move quickly, but if the water gets too warm, the chemicals in its body do not function properly. As you can see, physical factors like waves, temperature, desiccation (exposure to air), light, substrate type, salinity,

dissolved gasses, and chemical minerals and nutrients are some of the things affecting the nudibranch.

What are the physical factors that influence you on a daily basis?

Choose any marine organism, and describe the different physical factors that it must cope with.

Zonation is the distribution of such as animals or plants in distinct patterns or regions. The zones are characterized by the organisms that live in them. But why do these organisms settle in these zones? A combination of biotic and abiotic factors influences where organisms can live. There are specific requirements that organisms need, and these are some of the factors that shape zonation. Amount of sunlight, water, and oxygen, for example, in combination with competition and predation by other organisms can impose strict limits on the distribution of an organism like algae or snails.

A famous example is the study of zonation of different kinds of barnacles conducted by Joe Connell in England. He discovered that a larger barnacle, *Balanus* was very successful at outcompeting a smaller barnacle *Chthamalus*, by growing over it. *Chthamalus* however, can tolerate longer periods of dryness than *Balanus*, and thus could grow higher in the intertidal zone, and thus formed a distinct band above the superior competitor that required more water and was forced to remain lower. The combination of biotic (competition) and abiotic (exposure to air) factors together influenced the zonation of these barnacles.

Examine your intertidal data, or data from the OPIHI website for zonation patterns. (See “Visualizing Zonation” in Extending the Learning)

What is your hypothesis about the biotic and abiotic factors contributing to those patterns?