

LIFE ON EARTH

*An Encyclopedia of Biodiversity,
Ecology, and Evolution*

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Economics

Economics is the study of human choices. Whether at the microlevel of the household or firm, or the macrolevel of nation-states, twentieth-century economics was primarily concerned with the choice of how best to allocate scarce resources to achieve individual, community, and societal goals. Maximizing efficiency has been the primary method of solving allocation problems at these varying scales. To do so, all units of a particular allocation problem must be valued in a common metric, most often money. This quest for an efficient, monetized allocation scheme led to the late-twentieth century dominance of market mechanisms and institutions in industrialized economies. Although originally conceived as the study of the "people's household," economics today is mostly concerned with the study of market choices in a variety of contexts.

Economics was not always so narrowly focused on the study of market behavior. The first economists of the industrial revolution were philosophers with broad interests and interactions with diverse pursuits of knowledge. The writings of Adam Smith, Thomas Malthus, and other classical economists are thought to have influenced Darwin in constructing his theories of evolution. However, a philosophy of economics grounded in contemporary knowledge of other disciplines and structured by physical resource scarcity and limits to technology has largely been abandoned

in favor of a social science grounded in mathematical abstraction and a narrowly conceived theoretical architecture. Modern economic theory—applied to topics ranging from mate selection and stock market valuation to interest rate policy and environmental protection—is based on an axiom of efficiency by which optimal (the best) choice is determined at the point where marginal benefits of an action are equated with its marginal costs. The choice to produce or consume the next unit of a good or service is what economists refer to as a marginal choice, and it is argued as the basis for all efficient decision-making.

In a free market, in which consumers and producers are allowed to weigh their own marginal costs and benefits in making individual choices, the agglomeration of efficient individual decisions is argued as the social system that produces the most goods and services. This market distribution of maximum production—under constraints of labor, land, capital, and technology—does not consider allocation fairness, the scale of market activity, or any distinction between necessity and luxury goods. More is preferred to less in a system based on maximizing individual gains.

As economics is the dominant social science and preeminent advisor to nearly all levels of governance and policy-making, understanding its implications is paramount to protecting biodiversity. Economics as taught in most educational institutions has three major implications for the protection of biodiversity. First, decision-making based on principles of economics has no consideration for the scale of any activity. More goods and services are always preferred to less. Whether a particular resource allocation takes up more or less resources does not influence its adoption. A science of choice without self-imposed limits can be pursued only at the competitive exclusion of all other uses of energy and raw mate-

rials, and thus poses a fundamental threat to the biodiversity that all life depends upon.

The second major implication of economics on biodiversity has been its influence in the design of programs to manage and protect biodiversity in accordance with market principles. Many environmental protection policies must be justified on both economic and scientific grounds. Economic criteria revolve around measuring marginal costs and marginal benefits. This requires placing monetary value on nonmarket goods (such as biodiversity) in order to construct tradeoffs between conflicting resource uses. Economists have developed methods for imputing monetary value to natural resources and ecosystem services, including individual species. In this manner, the monetary value of a species or ecosystem can be compared with the monetary value of goods and services forgone for its protection. However, although such valuation can be a useful exercise for policy-makers in certain well-defined contexts, it cannot guarantee biodiversity protection. In fact, monetary valuation implies substitutability between market and nonmarket goods and services, a dangerous implication in the case of biodiversity that has no manufactured equivalent. A significant literature has demonstrated the "rationality" of driving a species to extinction under a market system of choice and a monetary measure of value.

A third implication of standard economic theory on biodiversity is the use of marginal units of analysis and continuous functions of change. Central to economic theory is the notion that optimal decisions must be made at the margin. In other words, it is only the next unit of a resource consumed or output produced that matters in the calculus of optimal decision-making. However, attention to the next unit fails to consider irreversibility, feedback loops, discontinuous change, and other

complexities inherent in natural and social systems. A science of choice based on marginal change applied in a setting that does not respond predictably can result in unintended consequences.

Standard economic theory has come under intense criticism from both its practitioners and from natural scientists who seek to understand its implications on fundamental ecosystem services. Recent cooperative efforts between economists, other social scientists, and natural scientists have made gains in creating an economics for the twenty-first century that is more holistic in approach, broader in scope, and interdisciplinary in content. For instance, the transdiscipline of ecological economics argues for well-defined limits to substitution, minimum stocks of natural capital, preservation of ecosystem function, and a focus on resilience over optimality.

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See also: Industrial Revolution/Industrialization; Sustainable Development; Urbanization; Valuing Biodiversity

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Ecosystems

Ecosystems consist of co-occurring organisms, their connections to each other and to surrounding environments, and the parts of their environments that are controlled or incorporated into their lives to such an extent that sep-