

In *Encyclopedia of Bioethics, Revised Edition*,
Warren T. Reich, ed. New York: Macmillan Library
Reference, Simon and Schuster, 1995. Pages 671-75.
Also in later editions.

ENDANGERED SPECIES AND BIODIVERSITY

Although projections vary, reliable estimates are that about 20 percent of Earth's species may be lost within a few decades, if present trends go unreversed. These losses will be about evenly distributed through major groups of plants and animals in both developed and developing nations, with special concerns over tropical forests (Ehrlich and Ehrlich, 1981; Wilson, 1988).

The United Nations at the 1992 Earth Summit in Rio de Janeiro launched the Convention on Biological Diversity, signed by 153 nations that are "concerned that biological diversity is being significantly reduced by certain human activities" and who are "conscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity," and "conscious also of the importance of biological diversity for evolution and for maintaining life sustaining systems of the biosphere" (United Nations, 1992, Preamble).

The U.S. Congress has lamented the lack of "adequate concern [for] and conservation [of]" species, and has sought to protect species through the Endangered Species Act, as well as through the Convention on International Trade in Endangered Species (U.S. Congress, 1973, Sec. 2(a) (1)). About five hundred species, subspecies, and varieties of fauna have been lost since 1600 in what is now the continental United States. The natural rate would have been about ten (Opler, 1976). In Hawaii, of sixty-eight species of birds unique to the islands, forty-one are extinct or virtually so. Half of the twenty-two hundred native plants are endangered or threatened. A candidate list for all states contains over two thousand taxa (species and significant subspecies and forms) considered to be endangered, threatened, or of concern, three categories used to rank degree of jeopardy (U.S. Fish and Wildlife Service, 1990). Human-caused extinctions threaten to approach and even exceed the catastrophic extinction rates of the geological past.

Even where species are not endangered, almost all inhabited lands are impoverished of their native fauna

and flora, owing to development, loss of habitat, hunting, collection, trade in fauna and flora, toxic pollutants, introduction of exotic species, and other disturbances produced by humans. Sustainable biodiversity, the use of biotic resources so as to leave them unimpaired for future generations, is an increasing concern. Another concern is the loss of wetlands, permanently or periodically flooded or wet areas, which today in many areas are less than 10 percent of their original area. There is hardly a forest, grassland, or desert system in the developed world that is not impoverished of its once-native fauna and flora. Old-growth or pristine forests have been cut rapidly, as have tropical rain forests. Island ecosystems, often with species peculiar to that location and found nowhere else, are particularly at risk.

In the conservation of endangered species and biodiversity, bioethics in principle and in practice involves an unprecedented mix of science and conscience, especially since the species and ecosystem levels seldom figured in earlier ethical deliberations. A rationale for saving species that centers on their worth to persons is anthropocentric; a rationale that includes their intrinsic and ecosystemic values, in addition to or independently of persons, is naturalistic.

On an anthropocentric account, the duties involved are to persons; there are no duties to endangered species, though duties may concern species. Persons have a strong duty of nonmaleficence—not to harm others—and a weaker, though important, duty of beneficence—to help others. Many endangered species—which ones we may not now know—are expected to have agricultural, industrial, and medical benefits. They may be of scientific value, serve as indicators of ecosystem health, or provide genetic breeding stock for improvement of cultivated plants. Humans ought to conserve their global resources, a matter of prudence and enlightened self-interest in general, but a matter of moral concern when some persons threaten the benefits of these resources for other persons. Nonrenewable resources may have to be mined and consumed, but biological resources can be perennially renewable.

A developing concern between the species-rich, often underdeveloped countries and the developed countries, which are frequently responsible in part for environmental degradation, is who should bear the costs of saving species relative to benefits gained. Historically, native plant species, seeds, and germ plasm have been considered not to be owned by any nation. Developing nations are now claiming ownership by the country of origin, arguing that these resources cannot be used by those in other nations without negotiating compensation. At the same time, developing nations claim that their biological resources are being conserved for the benefit of other nations, and that the developed nations ought to pay developing nations not only for new con-

servation measures put into effect there but also for the lost opportunity costs of development in such conserved areas.

The Convention on Biological Diversity states: "States have sovereign rights over their own biological resources" (United Nations, 1992, Preamble) and continues, "Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation" (Art. 15). Nevertheless, the problem of reconciling biodiversity as a common heritage of humankind with biodiversity as a national resource remains unresolved. States may control access to biodiversity, but this does not imply ownership. The United States refused to sign the Convention over questions of ownership, both of the wild biodiversity and of beneficial technology derived from it.

On the harm side, the loss of a few species may have no evident results now, but the loss of many species imperils the resilience and stability of the ecosystems on which humans depend. The danger increases with subtractions from the ecosystem, a slippery slope into serious troubles. Many species that have no direct value to humans are part of the biodiversity that keeps ecosystems healthy. On the benefits side again, there are less tangible benefits. Species that are too rare to play roles in ecosystems can have recreational and aesthetic value—even, for many persons, religious value. Species can be curiosities. They can be clues to understanding natural history. Destroying species is like tearing pages out of an unread book, written in a language humans hardly know how to read, about the place where they live. Humans need insight into the full text of natural history.

Such anthropic reasons are pragmatic and impressive. They are also moral, since persons are benefited or hurt. But can all duties concerning species be analyzed as duties to persons? Many endangered species have no resource value, nor are they particularly important for the other reasons given above. Are there worthless species? As curiosities and relics of the past, perhaps all species can be given an umbrella protection by saying that humans ought to preserve an environment adequate to match their capacity to wonder. Nature is a kind of wonderland. But this introduces the question of whether preserving resources for wonder is not better seen as preserving a remarkable natural history that has objective worth—an evolutionary process that has spontaneously assembled millions of species. A naturalistic account values species and speciation directly.

A further rationale is that humans of decent character will refrain from needless destruction of all kinds, including destruction of any species. Such a prohibition seems to depend, however, on some value in the species

as such, for there need be no prohibition against destroying a valueless thing. The deeper problem with the anthropocentric rationale is that its justifications are less than fully moral, fundamentally exploitive, and self-serving, even if subtly so. This is not true intraspecifically among humans, when out of a sense of duty an individual defers to the values of other persons. But it is true interspecifically, since *Homo sapiens* treats all other species as resources. Ethics has always involved partners with entwined destinies. But ethics has never been very convincing when pleaded as enlightened self-interest (that one ought always to do what is in one's intelligent self-interest), including class self-interest, even though in practice altruistic ethics often needs to be reinforced by self-interest. To value all other species only in terms of human interests is rather like a nation's arguing all its foreign policy in terms of national self-interest. Neither seems to be completely moral.

It is safe to say that in the decades ahead, the quality of life will decline in proportion to the loss of biotic diversity, though it is often thought that one must sacrifice that diversity to improve human life. So there is a sense in which humans will not be losers if we save endangered species. Humans who protect endangered species will, if and when they change their value priorities, be better persons for their admiring respect for other forms of life. But this should not obscure the fact that humans can be short-term losers. Sometimes we do have to make genuine sacrifices, at least in terms of what we presently value, to preserve species. If, for instance, Americans wish to save the spotted owl, they will have to pay higher prices for timber and accept some job losses and relocations.

Dealing with a problem correctly requires an appropriate way of thinking about it. On the scale of evolutionary time, humans appear late and suddenly. Even later and more suddenly they increase the extinction rate dramatically. What is offensive in such conduct is not merely the loss of resources but also the maelstrom of killing and insensitivity to forms of life. What is required is not prudence but principled responsibility to the biospheric Earth.

There are problems at two levels when considering duties to species; one is about facts (a scientific issue), and one is about values (an ethical issue). First, what sort of biological entity is a species? Indeed, do species exist at all? No one doubts that individual organisms exist, but species can have a more controversial factual reality. Taxonomists regularly revise species designations and routinely put after a species the name of the "author" who, they say, "erected" the taxon. If a species is only a category or class, boundary lines may be arbitrarily drawn, and the species is nothing more than a convenient grouping of its members, an artifact of taxonomists. Some natural properties are used—reproduc-

tive structures, bones, teeth. But which properties are selected and where the lines are drawn vary with taxonomists.

If this approach is pressed, species can become a conventional concept, a mapping device, that is only theoretical, something like the lines of longitude and latitude. Sometimes endangered species designations have altered when taxonomists have decided to lump or split previous groupings. To whatever degree species are artifacts of taxonomists, duties to save them seem unconvincing. No one proposes duties to genera, families, orders, phyla; biologists concede that these do not exist in nature.

On a more realist account, a biological species is not just a class; it is a living historical form (Latin *species*, a natural kind), propagated in individual organisms, that flows dynamically over generations. Species are dynamic natural kinds, historically particular lineages. A species is a coherent, ongoing form of life expressed in organisms, encoded in gene flow, and shaped by the environment. In this sense, species are objectively there as living processes in the evolutionary ecosystem—found, not made, by taxonomists. The claim that there are specific forms of life historically maintained in their environments over time does not seem arbitrary but, rather, as certain as anything else we believe about the empirical world, even though at times scientists revise the theories and taxa with which they map these forms.

Species are not so much like lines of latitude and longitude as like mountains and rivers, phenomena objectively there to be mapped. The edges of such natural kinds will sometimes be fuzzy, to some extent discretionary. We can expect that one species will slide into another over evolutionary time. But it does not follow from the fact that speciation is sometimes in progress that species are merely made up, instead of found as evolutionary lines articulated into diverse forms, each with its more or less distinct integrity, breeding population, gene pool, and role in its ecosystem (Rojas, 1992).

Having recognized what a species is, the next question is why species ought to be protected. The naturalistic answer is that humans ought to respect these dynamic life forms preserved in historical lines, vital informational processes that persist genetically over millions of years, overleaping short-lived individuals. It is not *form* (species) as mere morphology, but the formative (speciating) process that humans ought to preserve, although the process cannot be preserved without its products. Endangered "species" is a convenient and realistic way of tagging this process, but protection can be interpreted (as the Endangered Species Act permits) in terms of subspecies, variety, or other taxa or categories that point out the diverse forms of life.

A consideration of species is both revealing and challenging because it offers a biologically based coun-

terexample to the focus on individuals—typically sentient and usually persons—so characteristic in Western ethics. In an evolutionary ecosystem, it is not mere individuality that counts; the species is also significant because it is a dynamic life form maintained over time by an informed genetic flow. The individual represents (re-presents) a species in each new generation. It is a token of a type, and the type is more important than the token. A biological identity—a kind of value—is here defended. The dignity resides in the dynamic form; the individual inherits this, exemplifies it, and passes it on.

A species lacks moral agency, reflective self-awareness, sentience, and organic individuality. Some have been tempted to say that species-level processes cannot count morally. But each ongoing species defends a form of life, and these diverse species are, on the whole, good kinds. Such speciation has achieved all the planetary richness of life. All ethicists say that in *Homo sapiens* one species has appeared that not only exists but also ought to exist. A naturalistic ethic refuses to say this exclusively of a late-coming, highly developed form, and extends this duty more broadly to the other species—though not with equal intensity over them all, in view of varied levels of evolutionary achievement. Only the human species contains moral agents, but conscience ought not to be used to exempt every other form of life from consideration, with the resulting paradox that the sole moral species acts only in its collective self-interest toward all the rest.

Extinction shuts down the generative processes. The wrong that humans are doing, or allowing to happen through carelessness, is stopping the historical gene flow on which the vitality of life is based, and which, viewed at another level, is the same as the flow of natural kinds. Every extinction is an incremental decay in this stopping of life. Every extinction is a kind of super-killing. It kills forms (species) beyond individuals. It kills "essences" beyond "existences," the "soul" as well as the "body." It kills collectively, not just distributively. We do not merely lament the loss of potential human information; we lament the loss of biological information, present independently of instrumental human uses of it. A shutdown of the life stream on Earth is the most destructive event possible. Each human-caused extinction edges us further in this direction; already the rate may be catastrophic.

A consideration of species strains any ethic fixed on individual organisms, much less on sentience or persons. But the result can be biologically sounder, though it revises what was formerly thought to be logically permissible or ethically binding. When ethics is informed by this kind of biology, it is appropriate to attach duty dynamically to the specific form of life. The species line is the more fundamental living system, the whole of which individual organisms are the essential parts. The species,

too, has its integrity, its individuality; and it is more important to protect this than to protect individual integrity. The appropriate survival unit is the appropriate level of moral concern.

A species is what it is inseparably from the environmental niche into which it fits. Particular species may not be essential in the sense that the ecosystem can survive the loss of individual species without adverse effect. But habitats are essential to species, and an endangered species typically means an endangered habitat. Species play lesser or greater roles in their habitats. This leads to an enlarged concern for the preservation of species in the system. It is not merely *what* they are, but *where* they are that one must value correctly. This limits the otherwise important role that zoos and botanical gardens can play in the conservation of species. They can provide research, a refuge for species, breeding programs, aid for public education, and so forth, but they cannot simulate the ongoing dynamism of gene flow over time under the selection pressures in a wild ecosystem. They amputate the species from its habitat.

Extinction is a quite natural event, but there are important theoretical and practical differences between natural and anthropogenic (human-caused) extinctions. Artificial extinction, caused by human encroachments, is radically different from natural extinction. Relevant differences make the two as morally distinct as death by natural causes is from murder. Though harmful to a species, extinction in nature is seldom an evil in the system. It is, rather, the key to tomorrow. The species is employed in, but abandoned to, the larger historical evolution of life. There are replacements. Such extinction is normal turnover in ongoing speciation.

Anthropogenic extinction differs from evolutionary extinction in that hundreds of thousands of species will perish because of culturally altered environments that are radically different from the spontaneous environments in which such species are naturally selected and in which they sometimes go extinct. In natural extinction, nature takes away life when it has become unfit in habitat, or when the habitat alters, and typically supplies other life in its place. Artificial extinction shuts down tomorrow, because it shuts down speciation. Natural extinction typically occurs with transformation, either of the extinct line or of related or competing lines. Artificial extinction is without issue. One opens doors; the other closes them. In artificial extinctions, humans generate and regenerate nothing; they only dead-end these lines.

Through evolutionary time nature has provided new species at a net higher rate than the extinction rate; hence the accumulated global diversity. There have been infrequent catastrophic extinction events, anomalies in the record, each succeeded by a recovery of previous diversity. Although natural events, these ex-

inctions so deviate from the normal trends that many paleontologists look for causes external to the evolutionary ecosystem—supernovas or collisions with asteroids. Typically, however, the biological processes that characterise Earth are both prolific and have considerable powers of recovery after catastrophe. Uninterrupted by accident, or even interrupted so, they steadily increase the numbers of species.

An ethicist has to be circumspect. An argument may commit what logicians call the genetic fallacy in supposing that present value depends upon origins. Species judged today to have intrinsic value may have arisen anciently and anomalously from a valueless context, akin to the way in which life arose mysteriously from nonliving materials. But in an ecosystem, what a thing is differentiates poorly from the generating and sustaining matrix. The individual and the species have their value inevitably in the context of the forces that beget them. There is something awesome about an Earth that begins with zero and runs up toward five to ten million species in several billion years, setbacks notwithstanding.

Several billion years' worth of creative toil, several million species of teeming life, have been handed over to the care of the late-coming species in which mind has flowered and morals have emerged. On the humanistic account, such species ought to be saved for their benefits to humans. On the naturalistic account, the sole moral species has a duty to do something less self-interested than count all the products of an evolutionary ecosystem as human resources; rather, this host of species has a claim to care in its own right. There is something Newtonian, not yet Einsteinian, as well as something morally naive, about living in a reference frame where one species takes itself as absolute and values everything else relative to its utility.

In addition to the deeper ethical principles at issue in conservation of species, questions of pragmatic strategy arise. One strategy proposed when there are limited resources is to sort jeopardized species into three groups: those that are probably going extinct even if we try hard to save them, those that will probably survive without our help, and those that will probably go extinct unless we intervene. This strategy is called triage. An alternative, or complementary, strategy is to focus more on endangered ecosystems than on single species, an approach that may result both in more effective management and in more efficient use of resources. Another strategy discourages claiming biodiversity as a national resource while thinking of conservation in other nations in terms of foreign policy, for if biodiversity is the common heritage of humankind, all nations share duties to protect it.

Directly related to this entry are the entries ANIMAL WELFARE AND RIGHTS, articles on ETHICAL PERSPECTIVES ON THE TREATMENT AND STATUS OF ANIMALS, and WILDLIFE CONSERVATION AND MANAGEMENT; ENVIRONMENTAL ETHICS, articles on DEEP ECOLOGY, and LAND ETHIC; ENVIRONMENTAL POLICY AND LAW and HAZARDOUS WASTES AND TOXIC SUBSTANCES. For a discussion of related ideas, see the entries ENVIRONMENT AND RELIGION; FUTURE GENERATIONS, OBLIGATIONS TO; and RIGHTS, article on RIGHTS IN BIOETHICS. Other relevant material may be found under the entries AGRICULTURE; BIOETHICS; CLIMATIC CHANGE; ENVIRONMENTAL ETHICS, the OVERVIEW, and article on ECOFEMINISM; EVOLUTION; NATIVE AMERICAN RELIGIONS; and SUSTAINABLE DEVELOPMENT. See also the APPENDIX (CODES, OATHS, AND DIRECTIVES RELATED TO BIOETHICS), Section VI: ETHICAL DIRECTIVES PERTAINING TO THE ENVIRONMENT.

Bibliography

- EHRlich, PAUL, and EHRlich, ANNE, 1981. *Extinction: The Causes and Consequences of the Disappearance of Species*. New York: Random House.
- NORTON, BRYAN G., ed. 1986. *The Preservation of Species: The Value of Biological Diversity*. Princeton, N.J.: Princeton University Press.
- OPLER, PAUL A. 1976. "The Parade of Passing Species: A Survey of Extinctions in the U.S." *The Science Teacher* 43, no. 9:30-34.
- ROJAS, MARTHA, 1992. "The Species Problem and Conservation: What Are We Protecting?" *Conservation Biology* 6, no. 2:170-178.
- ROLSTON, HOLMES, III. 1985. "Duties to Endangered Species." *Bioscience* 35:718-726.
- , 1988. "Life in Jeopardy: Duties to Endangered Species." Chap. 4 in his *Environmental Ethics: Duties to and Values in the Natural World*. Philadelphia: Temple University Press.
- UNITED NATIONS ENVIRONMENT PROGRAM, 1992. *Convention on Biological Diversity, 5 June 1992*.
- UNITED STATES CONGRESS. 1973. Endangered Species Act of 1973. 87 Stat. 884. Public Law 93-205.
- UNITED STATES FISH AND WILDLIFE SERVICE. 1990. List in 55 *Federal Register* no. 35 (February 21): 6184-6229.
- WILSON, EDWARD O., ed. 1988. *Biodiversity*. Washington, D.C.: National Academy Press.