

Module One Lesson 2: Narrative

Driving Question: What is an Ecosystem?

Before considering the ecology of cities *in-depth*, we had better make sure that we understand ecosystems *in general*. We define an ecosystem as *a community of living things that interact with each other and with the physical environment*. So, the saltmarshes along the coastline are distinct ecosystems. The wooded valleys of the White Mountains in New Hampshire (the ones you can see from the Prudential Building) are also unique ecosystems. So are the rivers and streams that cross through our landscapes. But, what makes ecosystems different from each other? What makes a hot desert different from a rain forest, or a snow-covered mountain peak? Ecosystems are distinguished by their physical characteristics, such as precipitation, temperature and available sunlight. These factors are the non-living elements we call *abiotic factors*. These physical characteristics of each ecosystem determine which plants and animals can live there. The living organisms are the *biotic components* of the ecosystem. The organisms living in a given ecosystem are linked together by their need for similar conditions. They are all adapted to live in that type of environment. Our investigations will reveal that the organisms in an ecosystem are all interdependent upon each other for their survival as well.



Above left: Saltmarsh and barrier beach ecosystem from Cape Cod Bay, Massachusetts. Saltmarshes are characterized by having both fresh water from the mainland and saltwater from the ocean – all mixing vigorously because of the action of the tides. These ecosystems were common along Boston’s coastline until nearly 350 square miles of saltmarsh were filled in the 18th, 19th and 20th centuries to provide additional building space for the growing city. The extent of the value of saltmarsh ecosystems was not fully understood until after they were lost to development. These ecosystems provide homes to shellfish, finfish and other species important to humans as food. In addition, these marshes absorb the energy and floodwaters of storms, such as hurricanes and winter gales. Storm damage to our coastal cities is made much worse when saltmarshes are missing from the coastline. The damage caused to New Orleans by Hurricane Katrina was made much worse by the loss of nearly 2500 square miles of marshes in that region.

Above right: A diamondback terrapin female leaves the saltmarsh to lay her eggs in the sand dunes of the barrier beach. These turtles are important predators in saltmarsh ecosystems. Their populations have been severely reduced due to the loss of habitat from the filling of marshes. They are protected in Massachusetts by the State’s Endangered Species Protection Laws.

The study of ecology and ecosystems is a relatively new science, only about a hundred years old. Ecology as a term was coined by the German zoologist Ernst Haeckel in 1866 and is derived from the Greek word *Oikos*, which roughly translated means *house*. The idea here is that ecology is the study of systems that are all interconnected – just like people living together in a house. This holistic approach to biology challenges some of the traditions of the scientific method, which tends to reduce all questions to a single variable. Ecologists also use the scientific method, but their models tend to be focused on the interaction among the organisms living together in a system. It's the *systems* thinking that is the unique contribution of ecology to the life sciences. The ecological approach holds great potential for understanding urban systems as well.



Above: Aldo Leopold cataloging data at his study site in Wisconsin. Not only was Professor Leopold a pioneering scientist in ecological systems, but through his writings was able to reach the general public with the idea that ecosystems were precious resources to be protected and saved. His most famous work, entitled A Sand County Almanac, became required reading for a whole generation of conservation scientists and activists who would follow in his footsteps. He developed the philosophy of the Land Ethic, which stated that ecosystems are valuable as they are and must be maintained. His most famous quote from the book is “A thing is right when it tends to preserve the integrity, stability, and beauty the biotic community”. This philosophy is a guiding idea for all ecologists today – including those that work in cities.

The key aspect of an ecosystem is that the organisms within that system interact in a variety of ways. They are interdependent upon one another for the sustainability of that ecosystem. The energy within the ecosystem moves among the living organisms through food webs and predator-prey relationships. For instance, in a New England forest, rabbits that feed on grasses, may get eaten by a red fox, who may in-turn, be consumed by a bear. The energy from the sun, that initially entered the ecosystem through photosynthesis by plants, gets distributed through the ecosystem through these food webs. Many other complex relationships exist as well. Remember from an earlier section in this module that honeybees get their food from the nectar in flowers. But this meal is not just a free lunch. The plants providing the nutritious nectar have evolved to do so in order to get bees to carry the pollen from flower to flower. That is how those flowers get pollinated and are able to continue their life cycle. Without bees, there would be many fewer species of plants in those ecosystems that have honeybees. The interactions among organisms are very complicated and include such things as cooperation and parasitism – all relationships that you will investigate.



Left: An adult male cardinal (Cardinalis cardinalis) munching on a seed. When cardinals eat seeds, many of them remain undigested and are excreted by the bird in other parts of the habitat. This helps the plants spread their genes through the ecosystem by disbursing them through birds. The dispersal of seeds is a key ecological function of birds that eat fruit and is a mutualistic relationship among some species of birds and plants. They both require each other in order to survive and reproduce.

- l Finally, sustainable ecosystems are those that continue to provide for the organisms that live there. Ecosystems are naturally *resilient*. That means they can withstand challenges such as storms, drought or fire. Typically, natural ecosystems have been surviving for thousands, or even millions of years. Protecting ecosystems from human disturbance is very complicated and requires more than just passive protection like fences. Ecosystems need clean water and air and a stable climate to survive. The natural resiliency of ecosystems is profoundly challenged when they include cities. This is where the study of *urban ecology* becomes so interesting and where you have a critical role to play!