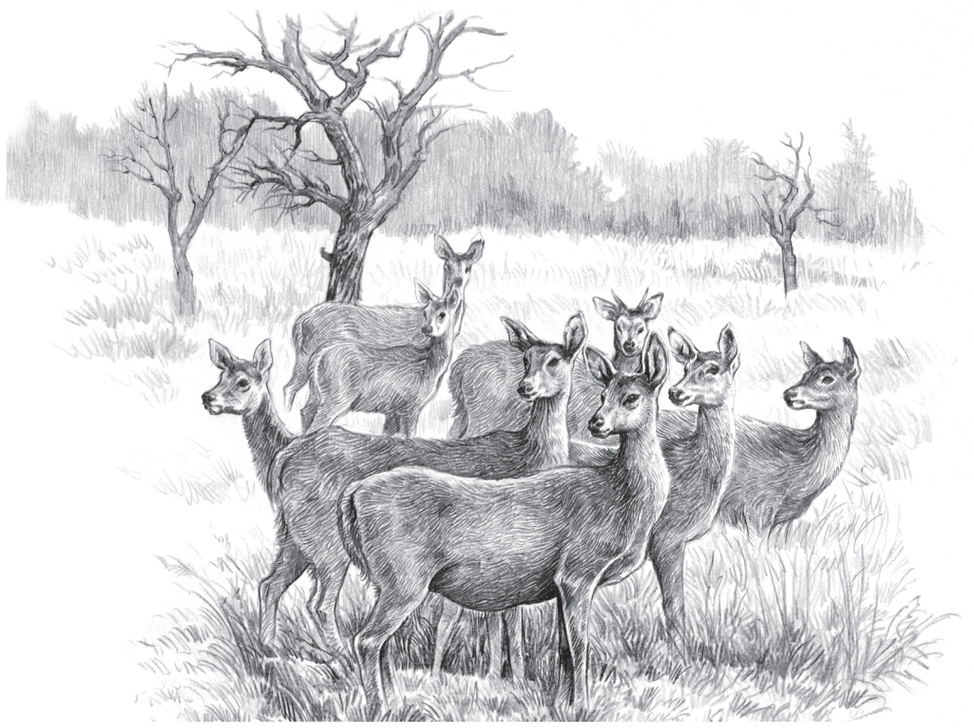
Communities & Interactions 3

STRUCTURE



3.1

In unit 2, we studied how the various components in nature are interconnected and nterlinked with each other and that in order to make the study of ecology simpler, ecologists categorize these components into the various levels of organization in nature.

Is it 'good or bad' for the big fish to eat the smaller ones? How does a 'fight' between two different bird species for the same resource in nature affect the balance in nature. In nature is 'cooperation' better that 'competition'? In this unit we will try to explore all these by looking at what are ecological communities; how do members in these communities interact with each other and what roles do these interactions play in maintaining the balance in nature.

3.2

On completion of this unit, you will be able to:

- Describe ecological communities and their key characteristics
- Define and give examples of the various types of interactions that take place among the members of a community
- State the ecological significance of these interactions

3.3 ECOLOGICAL COMMUNITIES

As discussed in Unit 2, an ecological community is defined as populations of various species occupying a particular area and interacting with each other. To put in simpler terms, when individuals of several species come together and interact with each other, they give rise to an ecological community. Following are some of the features that characterize communities:

Species diversity

It refers to the variety of species present in a community. Each community has a unique set of species. For instance, the types of species found in a grassland community will be different from those found in a desert or in an estuarine community.

Community Structure

In a community, the different constituent species occupy different niches and hence play different roles. Some species, however, may exert stronger influence on the larger community and its species members. Such species are called dominant species. A community is often named after its dominant species, e.g. a teak community, a *sal* community, etc. There may be one or sometimes more than one dominant species in a community. A dominant species may not always be abundant, but usually has greater productivity and biomass. The dominant species usually has the maximum impact on

the larger functioning of the communities and the environment, as it absorbs any major impact/change in the environment and regulates the environment to the benefit of other species and the community on the whole.

Ecological succession

Communities change and grow over a period of time. In most communities, the variety of species in a given area changes slowly over a period of time. This gradual process of change in the composition and function of communities is called ecological succession. Ecological succession is a way in which communities respond to changes in their environment. Succession is a normal process and is driven by various kinds of interactions between different species of a community and the environment. Natural, uninterrupted ecological succession leads to the development of young fragile communities into more mature, developed and sustainable ones.

Primary and Secondary Succession

Primary succession is the process of initial establishment of a community in an area where no Lifeforms existed before, e.g. ferns colonizing a barren rock. Secondary succession follows destruction of all or a part of an earlier community, e.g. grass seeds germinating after a forest fire.

As succession progresses, communities become relatively stable. Such a community, which has reached the final stages of succession and where the pace of succession becomes almost zero, is called a climax community, e.g. a teak forest is the climax community.

Over a period of time, have you ever observed a change in an ecosystem in your surroundings? Have you noticed, over a period of time, a wetland become 'grassier' or say a grassland becoming denser, with the number of trees increasing in it?

Yes, these changes are a part of ecological succession. Most often, these changes are more visible in ecosystems such as wetlands and grasslands. It is so, because unlike forests, these are young, growing stages of an ecological succession path and hence are highly dynamic and evolving in nature.

The Concept of Stability

As discussed earlier, communities grow/evolve over a period of time and this process is referred to as ecological succession. In general a mature/older community, which is likely to have more species with numerous interrelationships, is more resistant to an environmental change. This is an indicator of the stability of that community. Community stability increases with each step of ecological succession and is highest in a climax community. Such communities are quite resilient against disturbances.

3.3.1

Fill in the blanks:

a) When individuals of several species come together and interact with each other, they give rise to an _____.

b) Most ecological communities are characterized by the presence of a _____ species and are often named after these.

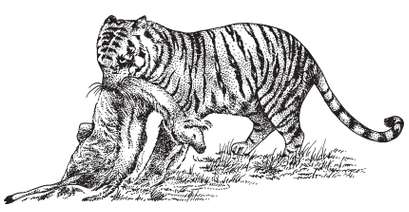
c) Communities grow and change over a period of time, this process is referred to as_____.

3.4 INTERACTIONS IN A COMMUNITY

Organisms of different species in a community do not stay in isolation from each other, and hence community ecology is concerned with the variety of interactions that take place between the various species. When any two organisms have some activities or requirements in common, they interact with each other. Species are inextricably linked, forming networked systems. In fact, constant interactions occur within (intra-specific) and between (inter-specific) them. Such interactions occur principally for habitat, food, defense, and reproduction. These interactions include:

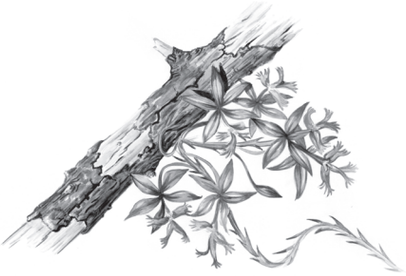
Predation: Predation is the consumption of one individual (prey) by another (predator). For instance, lion preys on deer, or a kingfisher feeds on fish in a pond.

Competition: In most communities, each organism faces competition from one or more organisms for common limited resources. Competition can again be of two types: interference and exploitation. Interference is where one organism hinders another organism's access to some resource, say food, water, shelter, etc., irrespective of the fact whether the resource is abundant or scarce. For instance some coral animals kill other nearby corals by poisoning them. In exploitation, two competing organisms have equal access to a particular resource, but differ in how quickly or efficiently they exploit it. In this way one organism gets more of the resource, thereby hampering the growth, reproduction and survival of the other. This kind of competition is usually exhibited only when a resource is scarce. For instance grasses thrive better in deserts than other plants because their root systems are more efficient in absorbing more water in a short time than those of other plant species.

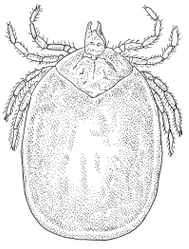


Mutualism: It is the type interaction, where both the interacting species are mutually benefited. A common example is the interaction between flowers and insects, where the flower is benefited by being pollinated and the insect gets the nectar. In some cases the mutual relationship has become so close that species involved cannot survive without each other. For example, certain species of fungi and algae live in close association as lichens. The fungus gets its food from the algae, while the algae get protection. If separated, neither can survive.

Commensalism: Commensalism is a cooperative relationship where one partner gains from the arrangement while the other is neither helped nor harmed, e.g. in dense forests, where sunlight does not reach the ground in sufficient quantity, orchids grow on other tree species. The orchid is benefited by getting sufficient light, but the tree is neither benefited nor harmed.



Parasitism: Parasitism is a oneway relationship where the parasite gains and the host is adversely affected. Parasites are usually smaller than their hosts. They do not kill or consume the hosts but only derive their nutrition from them, e.g. ticks attach themselves to dogs and suck the blood. Similarly tapeworms are found in the human intestine.



DID YOU KNOW?

Symbiosis refers to the phenomenon of 'living together' in close union. Symbiosis is sometimes interpreted to be a beneficial relationship—where the organisms involved get benefits by living together. However, ecologically, any interaction where two or more organisms live in close association is referred to as a symbiotic relationship, irrespective of whether the two are benefited or harmed, or remain unaffected. Thus symbiosis includes mutualistic, commensalistic as well as parasitic relationships.

There are thus three major types of interactions—predation, competition and symbiosis. The last includes mutualism, commensalism and parasitism.

3.4.1

State true or false

1. In a community, members of the different species do not interact with each other — True/False
2. Symbiosis is the act of living together in a close association — True/False
3. Predation is significant for maintaining the prey population — True/False
4. In a mutualistic interaction both the species get harmed — True/False

3.5 ECOLOGICAL SIGNIFICANCE OF INTERACTIONS

What do interactions between and among species signify in nature? Why should organisms interact with each other? Can they not remain and thrive in isolation? Do they benefit from the innumerable interactions that take place within a community? Do these interactions play a role in making communities more efficient and resilient? If yes, how? Let us look at some examples:

Predation is an efficient way of keeping prey population within the carrying capacity of the ecosystem. Imagine if there was no predation, the prey population would shoot up and will either degrade the natural habitat or will die back. Not only will the prey population suffer, but also the environment will get degraded due to overuse. Besides this, predation also helps in facilitating survival of the fittest among the prey, because usually during a chase, it is the weakest of the lot that gets caught. Thus predation ensures that a balanced, healthy prey population continues to grow.

Like predation, symbiotic interactions also have a defined role in keeping the natural world in balance. Most symbiotic interactions, over a period of time, help species evolve and create their niche. Had these symbiotic relationships not existed in nature, the associated species would have either not survived or would have demanded more resources within the ecosystem. For example, mutualistic associations not only help in exchange of benefits between two or more species, but also help in fortifying weaknesses of these species' adaptive strategies. When soil microorganisms and invertebrates cooperate (mutualism has been reported between a number of soil fungi and invertebrates like earthworms and millipedes), their distinct strategies complement one another: Microorganisms have very limited locomotion, which affects the proximity to environmental resources, but they have very strong digestive power and are capable of digesting most organic substrates. In contrast, invertebrates have competent locomotion and can thus favourably alter physical environments, e.g. through burrowing. However, the vast majority of these soil inhabiting invertebrates cannot produce enzymes to directly digest the cellulose and lignin that comprise a major part of the soil organic resources. Thus a mutualistic relationship between the two types of organisms helps in complementing each others' weaknesses / limitations.Interactions between organisms are the essence of the balance in nature.

3.6 RECAPITULATION

- A number of populations occupying an area and interacting with each other make an ecological community
- Most communities, especially terrestrial ones, are characterized and defined by a dominant species
- Community composition and structure grow and evolve over a period of time. This process is called ecological succession.
- Members of the same species and of different species living in a community interact with each other. These interactions are significant in maintaining the stability of a community.

3.7 CONCLUSION

In nature, organisms interact with each other. Such interactions help in maintaining balance in nature in a variety of ways—controlling population size, providing a broad base in terms of the number of niches, accommodating more variety and diversity of Lifeforms as well as helping in maintaining a variety of habitats for species.

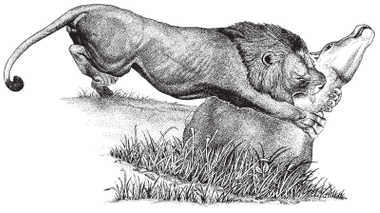
3.8

1. Illustrate how humans interact with other members of the ecological communities that they live in.
2. Distinguish between primary and secondary succession.
3. Experiments have shown that no two species occupy exactly the same ecological niche indefinitely in a habitat. This leads to competition among the species. Comment on the significance of this process.

3.9

Prey-Predator

In an ecosystem, species do not remain in isolation from each other. Species are inextricably linked, forming networked systems. In fact, constant interactions occur within (intra-specific) and between (inter-specific) species. Such interactions occur principally for habitat, food, defense, and reproduction. Some of the common terms used for these interactions are symbiosis, predation, parasitism and competition. Each of these has been explained in detail in the introductory chapter.



What do interactions between and among species signify in nature? Why should species interact with each other? Can they not remain and thrive in isolation? Do they benefit from the innumerable complementary interactions that take place within the ecosystems? Do these interactions play a role in making an ecosystem more efficient and resilient? In order to explain such concepts to your students, a game called Prey-predator is given below. Try it with your students.

Group size: Up to 40 players

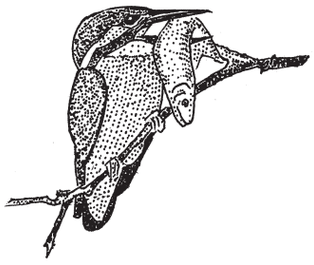
Duration: 30 minutes

Requirements: Chalk pieces, some twigs to represent food

Objective: To discuss predator-prey relationships.

a) Divide the players into two groups. One group represents the ‘prey’, the other group are ‘predators’. There should be approximately one predator for every four to six prey animals.

b) Tell the players that one end of the playing area has the prey’s food



THE IMPORTANCE OF BEING EATEN

Everybody wants to know how many tigers there are in a forest but not very often does one want to know how many sambhar or deer are there. But wildlife ecologists cannot afford to ignore prey species. It is the good health and adequate number of prey population which ensures a healthy predator population. While prey populations can thrive in the absence of predators, predators simply cannot survive without prey. In fact a predator spends considerable energy in finding and killing each prey animal. For example, it has been estimated that a tiger needs to kill about 3000 kg of live prey in a year to survive—about 50 ungulates, weighing about 60 kg each! Imagine if there were no sambhars and chitals, could tigers survive on 12000 rats of about 250 gms each? No, because the energy that a tiger would have spent on locating and killing a rat would be far more than the nutritional value it would have been able to derive from that rat. This is just one example to highlight the importance of good prey base for the survival of predator populations.

and the other end is the shelter for the prey. Mark (with chalk powder or stick) four or five circles (about half a metre in diameter) between the 'shelter' and the 'food' ends. These circles represent temporary shelters for the prey.

c) Place the food twigs at the 'food' end of the playing area. The prey animals have to stand at the 'shelter' end. The predators stand anywhere between the food and shelter ends, except in the temporary shelters.

At a whistle or clap, each round of the game begins.

d) The prey animals have to move from the shelter end to the food end, and collect two food tokens. After collecting the food tokens, they must return to the shelter. Unless they collect two food tokens they die (that is, they are out of the game in the next round). The predators must try and catch at least two prey animals each. Otherwise they die. Captured prey area taken to the predator who catches them.

The prey animals have two ways to prevent themselves from being caught: they may 'freeze' i.e. stand still when a predator is about half a metre away from them, or they may stand in the temporary shelters. If a prey animal freezes, the predator has to look for other prey. The prey can remain still or be in the temporary shelters for as long as they like, but if they do not have enough food at the end of the activity, they die.

The game can have up to four rounds.

Discussion

What methods did the prey use to escape? Which methods were easiest?

Which methods were effective?

What means did the predators use to capture prey? Which ways were the best?

Discuss the need for animals to strike a balance between safety and food.

3.9.1 PREY-PREDATOR: THE FEEDBACK

(credit points: 5)

a) Which standard students did you play this game with?

b) Where in the textbook does this concept occur?

c) Did the game achieve its purpose?

d) Did you need to take help of a colleague of yours in conducting the game?

d) Now that you have already tried two games with your students to explain different concepts in ecology, what do you think 'games' as a teaching-learning methodology have to offer?