

## The Ecosystem

Odum (1971) defines an ecosystem as: 'Any entity or natural unit, including all of the living organisms (i.e. the community) interacting with the non-living factors so that the flow of energy leads to a clearly defined trophic structure, biotic diversity and cycling of materials'.

The Ecosystem and the Niche 39 A community is most simply defined as comprising those species that live together in the same place. While an ecosystem includes not only the living things inhabiting a given area (i.e. the community) but all of the abiotic factors as well.

The term 'ecosystem' can be used to denote an area of almost any size. An ecosystem can be as big or as small as the person examining it dictates, from the local scale (e.g. a small pond) to the global scale (the entire biosphere). The global biomes (tropical rainforest, tundra, etc.) are good examples of very large ecosystems.

The boundaries of most 'ecosystems' are often arbitrarily defined to suit the needs of a particular ecologist's research project. Because most ecosystem ecologists are interested in the exchange of energy among biotic and abiotic components of an ecosystem, they will typically try to study confined areas where inflow and outflow of energy is restricted and thus easier to monitor (Lomolino et al., 2006).

However, in reality very few ecosystems are as isolated or independent from one another as they might first appear. In fact, ecosystems have blurred outlines and are not fixed entities in space or time. Ecosystems will change constantly over time, responding to things like climate change, invasion of new species, natural events etc.

Nevertheless, the concept remains a useful one. Let's examine an example of an ecosystem and see how it works as a stable, self-perpetuating whole. Look at Figure 6.1 and see the flow of energy, moisture, minerals etc., through the system.

### Important concepts in ecosystems

- **Biomass:** the mass of living biological organisms in a given ecosystem at a given time. Biomass can refer to species biomass, which is the mass of one or more species, or to community biomass, which is the mass of all species in the community.
- **Productivity:** a measure of the primary fixation of energy by plants and the subsequent use of that fixed energy by plant-eating herbivores, animal-eating carnivores and the detritivores that feed upon dead biomass.
- **Food webs:** representations of energy fixation and utilization within an ecosystem. They can be more simply regarded as representations of the relationships between species within an ecosystem or habitat. Food webs are usually divided up into different trophic levels.
- **Trophic level:** refers to the position of an organism within the food web. Green plants (producers) form the first trophic level. Herbivores (primary consumers) form the second trophic level, while carnivores (secondary consumers) form the third and even the fourth trophic levels

## **The Ecosystem and the Niche**

The Niche Within an ecosystem, each species survives because it has a special place or role in that ecosystem. This is what is meant by the term niche. It may apply to the physical location of the species. For instance, in deciduous forests the ground flora exploits the shady niche which eliminates competition from other light-demanding herbs. The ground flora is successful because it grows early in spring before the shade is too dense.

But niches can be much more than just a location. Many niches are physiological, e.g. the ground flora in New Zealand evergreen forest is physiologically adapted to be able to grow in continuous dense shade.

Another type of niche is one that involves species partitioning time. For example, in the tropical rainforest, certain species of fig tree fruit at different times of the year. This results in each species having its fruit eaten and seeds dispersed by pigeons. Thus the niche can be thought of as how an organism or population responds to the distribution of resources and competitors (e.g., by growing when resources are abundant, and when predators, parasites and pathogens are scarce) and how it in turn alters those same factors (e.g., limiting access to resources by other organisms, acting as a food source for predators and a consumer of prey).

In general, the more niches that exist in a given ecosystem, the more potential niches can be created. For example, in rainforests the wet tropical climate permits the growth of epiphytes on trees. Epiphytic bromeliads (whose niche is the moist tree trunk environment) collect their own water in a special cup. This tiny pond in turn provides a further niche for small animals that live and breed in these ponds, e.g. certain species of frogs.

Within ecosystems the living and non-living components interact with each other to produce a stable system in which the exchange of materials between the living and non-living parts follow circular paths. Ecosystems can vary in size from the smallest pond to the entire biosphere. Within a given ecosystem, different species occupy and exploit their own individual niches. Niches are more than just a physical location but can also include a combination of physiological and behavioural adaptations that give that species a particular advantage.