TROPHIC STRUCTURE

The structure and functions of ecosystems are very closely related and influence each other so intimately that they need to be studied together. The flow of energy is mediated through a series of feeding relationships in a definite sequence or pattern which is known as **food chain**. Nutrients too move along the food chain. The producers and consumers are arranged in the ecosystem in a definite manner and their interaction along with population size are expressed together as **trophic structure**. Each food level is known as **trophic level** and the amount of living matter at each trophic level at a given time is known as **standing crop** or **standing biomass**.

Before we study about energy flow or nutrient cycling, we must learn about the food-chains, that provide the path through which the flow of energy and matter take place in ecosystem.

FOOD CHAINS

The sequence of eating and being eaten in an ecosystem is known as food chain. All organisms, living or dead, are potential food for some other organism and thus, there is essentially no waste in the functioning of a natural ecosystem. A caterpillar eats a plant leaf, a sparrow eats the caterpillar, a cat or a hawk eats the sparrow and when they all die, they are all consumed by microorganisms like bacteria or fungi (decomposers) which break down the organic matter and convert it into simple inorganic substances that can again be used by the plants-the primary producers.

Some common examples of simple food chains are:

- Grass → grasshopper → Frog → Snake → Hawk (Grassland ecosystem)
- Phytoplanktons → water fleas → small fish → Tuna (Pond ecosystem)
- Lichens → reindeer → Man (Arctic tundra)

Each organism in the ecosystem is assigned a feeding level or trophic level depending on its nutritional status. Thus, in the grassland food chain, grasshopper occupies the Ist trophic level, frog the IInd and snake and hawk occupy the IIIrd and the IVth trophic levels, respectively. The decomposers consume the dead matter of all these trophic levels. In nature, we come across two major types of food chains:

I. Grazing food chain: It starts with green plants (primary producers) and culminates in carnivores. All the examples cited above show this type of food chain. Another example could be

Eg → Grass → Rabbit → Fox

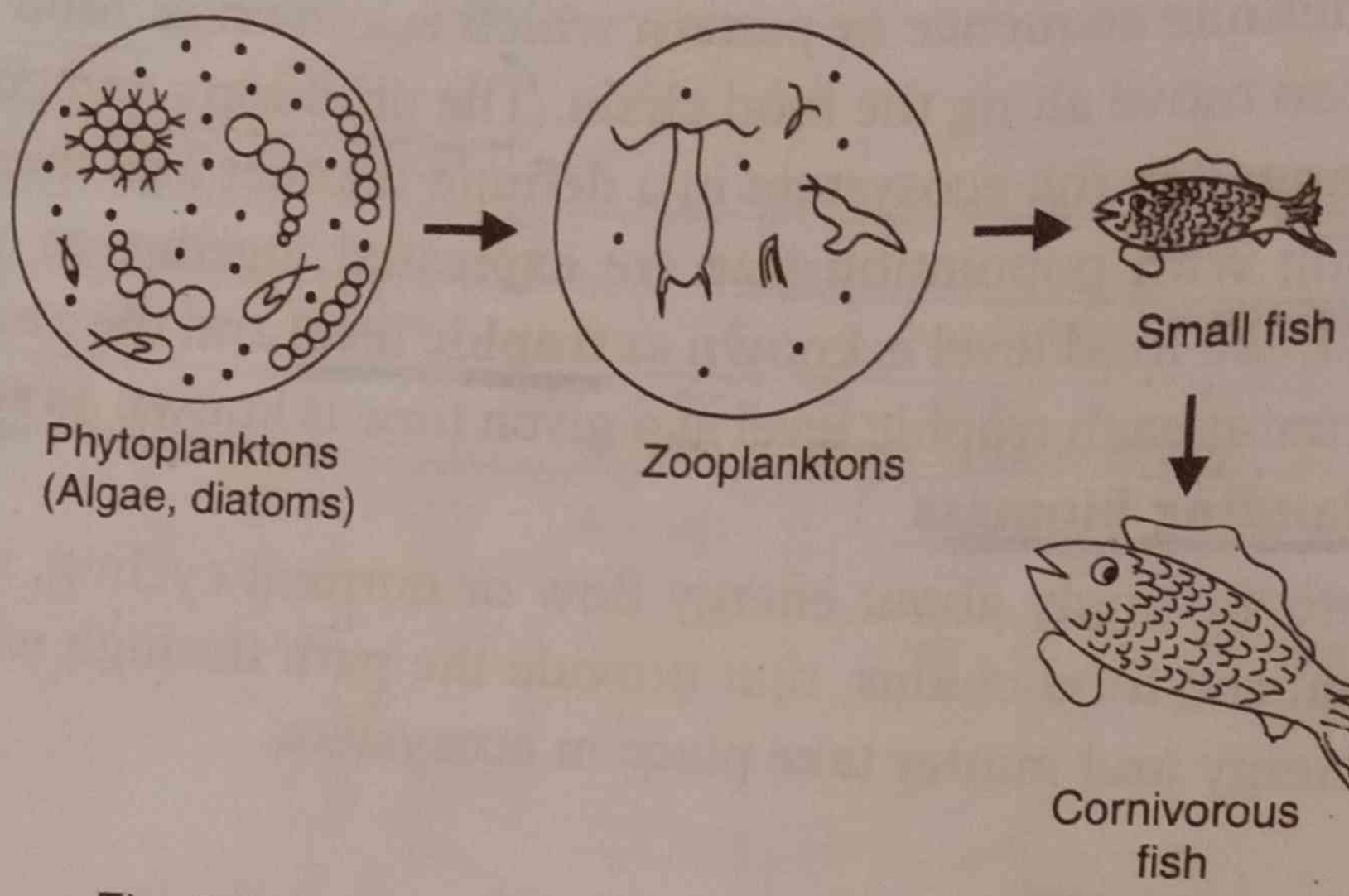

Fig. 3.2. A grazing food chain in a pond ecosystem.

II. Detritus food chain: It starts with dead organic matter which the detritivores and decomposers consume. Partially decomposed dead organic matter and even the decomposers are consumed by detritivores and their predators. An example of the detritus food chain is seen in a Mangrove (estuary).

↳ Dead organic matter → fungi → bacteria (Forest ecosystem)

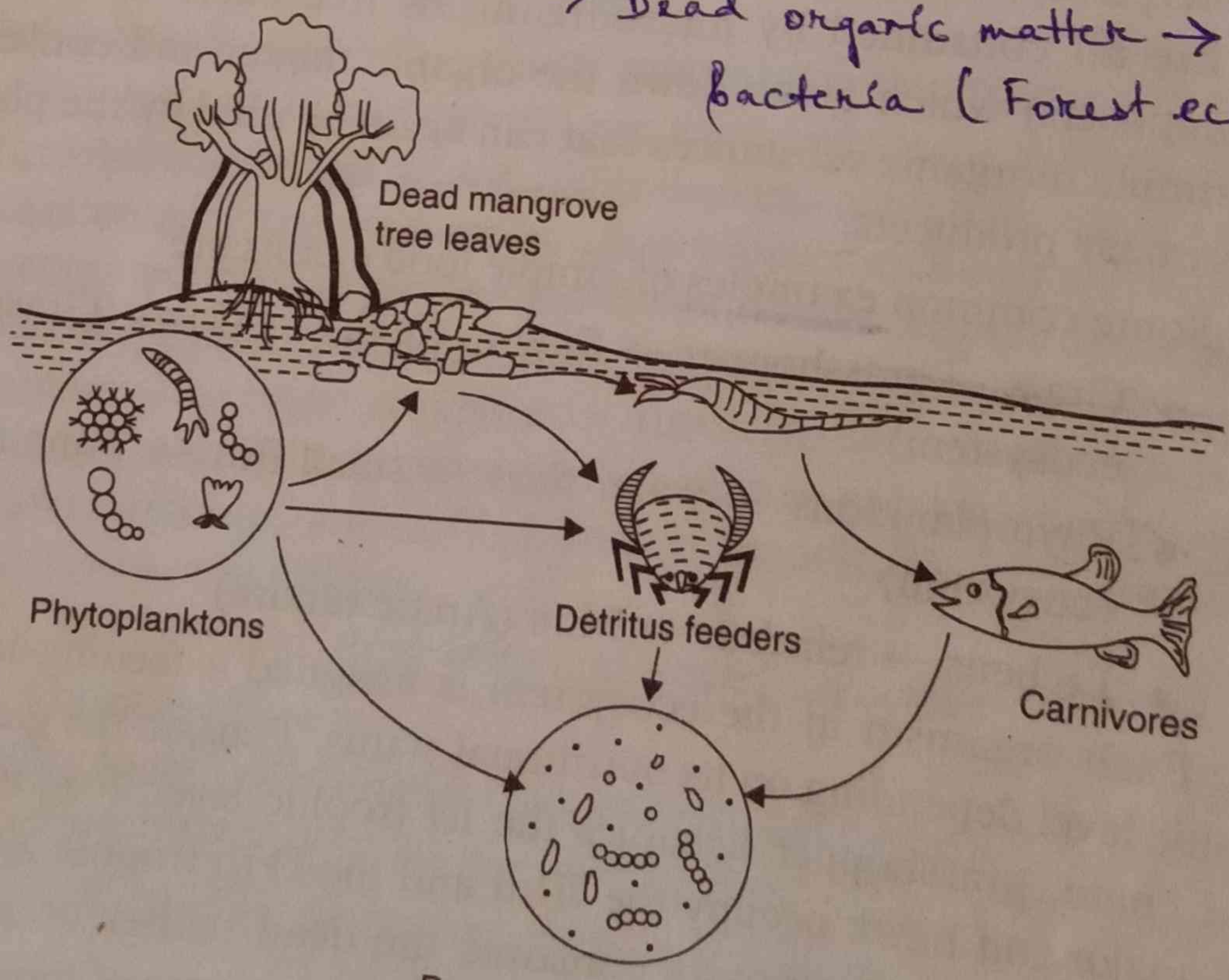

Fig. 3.3. A detritus food chain in an estuary based on dead leaves of mangrove trees.

FOOD WEB

Eg> Solar energy → Green plants (Producer) → Grasshopper → Lizard → Hawk
Green plants → Rabit → → Hawk
Green plants → Rat → Snake → Hawk

* Food chains in ecosystems are rarely found to operate as isolated linear sequences. Rather, they are found to be interconnected and usually form a complex network with several linkages and are known as food webs. Thus, **food web is a network of food chains where different types of organisms are connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level.** (*)

- The food chains also help in maintaining and regulating the population size of different animals and thus, help maintain the ***ecological balance.***
- Food chains show a unique property of **biological magnification** of some chemicals. There are several pesticides, heavy metals and other chemicals which are non-biodegradable in nature. Such chemicals are not decomposed by microorganisms and they keep on passing from one trophic level to another. And, at each successive trophic level, they keep on increasing in concentration. This phenomenon is known as biomagnification or biological magnification.

Just consider the simple food chains of arctic tundra ecosystem:

Cladonia → Reindeer → Man

Grass → Caribou → Wolf

If due to some stress, the population of reindeer or Caribou falls, it will leave little option for man or wolf to eat from the ecosystem. Had there been more biodiversity, it would have led to complex food web giving the ecosystem more stability.

Significance of food chains and food webs

Food chains and food webs play a very significant role in the ecosystem because the two most important functions of ***energy flow and nutrient cycling take place through them.***

■ ECOLOGICAL SUCCESSION

An ecosystem is not static in nature. It is dynamic and changes its structure as well as function with time and quite interestingly, these changes are very orderly and can be predicted. It is observed that one type of a community is totally replaced by another type of community over a period of time and simultaneously several changes also occur. This process is known as ecological succession.

Ecological succession is defined as an orderly process of changes in the community structure and function with time mediated through modifications in the physical environment and ultimately culminating in a stabilized ecosystem known as climax. The whole sequence of communities which are transitory are known as *Seral stages* or *seres* whereas the community establishing first of all in the area is called a *pioneer* community.

Ecological successions starting on different types of areas or substrata are named differently as follows:

(*i*) **Hydrarch or Hydrosere:** Starting in watery area like pond, swamp, bog

(*ii*) **Mesarch:** starting in an area of adequate moisture.

(*iii*) **Xerarch or Xerosere:** Starting in a dry area with little moisture. They can be of the following types:

Lithosere	:	starting on a bare rock
Psammosere	:	starting on sand
Halosere	:	starting on saline soil