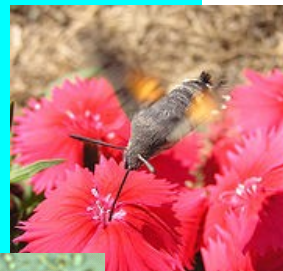


Chapter 2

Symbiosis , Phoresy, Commensalism, Parasitism, Mutualism, Predatorism and Cleaning Symbiosis

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Symbiosis

Symbiosis means a close and long term interactions between different species. In the year 1879, a German Mycologist Heinrich Anton de Bary defined the term symbiosis as “living together of unlike organisms”. Example of symbiosis is Clown fish and Sea anemone.

Based on **physical interaction** between the symbiont and the host, Symbiosis may be “**Endosymbiosis**” or “**Ectosymbiosis**”.

Endosymbiosis

Endosymbiosis is one in which one organism lives inside the tissues of other organisms either intracellularly or extracellularly. Examples of endosymbiosis is the root nodule bacteria (Actinomycete bacteria known as *Frankia*) found on the roots of leguminous plants that fixes nitrogen. There are some endosymbiont bacteria found in insects which provide up to 10-15% essential nutrients to these insects.

Ectosymbiosis

Ectosymbiosis is also sometimes referred to as **Exosymbiosis**. In this, the symbiont lives on the outer surface of the host, inner surface of the gastrointestinal tract and also in the exocrine glands, e.g., the ectoparasitic lice.

Symbiotic relationship may be “**Obligate**” or “**Facultative**”. In **Obligate** symbiotic relationship, there is necessity of survival of at least one organism, whereas in **Facultative** symbiosis, the relationship is beneficial but not essential for survival of the organisms.

Classification of Symbiosis

Based on **metabolic requirement**, Symbiosis may be classified as:-

- a. Phoresy
- b. Commensalism
- c. Parasitism
- d. Mutualism

a. Phoresy:

In this symbiotic relationship, the symbiont is simply carried by the host. The best example of Phoresy is the relationship between louse fly (Family: Hippoboscidae) and lice.



Fig.1. Example of phoresy; Two feather lice attached to the abdomen of a louse fly. © Drawing from Rothschild, M and Clay, T(1952) Fleas, flukes, & Cuckoos: A study of bird ectoparasites. Collins (New Naturalist Series), London. Drawing copyright © 1952, Collins Publishers

Lice are group of winged insects (Fig. 1) but have lost their wings secondarily through a process of evolution in favor of a passive form of transmission from host to host. Lice are transmitted through physical contact with their mates during breeding. This process ensures the lice to remain on a suitable host species. There exists an alternative process of transmission of lice from one host to the other through louse-fly (Family: Hippoboscidae). These

flies are found to be parasitizing the birds on whose body, lice are found after the death of the host. This behaviour of the lice are known as **Phoresy**. This transmission or redistribution process is risky, the lice do not feed on the flies instead they travel for a long distance along with the fly. As the lice cannot move fast, this process of attaching themselves over the fly body helps them to travel a long distance to escape a dead or dying host and find out a new or more favorable host. However, the process also involves with a high risk as the flies are not host specific. As a result, they are likely to carry the lice to an unfavorable host which may be unlikely environment for the survival of the lice.

b. Commensalism

It is a symbiotic relationship between two organisms in which one is benefited; however, the other is not significantly harmed or helped. The word has derived from the English “commensal” which means “sharing food” and the medieval Latin word *com* and *mensa*, meaning “sharing a table”. There is indirect metabolic dependency in commensalism.

A best example of Commensalism is the relationship of birds which follow the army ants that raids the forest floor. When the army ant colony moves through the forest floor, it stirs up many flying insects. As the birds follow the army ants, they catch the fleeing insects. In this example, the birds are benefitted, however, the army ant does not lose anything or unaffected.

The commensal relationship may vary in strength and duration which may be intimate, long-lived to a brief, weak interactions through intermediaries. Various commensal relationship may be **Phoresy**, **Inquilinism** and **Metabiosis**.

i. Phoresy:

In this type of relationship one animal is attached to the other for its transportation only. Example of Phoresy is the association between the louse fly (Family: Hippoboscidae) and lice, beetles and millipeds on birds. Phoresy can be either Obligate or Facultative.

ii. Inquilinism:

In this relationship, the commensal uses a second organism for housing. For example epiphytic plants such as orchids uses a plant on which it grows, or birds uses a hole on a tree where it nests.

iii. Metabiosis:

In this relationship one organism uses the materials created or left behind by the first after their death. Example of the Metabiosis is the hermit crab which uses the gastropod shells to protect themselves.

c. Parasitism:

Parasitism (Fig. 2) is a type of symbiotic relationship between two different organisms in which the parasite is dependent on the host metabolically. Therefore, in parasitic relationship the parasite is benefited and the host is harmed. Generally, the parasites are much smaller than their hosts, have specialized structures and a mode of life. They reproduce faster and in greater number than their hosts. Example of parasitism is the symbiotic relationship between *Fasciola gigantica* and cattle. Parasites reduces the hosts' fitness that ranges from general or specialized pathology (e.g. castration), impairment of secondary sex characteristics to modification of host behaviour. On the other hand, parasite increases their fitness by exploiting hosts for food, habitat and dispersal.

Parasites are classified based on their interactions with their hosts and life cycle. In essence, the parasitic symbiosis may take many forms

from **ectoparasites** to **endo parasites**. **Ectoparasites** live outside the body of the host, while the **endoparasites** live inside the body of the host. Endoparasites may be *intercellular* (inhabits inside the space of the host's body) or *intracellular* (inhabits inside the cells of the host's body). Intracellular parasites generally depend on a third organism for their transmission known as carrier or vector. An example of this is the *Plasmodium* infection in human being, which are transmitted by the female Anopheline mosquitoes. Parasites may be necrotrophic or biotrophic. Necrotrophic parasites kill their host, while biotrophic parasites depend on the survival of their hosts. It is seen that, biotrophic parasitism is an extremely successful mode of life. The parasitic phenomenon is considered to be a continuous types of interactions between species rather than an exclusive category. An *epiparasite* is one which parasitizes over a parasite. They are also known as *hyperparasite*. Example of *epiparasite* (*hyperparasite*) is the protozoa, which lives in the digestive tract of a flea that parasitizes over dog.

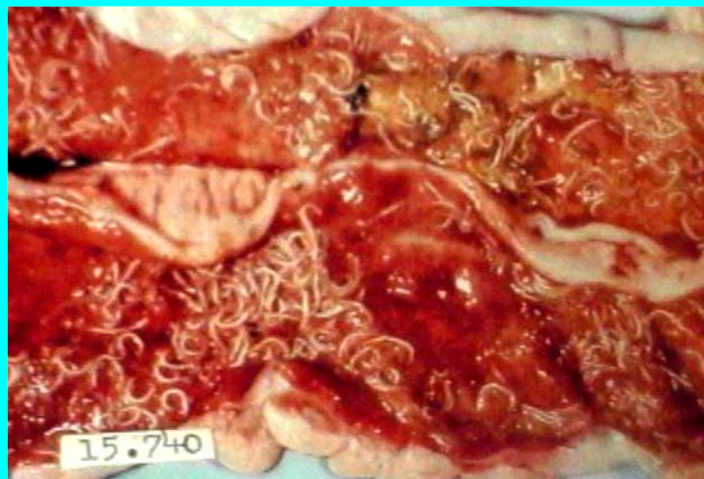


Fig.2 . Example of Parasitism ; *Trichuris* species in caecum of pig

d. Mutualism:

In this symbiotic relationship, each individual derives a fitness benefit. Within a species, it is known as *cooperation*. On the other hand, in *interspecific competition* each species experiences a reduced fitness and exploitation at the expense of the other.

Mutualism has a great role in the functioning of ecology and evolutionary biology. This interaction is vital for terrestrial ecosystem function. More than 70% of land plants rely on mycorrhizal relationship with fungi to provide them with inorganic compounds and trace elements. It also driven the evolution of much of the biological diversity e.g., flower forms and co-evolution between groups of species.

The mutualistic relationship

- i. Resource-resource relationship
- ii. Service –resource relationship
- iii. Service-service relationship

i.Resource-resource relationship:

In this type of relationship one type of resource is traded for a different kind of resource. This form of mutualism is considered most common. Mycorrhizal relationship between roots and fungi is the best example of resource-resource form of mutualism. In this, the plant provides carbohydrates to the fungus in return of for primarily phosphate and also for nitrogenous compounds. Another example is the rhizobia or root nodule bacteria that fixes nitrogen for leguminous plants in return for energy containing carbohydrates.

ii. Service–resource relationship

This type of mutualistic relationship is also common. For example, the nectar (Fig. 3) or pollen (food resource) is traded for pollen dispersal (a service).



Fig.3. Example of service-resource relationship; hummingbird taking nectar

iii. Service-service relationship



Fig. 4. Example of service-service relationship; mutualistic relationship between sea anemone and anemone fish

The relationship between sea anemone and anemonefish is the example of service –service relationship (Fig.4). Sea anemone has stinging tentacles which cannot be tolerated by the predators. Hence the anemones protect anemone fish from the predators. On the other hand, the fish defend the anemones against the butterfly fishes which attack them and eat.

Examples of some other symbiotic relationships are :

- a. Cleaning symbiosis
- b. Predatorism

a. Cleaning symbiosis :

Cleaning symbiosis is a type of mutualistic relationship which occurs in diverse taxa. In this the cleaners remove the ectoparasites from the body of their clients. The best example of cleaning symbiosis is the relationship between cattle egret and cattle. Egrets frequenting over the surface of cattle eat the external parasites.

b. Predatorism:

In this kind of relationship, one partner plunders over or forcefully acquires the food from the other. Example of predatorism is the relationship between tiger and deer.

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Symbiosis at Wikipedia : Use the search term **symbiosis** at www.google.com to retrieve information on symbiosis, phoresy, mutualism, parasitism and commensalism.

Acknowledgement:

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