The DIRT Society

Introduction to Ecology

It is impossible to fully understand any living thing without studying its environment. An organism and its surroundings are so critically linked that an entire scientific field of study exists to analyze and research that relationship. This study is called ecology, and its sole purpose is to understand interdependence.

Note: Ecology is the study of interdependence between organisms and their environments.

An organism interacts with the life around it, but it interacts with non-living matter as well. In ecology, these are referred to as **biotic** and **abiotic** components, respectively. To consider the effects of one without the other results in a flawed understanding of an ecosystem (which always includes both).

To give you an idea of what an ecosystem could look like and how it might operate, consider this simplified, miniature model:

The American Backyard

We'll use a backyard as an example, not because it is a particularly rich or diverse sample of your greater biome (ecological region), but because it is familiar to many people who may have overlooked its numerous interdependent lifecycles.

Within the backyard, you might find the following throughout the year: deciduous (leafy) trees, evergreen trees, dandelions, clover, bees, spiders, mosquitos, worms, squirrels, fleas, children, songbirds, snails, mushrooms, moss, etc. With magnification, you would see much more: Bacteria growing in a child's mouth and on its skin, fungi clinging to plant roots, protozoa and nematodes, larvae and eggs. This constitutes the backyard's biodiversity.

But none of this would exist without the abiotic material on which it depends. From lichens to you; everything relies on non-living material (such as climate, rainfall, minerals and sunlight) to survive. Moreover, we are all similarly dependent upon the death of living organisms. Without cycles of death and decomposition, our ecosystem would fail to recycle nutrients. Thus, all that you observe in a single backyard is dependent upon living, dead and abiotic matter to survive; including yourself.

You are a consumer. You need edible plants and, therefore, require water, sun, soil, decomposed organic matter, pollinating insects, worms, bacteria and all of the habitats and fuel that each of those biotic components may require to live and procreate. In short; you rely on many systems that can easily be taken for granted. Should you choose to supply your diet with vegetables grown in your backyard ecosystem, those needs become apparent. (Try growing food without any microorganisms aerating your soil and you'll quickly understand: Even the microscopic lives are critical lives.)

So we are all dependent on both biotic and abiotic matter. But how are all of these interconnected relationships organized?

There's a simple method of visualizing an ecosystem's cycles and ladders of nutrient transfer: a **food web**. At its core, a food web is a map connecting nutrients to consumers by drawing food chains. If you wrote down a few randomly selected organisms spotted in an American backyard at one time, you would very likely be able to draw a sort of food web. The following is an example:

You record the following: An oak tree, a patch of carrots, a squirrel, a raccoon, a green caterpillar, red clover, an earthworm, a robin, a crab spider and yourself. Which of these organisms depends on the other for food?

Food Chain 1: The caterpillar feeds on the carrots. It could easily be eaten up by the robin. The raccoon could eat the eggs in the robin's nest.

Food Chain 2: The caterpillar feeds on the carrots. If it matures into a butterfly, it would feed on the clover. In doing so, it might be consumed by the crab spider, which could then be eaten by the robin. The raccoon, again, could eat the robin's eggs. Anything not eaten, when dead, will decompose into soil.

Food Chain 3: The oak tree produces acorns that are eaten by squirrels and raccoons. The remnants of these fruits, as well as the feces produced, fall to the ground. This is digested by earthworms, which produce nutrient-rich organic matter in the soil. The carrot plants absorb these nutrients via root systems, and grow large tap roots and leafy green foliage. The caterpillar feeds on the leaves. You then pull a carrot (the tap root) and eat it. Some day in the future, you and the caterpillar will die and all of those nutrients will slowly be returned to the soil as either decomposed or digested material; feeding worm and oak.

There are many more chains, of course. So far, we have only discussed food. A proper ecological evaluation would also take into consideration the shelter the oak tree provides, the water you supply the carrots, the nitrogen-fixing bacteria among the clover roots, the hours of sunlight, etc. The relationships are diverse and interwoven.

To disregard these relationships will eliminate some individuals or communities, and invite new ones to take up the vacated space. If, for instance, the oak tree were removed, what might happen to the backyard? One scenario could be the slow loss of organic matter in the soil once the roots, leaves and wildlife shelter are gone. This would deter worms and microorganisms who feed on that soil, and their absence would mean a marked diminishment of birdlife. In order to coax life back into the plot, a gardener would have to amend the soil or wait years and years for native species to return in increments. Therein lies an enormous obstacle in maintaining ecosystems: ***What is easy to destroy is costly to replace.***

And, thus far, we've only focused on a tiny, limited sample of life on earth; a backyard.

Ecology and Farms:

Now try to focus on a bigger picture. A small farm could easily be 400 times as large as the backyard. To farm a swath of land that size requires constant evaluation of the ecosystem which contains it. Failure to monitor the biotic and abiotic cycles occurring within and just outside of the farm could result in devastating biodiversity loss, the migration of beneficial animals, habitat destruction, depleted crop yields, exposure to disease, infertile soil and susceptibility to pests. Thus, agroecology was developed.

Note: Agroecology is a fast-growing field of study that investigates natural, interdependent systems linked to agricultural operations.

Agroecology is an excellent way to better understand human society's negative and positive roles within our ecosystem, as the agricultural industry is both vital and comprehensive. However, understanding the basics of ecology will help you to become a better consumer and participant within your complex and diverse ecosystem.

The Fundamentals of Ecology:

A common first step toward understanding ecology, as it is in biology, is to evaluate the structure of living things. In biology, you may begin with an organism and work your way down to its cellular components. This enables you to reevaluate and understand the organism for what it is; a body built up of many functioning mechanisms and units. In ecology, however, you work upwards. Students begin with an individual and end with the entire network of interrelated ecosystems that form biospheres and planets. After this, they can evaluate an individual once more; finally comprehending its place within a much larger body. That network, as a whole, is the ecosystem.

The structure can be described in increasing levels of complexity, as follows:

1. The organism itself. One example might be you. Another could be a Bluff Oak.
2. Population. As a human, your population is that of human-kind. While populations are typically limited by location and other factors, the human population is a global one. You could start a family two thousand miles away from where you sit today, or you could never travel further than your city block. Most living populations are more isolated than you are. The Bluff Oak, for example, is found only in a small strip of coastal land within North America. Within this strip, there could be a population of Bluff Oaks within Mobile, Alabama. You are an individual within your population. One tree is an individual within its own population.
3. Outside of your own species, there are many other forms of life that inhabit the same space. As detailed above, your own backyard hosts other animals, as well as vegetation, fungi, bacteria, etc. The Bluff Oak we've isolated in Mobile, Alabama is surrounded by growing, decomposing, reproducing wildlife as well. The varying organisms within a space are collectively called its "community".
4. One step further is the ecosystem; the focus of ecology as a study. Your ecosystem includes you, your population, the community interacting with your population and, finally, the abiotic matter upon which you depend. When you consider your ecosystem, you must consider all of these; humans, animals, plants, microorganisms, sunlight, rain, rock, etc. Each participant in an ecosystem has a function.

Outside of an ecosystem is its biome, or ecoregion. These areas are defined by their climate and composition. Knowing the characteristics of a biome can help you understand general rules that apply within it. For example, a wildfire is not likely to destroy an entire rainforest. It may, however, incinerate a chaparral. The latter will be enriched by the fire; the former might never recover. Ecoregions, then, are broad areas that share a few key limitations and patterns thanks, in part, to their somewhat predictable components.

Combine all of these systems and networks together and you'll arrive at a biosphere. This is a word used to describe everything within a contained space, such as earth.

Now return back to the individual. What impact might they have on a body that enormous? If your individual is an oak tree, the answer is likely to be *little, and only after a good deal of time*. As a rule, change occurs slowly and over generations. Mutations, disasters and climactic shifts aside, ecosystems adapt with gradual steps.

If, however, your individual is a human…

Humans are unique among animals. We are the only known community that willingly and enthusiastically depletes its own resources when that consumption is not necessary. We will strip rainforests to build furniture, dump ash into clean water to avoid expense, hunt a species to extinction despite having plentiful food stores, and, most often, buy from the companies that do this (thereby feeling distanced and innocent of our contribution). Even now, understanding what we do about the delicate balance of interdependent systems, humankind tends to be slow to adapt. Our lives are short compared to the damage we cause, and this knowledge sustains our belief that we are guiltless, or the situation mild. If you consider, however, that generations to come will be dependent upon commercially produced fertilizers, amendments, food, shelter, and climate control, as opposed to coexisting with, and benefitting from, naturally occurring ecological systems; our decision to consume without care is a frightening one. If nothing else, we are dooming ourselves to a future where life will be completely dependent on a person's ability to pay self-interested manufacturers and distributors for the things they need to live.

Humankind has an odd position within its own ecosystem. We are one of the most destructive forces the planet has ever seen, and we show little sign of change. If nothing else, a general study of ecology will allow you to question that behavior.

Ecology is a study of interrelatedness. And no biotic or abiotic matter exists outside of its reach. In developing an understanding of the subject you, as a guaranteed participant, are informing yourself about your own role, limitations and responsibility. While that isn't always a pleasant lesson to learn, it is one that will enable society to function at a higher level; ensuring future success and the wellbeing of organisms seen and unseen. Furthermore, there can be no subject more fascinating. Ecology will continue growing indefinitely, changing daily, adapting to its own audience and giving back infinitely.