R-J

27-7-22

BIO 101 LECTURE NOTE

INTER-RELATIONSHIP OTUDO EMMANUEL

In ecology, a **biological interaction** is the effect that a pair of organisms living together in a community have on each other. They can be either of the same species (intraspecific interactions), or of different species (interspecific interactions). These effecsts may be short-term, like pollination and predation, or long-term; both often strongly influence the evolution of the species involved. A long-term interaction is called a symbiosis. Symbioses range from mutualism, beneficial to both partners, to competition, harmful to both partners. Interactions can be indirect, through intermediaries such as shared resources or common enemies. This type of relationship can be shown by net effect based on individual effects on both organisms arising out of relationship.

Predation

In predation, one organism, the predator, kills and eats another organism, its prey. Predators are adapted and often highly specialized for hunting, with acute senses such as vision, hearing, or smell. Many predatory animals, both vertebrate and invertebrate, have sharp claws or jaws to grip, kill, and cut up their prey. Other adaptations include stealth and aggressive mimicry that improve hunting efficiency. Predation has a powerful selective effect on prey, causing them to develop antipredator adaptations such as warning coloration, alarm calls and other signals, camouflage and defensive spines and chemicals. Predation has been a major driver of evolution since at least the Cambrian period.

Predation is a short-term interaction, in which the predator, here an osprey, kills and eats its prey.

Pollination

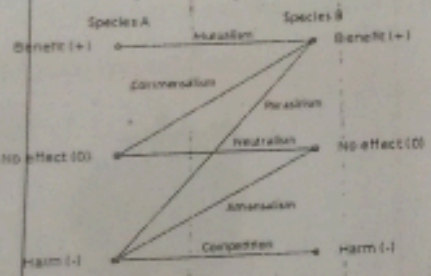
In pollination, pollinators including insects (entomophily), some birds (ornithophily), and some bats, transfer pollen from a male flower part to a female flower part, enabling fertilisation, in return for a reward of pollen or nectar. The partners have coevolved through geological time; in the case of insects and flowering plants, the coevolution has continued for over 100 million years. Insect-pollinated flowers are adapted with shaped structures, bright colours, patterns, scent, nectar, and

sticky pollen to attract insects, guide them to pick up and deposit pollen, and reward them for the service. Pollinator insects like bees are adapted to detect flowers by colour, pattern, and scent, to

collect and transport pollen (such as with bristles shaped to form pollen baskets on their hind legs), and to collect and process nectar (in the case of honey_bees, making and storing honey). The adaptations on each side of the interaction match the adaptations on the other side, and have been shaped by natural_selection on their effectiveness of pollination

Pollination has driven the coevolution of flowering plants and their animal pollinators for over 100 million years.

Symbiosis: long-term interactions



Symbiosis The six possible types of symbiotic_relationship, from mutual benefit to mutual harmThe six possible types of symbiosis are mutualism, commensalism, parasitism, neutralism, amensalism, and competition. These are distinguished by the degree of benefit or harm they cause to each partner."living together") is any type of a close and long-term biological_interaction between two different biological_organisms, be it mutualistic, commensalistic, or parasitic. The organisms, each termed a **symbiont**, may be of the same or of different species. In 1879, Heinrich Anton_de_Bary defined it as "the living together of unlike organisms". The term was subject to a century-long debate about whether it should specifically denote mutualism, as in lichens; biologists have now abandoned that restriction.

Symbiosis can be obligatory, which means that one or both of the symbionts entirely depend on each other for survival, or facultative (optional) when they can generally live independently.

Symbiosis is also classified by physical attachment; symbiosis in which the organisms have bodily union is called conjunctive symbiosis, and symbiosis in which they are not in union is called disjunctive symbiosis. When one organism lives on the surface of another, such as head lice on humans, it is called ectosymbiosis; when one partner lives inside the tissues of another, such as *Symbiodinium* within coral, it is termed endosymbiosis.

In a cleaning symbiosis, the clownfish feeds on small invertebrates that otherwise have potential to harm the sea anemone, and the fecal matter from the clownfish provides nutrients to the sea anemone. The clownfish is protected from predators by the anemone's stinging cells, to which the clownfish is immune. The clownfish emits a high pitched sound that deters butterfly fish, which would otherwise eat the anemone, making the relationship appear mutualistic

Physical interaction

Alder tree root nodule houses endosymbiotic nitrogen-fixing bacteria.

Physical interaction

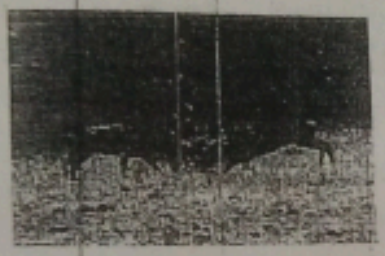
Root microbiome

Endosymbiosis is any symbiotic relationship in which one symbiont lives within the tissues of the other, either within the cells or extracellularly. Examples include diverse microbiomes, rhizobia, nitrogen-fixing bacteria that live in root nodules on legume roots; actinomycete, nitrogen-fixing bacteria such as *Frankia*, which live in alder root nodules; single-celled algae inside reef-building corals; and bacterial endosymbionts that provide essential nutrients to about 10%–15% of insects.

Ectosymbiosis is any symbiotic relationship in which the symbiont lives on the body surface of the host, including the inner surface of the digestive tract or the ducts of exocrine glands. Examples of this include ectoparasites such as lice; commensal ectosymbionts such as the barnacles, which attach themselves to the jaw of baleen whales; and mutualist ectosymbionts such as cleaner fish.

Competition

Competition can be defined as an interaction between organisms or species, in which the fitness of one is lowered by the presence of another. Limited supply of at least one resource (such as food, water, and territory) used by both usually facilitates this type of interaction, although the competition may also exist over other 'amenities', such as females for reproduction (in case of male organisms of the same species).



Male-male interference competition in red deer

Mutualism

Mutualism is an interaction between two or more species, where species derive a mutual benefit, for example an increased carrying capacity. Similar interactions within a species are known as co-operation. Mutualism may be classified in terms of the closeness of association, the closest being symbiosis, which is often confused with mutualism. One or both species involved in the interaction may be obligate, meaning they cannot survive in the short or long term without the other species. Though mutualism has historically received less attention than other interactions such as predation, it is an important subject in ecology. Examples include cleaning symbiosis, gut flora, Müllerian mimicry, and nitrogen fixation by bacteria in the root nodules of legumes.

Hermit crab, *Calcinus laevimanus*, with sea anemone.

Mutualism or interspecies reciprocal altruism is a long-term relationship between individuals of different species where both individuals benefit. Mutualistic relationships may be either obligate for both species, obligate for one but facultative for the other, or facultative for both.

Bryoliths document a mutualistic symbiosis between a hermit crab and encrusting bryozoans.

A large percentage of herbivores have mutualistic gut flora to help them digest plant matter, which is more difficult to digest than animal prey. This gut flora is made up of cellulose-digesting protozoans or bacteria living in the herbivores' intestines. Coral reefs are the result of mutualisms between coral organisms and various types of algae which live inside them.Most land plants and land ecosystems rely on mutualisms between the plants, which fix carbon from the air, and mycorrhyzal fungi, which help in extracting water and minerals from the ground.

An example of mutualism is the relationship between the ocellaris clownfish that dwell among the tentacles of Ritteri sea anemones. The territorial fish protects the anemone from anemone-eating fish, and in turn the stinging tentacles of the anemone protect the clownfish from its predators. A special mucus on the clownfish protects it from the stinging tentacles.
A further example is the goby, a fish which sometimes lives together with a shrimp. The shrimp digs and cleans up a burrow in the sand in which both the shrimp and the goby fish live. The shrimp is almost blind, leaving it vulnerable to predators when outside its burrow. In case of danger, the goby touches the shrimp with its tail to warn it. When that happens both the shrimp and goby quickly retreat into the burrow.Different species of gobies (*Elacatinus spp.*) also clean up ectoparasites in other fish, possibly another kind of mutualism.

A non-obligate symbiosis is seen in encrusting bryozoans and hermit crabs. The bryozoan colony (*Acanthodesia commensale*) develops a cirumrotatory growth and offers the crab (*Pseudopagurus granulimanus*) a helicospiral-tubular extension of its living chamber that initially was situated within a gastropod shell.

Many types of tropical and sub-tropical ants have evolved very complex relationships with certain tree species

Commensalism

Commensalism benefits one organism and the other organism is neither benefited nor harmed. It occurs when one organism takes benefits by interacting with another organism by which the host organism is not affected. A good example is a remora living with a shark. Remoras eat leftover food from the shark. The shark is not affected in the process, as remoras eat only leftover food of the shark, which does not deplete the shark's resources.

Parasitism

Parasitism is a relationship between species, where one organism, the parasite, lives on or in another organism, the host, causing it some harm, and is adapted structurally to this way of life. The parasite either feeds on the host, or, in the case of intestinal parasites, consumes some of its food. In a parasitic relationship, the parasite benefits while the host is harmed. Parasitism takes many forms, from endoparasites that live within the host's body to ectoparasites and parasitic castrators that live on its surface and micropredators like mosquitoes that visit intermittently. Parasitism is an extremely successful mode of life; about 40% of all animal species are parasites, and the average mammal species is host to 4 nematodes, 2 cestodes, and 2 trematodes.

Head (scolex) of tapeworm *Taenia solium* is adapted to parasitism with hooks and suckers to attach to its host.

Neutralism

Neutralism describes the relationship between two species that interact but do not affect each other. Examples of true neutralism are virtually impossible to prove; the term is in practice used to describe situations where interactions are negligible or insignificant.

Mimicry

Mimicry is a form of symbiosis in which a species adopts distinct characteristics of another species to alter its relationship dynamic with the species being mimicked, to its own advantage. Among the many types of mimicry are Batesian and Müllerian, the first involving one-sided exploitation, the second providing mutual benefit. Batesian mimicry is an exploitative three-party interaction where one species, the mimic, has evolved to mimic another, the model, to deceive a third, the dupe. In terms of signalling theory, the mimic and model have evolved to send a signal; the dupe has evolved to receive it from the model. This is to the advantage of the mimic but to the detriment of both the model, whose protective signals are effectively weakened, and of the dupe, which is deprived of an edible prey. For example, a wasp is a strongly-defended model, which signals with its conspicuous black and yellow coloration that it is an unprofitable prey to predators such as birds which hunt by sight; many hoverflies are Batesian mimics of wasps, and any bird that avoids these hoverflies is a dupe.In contrast, Müllerian mimicry is mutually beneficial as all participants are both models and mimics. For example, different species of bumblebee mimic each other, with similar warning coloration in combinations of black, white, red, and yellow, and all of them benefit from the relationship.

Amensalism

Amensalism (a term introduced by Haskell) is an interaction where an organism inflicts harm to another organism without any costs or benefits received by itself. A clear case of amensalism is where sheep or cattle trample grass. Whilst the presence of the grass causes negligible detrimental effects to the animal's hoof, the grass suffers from being crushed. Amensalism is often used to describe strongly asymmetrical competitive interactions, such as has been observed between the Spanish ibex and weevils of the genus *Timarcha* which feed upon the same type of shrub. Whilst the presence of the weevil has almost no influence on food availability, the presence of ibex has

an enormous detrimental effect on weevil numbers, as they consume significant quantities of plant matter and incidentally ingest the weevils upon it.

Amensalism

The black walnut secretes a chemical from its roots that harms neighboring plants, an example of antagonism.