

Developments in Ecology, 1900-1949

Overview

Through ancient descriptions of the relationship between organisms and the environment, the science of "ecology" can be traced to the philosophical interests of the Greeks during the time of Aristotle (384-322 B.C.). The Greek philosophical interest in nature paved the way centuries later for "naturalists" who—at home and in newly discovered lands—explored nature and classified its types. A true science of ecology did not emerge until the early twentieth century when scholars began looking at the natural environment as a place where there were "relationships." As ecology matured, ecologists began looking at animals and plants as communities and became concerned with population growth and its limits, cooperation and competition in nature, and, most recently, making evaluations of energy use and transfer in nature.

Background

"The science of nature" took a giant leap in the nineteenth century when naturalist Charles Darwin (1809-1882) published his views on evolution and natural selection, processes by which species change and forms succeed one another through adaptation to the environment to attain a better "fit." The direction of species change was called "succession" by evolutionists. The effects of environment and succession became fundamental concepts to ecology.

Late in the 1800s, a shift from exploration and classification toward trying to understand how nature works became a focus for scientists. With the new focus came an interest in studying plants and animals and their relationship with the environment. Scientists began to understand animals and plant populations as "communities." By the early 1900s, botanists and zoologists, both in England and the United States, studied plant and animal "communities" independently until a new science, "ecology," emerged that could embrace both fields.

While the new science had some foundation in Darwin's concepts of evolution and natural selection, most historians of ecology cite an indirect rather than direct role for Darwinism in the growth of the science of ecology. They suggest that internal changes in the fields of biology, botany, and zoology created ecology.

The independent science of ecology began in the 1890s. Many cite the German zoologist Ernst Haeckel (1834-1919) as the most likely "father" of ecology, based on his holistic approach to biology. Haeckel's ideas about energy flow in a closed system formed the foundation of modern ecology half a century after his work.

Impact

In the early 1900s, the new science of ecology struggled to establish its independence from biology and zoology. Its emergence was tied to changes in the other sciences that did not acknowledge the organism-environment relationship. Rather than just the study of organisms as individuals, the focus of ecology became the study of relationships in nature and how the relationships created a kind of "community."

In the United Kingdom, university scholars and new institutions, such as the British Ecological Society, founded in 1913, took the lead in ecology. World War I interrupted the development of ecology as many of the young scholars died in the war. Following the war, a general philosophical pessimism about the human role in nature and progress intervened. By the 1920s, however, scientists in a variety of biological, zoological, geological, mineralogical, and entomological studies began following a similar theoretical thread—that organisms and their environments were systematically, interdependently, and harmoniously balanced. How that balance worked became a subject of study for early ecologists.

In the first two decades of the twentieth century, the University of Chicago became a center for the study of ecology in the United States. For members of "The Chicago School," ecological interdependence in nature meant that nature evolved in such a way that animal and plant forms succeeded one another to benefit the community. Pioneering animal ecology at the University of Chicago at this time was Victor Shelford, who became the first president of the Ecological Society of America (1916). Shelford studied correlations between changes in animal populations and environmental changes.

New terms had to be created to discuss environmental relationships the ecologists described. Russian scientist Georgii Gause, for example, revived the term "niche," nearly forgotten from Darwinian studies. In 1921, Russian mineralogist Vladimir Ivanovich coined the term "biosphere" to offer a holistic view of nature, one in which all the parts were related. Ironically, plant and animal ecologists formed two distinct disciplines at this time.

Those interested in human populations were yet another group of scientists eventually found under the ecology umbrella. As far back as the eighteenth century, British clergyman Thomas Malthus (1766-1834) drew attention to the problem of rapid human population growth and a decreasing ability to feed more people. In his footsteps, early population ecologists, such as Raymond Pearl, Alfred J. Lotka, and V. Volterra, began developing mathematical formulas to study population growth and its limits.

Lotka published *Elements of Physical Biology* in 1925, inspiring a new aspect of ecology, called "population ecology," a science focused on not only population growth but competition between species occupying the same environment.

Early studies on the genetic control of growth—a field that would become known as ecological genetics—were carried out by Julian Huxley (1887-1975) and Edmund Ford in Great Britain from 1923-1926. Working with fresh water crustaceans, they found that

genes controlled the time and occurrence of physiological processes and that animal population growth and change could be calculated.

In 1927, in his book *Animal Ecology*, British biologist Charles Elton popularized the concept of an animal's "niche" in local ecology, portraying niche as a kind of "job" an animal has in nature. Elton, a zoologist, rebelled against the emphasis on comparative anatomy, popular at the time, and focused on animals' natural habitat.

Studying in the Canadian Arctic with the Hudson Bay Company, Elton discovered simplifications in environmental relationships that may have been overlooked in more complicated ecosystems. He was interested in population size and its constraints, leading him to comparatively study populations of furbearing mammals and the records of Arctic fur trappers. In his next book, *Animal Ecology and Evolution* (1930), Elton stressed the idea that there was no "balance" in nature, that in times of environmental stress animals can change their habitat, a process just the opposite of natural selection by which the environment selects positive traits in animals. In 1932, Elton established the Bureau of Animal Population at Oxford.

In 1931, at the University of Chicago, Warder C. Allee, a professor of zoology, published "Animal Aggregation: A Study in General Sociology." Allee, a founding figure in American ecology, maintained that animals cooperated for their group benefit. Allee challenged the animal behaviorists who established the concept of "pecking orders" in nature. Allee said that pecking orders were not universal and a dangerous model on which to make comments on human societies. He stressed that success for populations—both in nature and in human societies—was to be found in cooperation. Population growth and its limits, said Allee, were controlled by an "optimum clumping factor," by which overcrowding limits population.

American ecologist Frederick E. Clements stressed in the 1930s that ecological relationships between species occupying a particular territory could form a coherent system able to be studied as a unit. Clements worked with Victor Shelford, who was the first president of the Ecological Society of America. Together they published *Bio-ecology*, which developed the concept of the "biome"—the community of plants and animals in a zone. While theories proposed by Allee and Clements stressed community cooperation in nature, their work conflicted with that of Pearl and Lotka, who stressed individuals and their intra-population competition.

At this same time, Canadian William Thompson argued that natural relationships were unpredictable and competitive, while Gause was trying to show that competing species could not occupy the same niche. Gause postulated what he called the "competitive exclusionary principle" by which populations became limited through competition for food.

Visiting the Galapagos Islands in the late 1930s, British young ornithologist David Lack restudied the finches that helped Darwin form his theory of natural selection. Lack's examination of their food and the environment refocused attention on Darwinian theory

and helped further the popularity of Darwin's famous voyage on H.M.S. *Beagle* and reinforced Darwin's thesis that interaction between a species and the environment could mean extinction if the species could not adapt. Lack's book, *Darwin's Finches* (1947), addressed both the evolution and the principle of competitive exclusion and ecological effects.

During the 1940s and after World War II until mid-century, the science of ecology and the environmentalist movement began to converge as both ecologists and environmentalists felt that nature was something that humans must proactively protect. In the 1940s, the British government created a wildlife conservation committee and, in 1949, created from that committee the Nature Conservancy.

Just prior to 1950, there was a shift in the focus of ecology away from a descriptive examination of environmental niche toward analyses of energy use and distribution. In 1942, American ecologist Raymond Lindeman delivered a classic paper in which he demonstrated that the transfer of the Sun's energy in part of Cedar Lake Bog (Minnesota) was transferred to another part of the lake, but with a loss of energy. By the end of the 1940s and using Lindeman's foundation, two American brothers, Eugene and Howard Odum, introduced the concept of "systems ecology." The work of Lindeman and the Odums had its roots in the concept of "ecosystem," a unit consisting of interacting organisms and all of the aspects of the environment in which they interact. The Odums worked with the idea that ecosystems could be represented and analyzed in terms of "energy flow." They and others tried to create mathematical models that would explain ecosystem energy and its flow.

Although the growth of the science of ecology and concern for the environment converged toward the middle of the twentieth century, ecology should not be confused with "environmentalism," although environmentalists and ecologists today accept the idea that a species can be wiped out by the destruction of their fragile ecosystem. The ideas ecologists and environmentalists share are a combination of Darwinism and introspective examinations of plants and animals and how and where they live. These concepts form both the foundation for the modern science of ecology as well as the emotional and political aspects of concern for the welfare of the Earth and its plant and animal inhabitants.

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Further Reading

Books

Allee, Warder Clyde. *Cooperation Among Animals*. New York: Henry Schuman, 1951.

Boughey, Arthur. *Ecology of Populations*. New York: MacMillan, 1968.

Bowler, Peter J. *The Norton History of Environmental Science*. New York: W.W. Norton, 1992.

Bramwell, Anna. *Ecology in the 20th Century: A History*. New Haven: Yale University Press, 1989.

Kingland, Sharon E. *Modeling Nature*. Chicago: University of Chicago Press, 1985.

THE GROWTH OF ENVIRONMENTALISM, 1900-1949

Ecology, the scientific study of relationships in the natural environment, is often confused with "environmentalism," a concern with conserving the natural environment by protecting it from the adverse affects of human use. Nineteenth-century American writers such as Henry David Thoreau expressed concern that development was spoiling natural areas. As the nineteenth century ended, public, state, and national parks developed in the United States to conserve areas of natural beauty. Before World War I President Theodore Roosevelt, an outdoorsman, established the national parks system to preserve wilderness in the early 1900s.

In the 1930s the American experience with the Dust Bowl of the Midwest showed that the destruction of the soil by reckless farming could permanently affect the land. By this time, the harmful effects of industrialization and urbanization also became apparent. Public concern about shrinking natural resources translated into some government action during the 1930s New Deal program, yet there was growing tension between those who wanted unrestrained exploitation of nature and those seeking to conserve it. The tension was also felt in Great Britain and in Europe, where conservationists often became associated with left-wing and socialist movements. Environmentalists' ideas likely grew out of what some historians call "the Haeckelian religion of nature," a philosophy based on the emotional aspects of German biologist Ernest Haeckel's work. Great Britain and Europe saw the rise of "green" political parties concerned with conservation vigorously opposed by right-winged industrialists, whom the environmentalists saw as destroying nature. Exploitation versus conservation became—and remains—an emotional and political issue.

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