

e4 Ecological Groups < food web >

... isn't all shade-grown coffee and soy-based inks on recycled paper. —Joe Queenan.¹

Ecology, the word coined in 1866 by Ernst Heinrich Haeckel (1834-1919) (German *Ökologie*, from Gk. *öko-* dwelling, or home, and *-logie* study) is the life science that explores the interrelationships of organisms with their environment (their surroundings, their setting, which the Latin word *viron* “circle” means). It is what in the eighteenth century was referred to as “natural history.”²

Ellen Goldensohn finds that the definition of ecology is still well given by the entry for *Histoire naturelle*, attributed to Denis Diderot in the *Encyclopédie*, 1751-72, when it was understood to be the ultimate scientific discipline:³

The object of Natural History [ecology] is as extensive as nature; it condenses all the beings which live on the earth, which lift themselves into the air, or which remain in the bosom of the waters. ... Natural history in its widest extent would embrace the entire universe. ... But the more we have acquired knowledge, the more we have been ... forced to divide it into different kinds of sciences. This division is not always exact, because the sciences are not so distinct that ... they do not merge into one another and connect at several points, in both their generalities and their particulars.

Ecology, more narrowly, is the study of the way (living) organisms (divided into three groups: 1) plants as producers, 2) animals as consumers, and 3) fungi and many bacteria as decomposers) interact with the environment of inorganic (not due to life) substances and energy (such as sunlight or volcanic heat). Syntrophy is when metabolic wastes of some, are food or an energy source essential for others. Syntrophic networks ranging from in your gut to in noxious sediments, are discussed by T. Fenchel and B. J. Finlay in *Ecology in Evolution in Anoxic Worlds*, 1995.⁴

Of fungi, Elio Schaechter writes:⁵

We enlist their help in making bread, wine and beer, and are vexed by the disease that they cause in humans, animals and plants. We know them as unicellular yeasts, filamentous moulds and complex-looking mushrooms. Less widely appreciated is their most important pursuit: they are the essential decomposers of vegetable matter. Quite simply, life on Earth would not be possible without the recycling activity of fungi.

Sobering though is Peter J. Morin's observation:⁶

Spectacularly complex natural ecosystems, such as tropical rainforests and coral reefs, have alternately inspired speculations about the causes of diversity and stymied the kinds of experiments required to sort pattern from process. Long-lived organisms, such as trees and corals, simply respond too slowly to experimental manipulations of productivity; it would take many human generations for responses to become apparent, even assuming that alterations of productivity at the appropriate scale could be engineered. That is why purpose-built ecosystems composed of short-lived organisms ... are playing an increasingly prominent part in tests of ecological theory.

So ecology, more holistically, is the study of the workings of *ecosystems* (term introduced in 1935 by A. G. Tansley),⁷ each composed of a biological community and its associated abiotic environment. Ecosystems do not exceed the constraints of thermodynamic laws. Processes that are observed:

1) neither create nor destroy energy —First law (formulated by Julius Robert Mayer (1814-1878)⁸ in 1842 but disregarded until James Prescott Joule in 1843 aired his “conservation of energy law”).⁹

2) produce entropy or dissipate energy —Second law (which gives us time's arrow).

3) allow energy to flow through the system, when it is open, or non-isolated, in a way that defines the system —partly deduced from 2, Third law (absolute zero temperature implies zero entropy).

4) form an ordered structure (called a “dissipative structure” by H. J. Morowitz in 1992)¹⁰ —tentative Fourth law of thermodynamics that, as proposed by Sven E. Jørgensen beginning in 1992, is inductively testable in so far as it anticipates “which ordered structure among the possible ones will be selected, or which factors determine how an ecosystem will grow and develop.”¹¹ □