

By Holmes Rolston, III

In Defense of Ecosystems

The Endangered Species Act has been so significant that some environmentalists propose an Endangered Ecosystems Act. This concern for ecosystems is appropriate. Our concern must be for the fundamental unit of survival and, zoos and botanical gardens notwithstanding, the preservation of individuals is really impossible without the preservation of ecosystems. A species is what it is where it is—a bear without a forest is a compromised bear. An ecologically informed society must save organisms within ecosystems.

This shift of focus from individuals or species to ecosystems can be defended using the familiar reason of self-interest: Biotic diversity is an important human resource. Another reason is one of morality: Humans ought to respect life, of both fellow humans and wild creatures, and ecosystems are necessary to support life. An ecosystem is instrumental to plant, animal and human life. That is why we care. What more needs to be said?

At bottom, however, the defense of ecosystems involves more vision, more moral courage. “A thing is right,” concluded the naturalist Aldo Leopold, “when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise.” Leopold wanted a “land ethic,” one that embraced concern for individual plants, animals and persons, but also, and fundamentally, loved and respected biotic communities.

*An environmental ethic
cannot be complete
without concern for
the living community
as a whole*

Can we make sense of this deeper ethic? Can we value ecosystem communities for what they are in themselves?

A positive answer requires a mix of biology and ethics. Ecology discovers what is taking place in ecosystems, what biotic community means as an organizational mode enveloping organisms. Ethics discovers the values in such community-systems and our human duties toward them. We need an understanding of what ecosystems are before we can make an informed judgment whether humans ought to preserve them. To move from biology to ethics we have to make clear a model of community.

What are ecosystems?

To some, ecosystems seem to be little more than random, statistical processes. In this view, a tundra is a loose collection of externally related parts. Much is not organic at all (rain, groundwater, rocks, nonbiotic soil particles, air), while some of the organic material is dead and decaying debris (fallen trees, scat, humus). These things have no organized needs; the collection of them is a jumble, hardly a community.

The plants and animals within an ecosystem do have needs—each defends its own life. Nevertheless, in this view, the interplay among plants and animals is simply a matter of their distribution and abundance: how they get dispersed here and not there, birth rates and death rates, population densities, moisture requirements, parasitism and predation, checks and balances. There is only a catch-as-catch-can scrimmage for nutrients and energy, really not enough integrated process to call the whole a community.

Unlike plants and animals, an ecosystem has no organized center—no genome, no brain, no self-identification. It does not defend itself against injury or death, as do bluejays and milkweeds. It is not irritable. It has no *telos*—no unified program it is set to execute. In this sense, the parts (foxes, wolves, sedges) are more complex than the wholes (forests, grasslands).

We respect a plant or animal because it defends its organized biological identity, but an ecosystem (we

Bombay Hook National Wildlife Refuge, Delaware River

To some, an ecosystem seems to be little more than a random process without a unified program.



Larry Lefever from Grant Heilman



Desert east of Las Vegas Ed Cooper

Although the connections are loose, the looseness generates unique individual organisms.

may first think) is too low a level of organization to be so respected. To make an analogy with human society: However much society supplies a context of support and identity, it is the person, the high point of individuality, that is valued. Similarly, in nature we should count the nearest thing—the organism—as the moral focus in ecosystems.

Indeed—to take the argument a stage further—a basic problem is that ecosystems have no experiences: They do not and cannot “care.” The higher

animals within them can and do care, looking out for their own interests (in fact, these interests can at times constrain human conduct). But ecosystems have no interests about which they or we can care.

More troublesome still, an ecosystem, in the view of some, is a jungle where the fittest survive, a place of contest and conflict, beside which the organism is a model of cooperation. In animals, the heart, liver, muscles and brain are tightly integrated, as are the leaves, cambium and roots in plants.



Ecosystems select over the long term for individuality, for diversification, for quantity and quality of life.

But the ecosystem “community,” so-called, is all pushing and hauling between rivals, or else all indifference and haphazard juxtaposition—in any event, nothing to call forth our admiration.

Ecosystems as communities

To say that and nothing more is to misunderstand ecosystems. Even before the rise of ecology, biologists had concluded that to portray a gladiatorial survival of the fittest was a distortion. Biologists prefer as a model

the selection of the better adapted. A bear fits a forest just as much as its heart fits its lungs. There are differences—the heart and lungs are close-coupled in a way that bear and forest are not. Still, the bear requires its forest community; the bear-organism fits there, as surely as its organs fit together to compose a bear.

There is a crucial element of struggle, but it is equally important to see this as taking place within the context of a community. Ecological science emphasizes how there is a biological, though not a cultural, sense in which deer and cougar cooperate, and the integrity, beauty and stability of each is bound up with the other. Predator and prey, parasite and host, grazer and grazed—all require a coevolution,

since the health of the predator, parasite or grazer is locked into the continuing existence, even the welfare, of the prey, host or grazed. In ecosystems, contending forces are in dynamic process. Like business, politics and sports, ecosystems thrive on competition.

The community connections are looser than the organism’s internal interconnections. But that does not mean they are less significant. Admiring concentrated unity in organisms and stumbling over environmental looseness is like valuing mountains and despising valleys. Unity is admirable in the organism, but the matrix the organism requires in order to survive is the open, pluralistic ecology.

Dialectic with the loose environment, rich in opportunity, demanding in know-how, invites and requires creativity. Indeed, internal complexity—heart, liver, muscles, brain—arises as a way of dealing with a complex, tricky environment. The skin-out processes are not just the support, they are the subtle source of the skin-in processes. Had there been either simplicity or lock-step concentrated unity in the surroundings, no internal unity could have evolved. There would have been less elegance in life.

To look at one level for what is appropriate at another level makes what philosophers call a category mistake. Often, we look to ecosystems for what we respect in individual animals and plants, find such characteristics missing, and then judge that ecosystems do not count morally. We fault communities for not being individual organisms.

One should not look for a single center or a fixed program in ecosystems. Instead, one should look for a matrix, for interconnections between centers (individual plants and animals), and for creative stimulus and open-ended potential. Everything will be connected to many other things, sometimes by obligate associations, more often by partial and pliable dependencies and, among other things, there will be no significant interac-

tions. There will be functions with a communal sense: shunts and criss-crossing pathways, cybernetic subsystems and feedback loops.

An ecosystem generates a spontaneous order that exceeds in richness, beauty, integrity and dynamic stability the order of any of its component parts. It is an order that feeds, and is fed by, the richness, beauty and integrity of its components. Though its organized interdependencies are "loose," they are all as vitally linked as liver and heart. The equilibrating ecosystem is not merely a balance of push-pull forces. It is an equilibrating of materials and energies that support life, of lives that are entwined with each other—in that sense, an equilibrating of values.

Ecosystems shaping evolution

Over the short term ecosystems are cyclic. In ecosystem succession, one species pushes out another until the way is paved for climax species to become established. On regional scales the succession of species within an ecosystem is always somewhere being upset, by such events as fires, floods, disease epidemics, windstorms, volcanic eruptions and glaciation.

But over evolutionary time, ecosystems are strikingly historical. Over geological time extinction and re-speciation in ecosystems have increasingly differentiated natural kinds, steadily increasing the number of species on Earth from zero to five million or more. Aldo Leopold wrote, "Science has given us many doubts, but it has given us at least one certainty: the trend of evolution is to elaborate and diversify the biota." R.H. Whittaker found that on continental scales and for most groups, "increase of species diversity . . . is a self-augmenting evolutionary process without any evident limit." There is a tendency toward what he called "species packing," more and more species fitted into ecosystems over evolutionary time.

Superimposed on this increase of quantity has been an increase in the

Human cultures emerge from Earth's ecosystems and remain tethered to them. Humans do not count so much that they have the right to degrade them.



Sierra Nevada, Yosemite Stephen P. Parker

quality of individual lives in the upper rungs of the food chains. One-celled organisms evolved into many-celled, highly integrated organisms. Photosynthesis evolved and came to support locomotion—swimming, walking, running, flight. Stimulus-response mechanisms became complex instinctive acts. Warm-blooded animals followed cold-blooded ones. Complex nervous systems, conditioned behavior and learning emerged. Sentience appeared—sight, smell, hearing, taste, pleasure, pain. Brains coupled with hands. Consciousness and self-consciousness arose. Humans appeared, with their intense concentrated unity. Rising above spontaneous wild nature, humans can form cultures and

deliberately rebuild much of their environment. In some sense culture transcends the evolutionary forces of natural selection.

These developments free individuals. A falcon, which can overlook a territory, migrate, or switch prey, is more liberated in its ecosystem than is the grass further down in its food chain. Plants are self-nourishing but rooted to the soil. The higher creatures, like the falcon, just because they do depend on the energy capture and food synthesis of rooted plants, gain mobility, sentience, perception.

These developments do not take place in all ecosystems or at every level—microbes, plants and lower ani-
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Ecosystems

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imals continue and serve continuing roles. All the understories remain occupied. As a result, the quantity of life and its diverse qualities continue undiminished.

Finally, the looseness in ecosystems generates uniqueness. The looseness introduces random events to every particular organism, which make for distinctive characteristics and fortunes—no two maple trees are alike. There is a wildness in ecosystems that resists being completely specified in geology, botany, zoology and ecology textbooks, even when principles set forth there are coupled with initial conditions. Scientific laws never catch in individual detail all that goes on in a particular swamp or canyon. No matter how well one knows a particular place, tomorrow and next year will bring surprises.

Ecosystems as selective systems

That ecosystems select for individuality is a strange, liberating priority. That process—the increase of individuals in kind and complexity, in quantity and quality, resulting in no two of a kind exactly alike—is as much to be defended as any of its products. The flourishing and freedom of individuals are possible in such a system, indeed they are promoted by it.

Organisms defend only their own selves, with individuals defending their continuing survival and species increasing their kinds. But the ecosystem spins a bigger story, promoting new arrivals, increasing kinds and the integration of kinds.

Ecosystems are also selective systems. They select over the long term for individuality, for diversification, for sufficient containment, for quantity and quality of life. In ways that are appropriate for biological communities, ecosystems use communal processes—the conflict between organisms, more or less probable events, plant and animal successions, speciation over historical time—to generate an ever-richer community.

The ecosystem is a kind of field, with characteristics as essential for life as any property of an organism. The individual or species and its environment are not linked by accident, and the organizational differences between them are not accidental either.

A current debate among biologists is about the levels at which selection takes place—individual organisms, populations, species, genes. The recent tendency, to emphasize selection pressures at the genetic level, forgets that a gene is always within an organism, within an ecosystem. It is true that the genetic material, the DNA, arises from molecular mutations, but the particular DNA that survives is selected for adaptive fit in an ecosystem. The configurations of DNA therefore record the story of a particular form of life in the historical ecosystem. We cannot make sense of molecular life without understanding ecosystem life. The one level is as vital as the other.

Sometimes it is even held that organisms or their biochemical molecules are “real,” actually existing as entities, whereas ecosystems are just collections of interacting individuals. (In this view, oak trees are real, but forests are nothing more than collections of trees.) This too is a confusion. Any level is real if it shapes behavior on the level below it. Thus the atom is real because that pattern shapes the behavior of electrons; the cell because that pattern shapes the behavior of amino acids; the organism because that pattern coordinates the behavior of hearts and lungs.

The community is real because the niche shapes the morphology and behavior of the oak trees within it. Being real at the level of community does not require boundaries or complex centeredness. It only requires an organization that shapes, perhaps freely so, the behavior of its members.

An ecological ethic

If we say that ecosystems are of value only for their contribution to human experience, we miss the values intrinsic to the system. The humanist posi-

tion takes a part—the human part—for the whole. It has a bias, valuing one late product of the system: psychological life. It subordinates everything else to this. It mistakes the last chapter for the whole story.

What is of value in the biological world is not just the production of human pleasures and positive experiences. What is right includes ecosystem patterns, organisms in their generating, sustaining environments.

How do we justify gains in human satisfaction against losses in ecosystem process? As a general rule, humans count enough to have the right to flourish within ecosystems, but they do not count so much that they have the right to degrade or shut down ecosystems. Our human satisfactions are, and ought to be, sufficiently contained within these objectively satisfactory ecosystems. If this cannot be a rule with which to judge the past, since our environments are so greatly modified, at least it can help envision the future. From here on, an important ethical constraint in environmental decisions should be concern for the integrity, stability and beauty of biotic communities.

Ecosystems are the womb of life, the archetypal garden. They select for adaptive fit, have projected over time lives increasingly rich in quality and quantity, and continue now to support myriad species and individuals, with higher levels of autonomy and experience at the top food-chain levels. Human cultures emerge from Earth's ecosystems and remain tethered to them. If we do not see that such biotic communities are admirable, satisfactory and morally considerable—why not? □

Holmes Rolston, III, is professor of philosophy at Colorado State University. His book Environmental Ethics (Temple University Press) and his chapter in Companion to a Sand County Almanac (University of Wisconsin Press, edited by J. Baird Callicott) both defend in more detail duties to ecosystems.