Where Do Organisms End?

CRAIG HOLDREGE

This short essay was stimulated by a question Eliot Schneiderman — a biologist and neighbor — raised after reading the description of bloodroot in The Nature Institute's *In Context* #2. Eliot mentioned that ants are known to disperse the seeds of bloodroot. He briefly described this fascinating process and then remarked: "You described bloodroot in its annual cycle, but don't the ants belong to the wholeness of bloodroot as well?"

My immediate reaction was: Of course! I had tried to show that we need to go beyond any one momentary state of the plant and begin to grasp it as a process in time. But I didn't go further, which Eliot pointed out. It is a further step to view everything we call the "environmental interactions" of an organism as part of that organism, for without these interactions the organism wouldn't exist. Because our minds grasp spatial entities most easily, we tend to become lazy and not make the effort to see how every organism extends beyond itself as a physical entity, revealing itself functionally as part of a larger whole.

Ants and Seeds

Seeds are a favorite food of birds, rodents, and some insects. They are often eaten soon after the fruit opens and they fall to the ground. In the case of bloodroot — and many other plants — ants do not eat the seeds but instead pick them up and carry them to their nest. Each bloodroot seed has a small outgrowth called an elaiosome. The elaiosome grows outside the seed coat and is not part of the germ. It is mainly fed to the larvae of the ants. Biochemical analysis shows that elaiosomes are nutritious, being rich in fats and sugars. The fast-growing larvae thrive on this nutrient-rich food.

The seed itself, retaining its potential for germination, is discarded, usually with other organic waste from the nest. As Andrew Beattie, who studied these ant-plant interactions, put it, the seeds are placed on "private compost heaps" (Beattie 1985, p. 2). In fact, plants do grow out of such "seed beds" and often are more numerous and tend to take hold better than seeds that don't originate in ant nests.

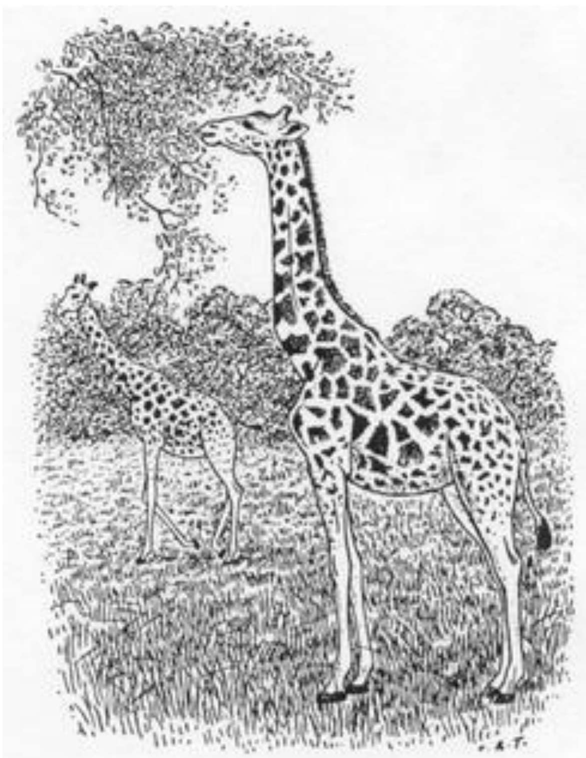
In this manner, bloodroot spreads out in lowland forests with the help of ants. Bloodroot is found in clusters of a few to perhaps ten or twenty flowering stalks. These "plants" are usually connected subterraneously — meaning they are actually branches from the same plant that, under good conditions, continues to grow year by year. When the ants come, they move the plant, via the seeds, beyond these narrow bounds, and provide the conditions for a new colony of bloodroot to develop. In this sense the ants belong to bloodroot, just as bloodroot — as food — belongs to the ants.

Giraffes and Acacias

Giraffes prefer the leaves of acacia trees to leaves of most other plants — although acacias have thorns. Giraffes browse in the crowns of the trees, reaching up to a height of fifteen or more feet. Scientists in South Africa observed that giraffes browsed acacias near water holes more intensely than trees far away from such water sources (du

Toit et al. 1990). Acacias grow new shoots after the onset of the rainy season (one or two times a year). The scientists found that the shoots from the more heavily browsed trees grew back very rapidly, and grew to greater length, which compensated for the intense browsing. In contrast, the lightly browsed acacias grew smaller shoots, so that the net shoot extension was the same in both habitats.

In other words, giraffe browsing stimulated growth of the acacias in relation to the degree of browsing -- a wonderful example of dynamic balance, which then becomes disturbed when the



habitat is too small for the number of giraffes living in it. The heavily browsed acacias reacted to giraffe feeding in another, perhaps more surprising way. The leaves that grew in the rainy season after browsing were more nutrient-rich and contained significantly fewer condensed tannins, which make leaves less palatable. Tannins are substances formed after cessation of leaf growth, while nutrient-rich phosphorus and nitrogen compounds are formed during growth. Stimulated by browsing, the acacia leaves remained in a more juvenile state, which is exactly the type of leaf giraffes prefer!

In conceiving abstractly of discrete organisms, we think of giraffe and acacia as separate entities, which of course they are *physically* when the giraffe is not feeding. But the fed-on acacia is not the same after giraffe browsing. It takes more minerals out of the soil and forms nutrient-rich substances in its leaves, while suppressing leaf-aging as indicated in less tannin formation. In this way the giraffe has become part of the acacia. Then, when it feeds again, the giraffe feeds on something that is connected to its own activity. The apparently clear boundary between organisms dissolves and we are led to picture organisms as *interpenetrating* each other rather than being *next* to each other.

Bison and Prairie

Observing bison, I'm not alone in intuitively sensing that the bison and the prairie belong together. With the reintroduction of bison herds into prairie reserves in the Midwest, scientists have been able to observe how bison — along with fire — help to create and maintain prairies (Knapp et al. 1999).

Ungrazed long-grass prairies tend to become populated with a fairly small number of grass species. Bison feed mainly on grasses and usually avoid wildflowers. When bison have grazed a previously ungrazed area for a time, the composition of species shifts and a greater diversity of plants, especially wildflowers, arises. A rich and dynamic balance of species is maintained as long as the bison can move from place to place and are not forced to overgraze an area.

Bison are often found in late spring and early summer in areas that burned a few months before. Frequently burnt prairie that is not grazed typically has a low species diversity. When it is grazed by bison, not only do the bison have young, fast-growing, and nutrient-rich grasses to feed on (think of the giraffes and the acacias), but slowly the plant composition becomes more diverse, with more species of wildflowers and grasses taking hold.

If we imagine a herd of bison grazing and moving through a prairie, then we can recognize other ways in which the bison influence the prairie. Where bison defecate, urinate, or die, leaving the carcass, a zone of fertile soil and a new microhabitat are created. In such areas, grasses tend to thrive, attracting the bison returning to the area. Their feeding in turn stimulates the changes discussed above. The prairie becomes, as a result, a more diverse patchwork of microhabitats.

This tendency is increased by a particular habit of bison: in contrast to cattle, bison wallow. They paw the ground and then roll in the exposed soil. This activity creates, over time, circular denuded depressions about ten to fifteen feet in diameter and up to a foot deep in the middle. “Relic wallows still exist in many areas where bison have not occurred in the past 125 years” (Knapp et al., 1999).

Wallows collect rain water in the spring and support the growth of ephemeral wetland species. In the summer they dry out and become parched, supporting only drought-tolerant plants. Wallows thus become islands with a unique plant composition and contribute to the diverse, patchwork character of the prairie.

Bison are integral and active members of an entire landscape, the prairie. We could even say they landscape the prairie. From this perspective it seems justified to speak of the bison as an essential organ of the prairie. (Ecologists speak of a “keystone” species.)

The Ever-Extending Organism

These brief descriptions can lead us from a traditional notion of separate biological organisms to the conception of an ecological organism, of which the biological organisms are a part. Each species — bloodroot, giraffe, or bison — appears as a unique member of a habitat or landscape, like tissues or organs within an organism. In turn, we can study habitats and landscapes as dynamic members of larger ecosystems and bioregions.

Finally, we are led to the concept of the whole earth as an organism.

The further we move from the distinct biological organism to its larger dimensions, the more difficult it becomes to produce concrete and vibrant concepts that express organismic qualities. One always runs the danger of relying on schematic representations of interacting ecological factors. The ant, the fungus, the tree, the wildflower, the bacteria become mere intersections in a web of abstractions. We want to grasp what seems to be a palpable whole, but what we're left with has little life-blood coursing through it.

This is one of the reasons that I, personally, often focus on individual species. It is easier to develop organismic, relational thinking when one chooses a particular animal or plant as focal point from which to radiate out. Through such work one can develop the necessary mobility of thought to begin approaching, say, a forest habitat or a wetland in a similar fashion.

As difficult as it may be, we need more and more to *see* the organism in the habitat and in the landscape; otherwise, we wander blindly through a world of unseen relationships.

Life-Appropriate Ecology

The science of ecology has brought, on the one hand, wonderful phenomena into view — without which I wouldn't have been able to write this essay. But, on the other hand, the concepts ecologists use often stand in the way of understanding.

Ecologists rely largely on Darwinian concepts when viewing phenomena and framing their hypotheses, models, and explanations. On this view, each species embodies *survival strategies* that allow it to *survive* in the face of *competition* with other organisms. Every characteristic, each process, is interpreted as a means to survival. In this context, I will ignore the inherent danger of anthropomorphizing that goes with using such concepts. More fundamentally, they reveal an error in judgment.

When scientists speak of survival strategies and competition, then they have decided from the outset that organisms *are* single, discrete entities. This pre-judgment then demands that organisms interact and compete only *secondarily*. This is the ecological version of atomism. But all of ecology shows — when one looks to the phenomena and not the theories — that this is not the case. The organism *is* interaction with other organisms within the context of a habitat.

The single organism (or species) that is supposed to compete with others *does not exist*. It is far more appropriate to view organisms as members of a differentiable whole that has never dissolved into discrete entities. As the German neurologist and psychiatrist Kurt Goldstein pointed out, in biological terms, competition begins when the functioning of the whole becomes disharmonious or diseased; *then* self-preservation becomes an overriding tendency in an organism (Goldstein 1963, p. 443 ff.).

Discussing the concept of "struggle for existence" in his seminal work, *The Origin of Species*, Charles Darwin wrote that he would often use the term in a "large and metaphorical sense .... A plant on the edge of a desert is said to struggle for life against the drought, though more properly it should be said to be dependent on the moisture" (Darwin 1979, p.116). Although clearly aware of his loose use of language, Darwin did not think it was particularly relevant to understanding the phenomena. But, in fact, it makes all the difference in the world whether one uses the first expression, which separates the plant from the environment, putting it into a competitive relation, or whether one uses language that stays as close to the phenomena as possible. There is no question that saying the plant is "dependent on moisture" is a much more accurate and vital description than speaking of struggling or competing plants — expressions that create distance and conjure up independent agents.

It demands constant effort to form concepts and find expressions that stay near to the vibrancy of the phenomena and not to drift off into much easier atomistic, putting-things-together formulations merged with images of competition. But if we want to gain insight into the *living* interactions that characterize life, we have no choice but to overcome the many inadequate concepts used in ecology today.

~ ~ ~

A version of this article originally appeared in The Nature Institute's newsletter In Context *(Spring, 2000, pp. 14-16).*

References

Beattie, Andrew (1985). *The Evolutionary Ecology of Ant-Plant Mutualisms*. New York: Cambridge University Press.

Darwin, Charles (1979). *The Origin of Species*. New York: Penguin Books. (The first edition was published in 1859.)

du Toit, Johan T. et al. (1990). "Regrowth and Palatability of Acacia Shoots Following Pruning by African Savanna Browsers," *Ecology* 71:149-154.

Goldstein, Kurt (1963). *The Organism*. Boston: Beacon Press. (A reprint was published in 1995 by Zone Books in New York.)

Knapp, Alan K. et al. (1999). "The Keystone Role of Bison in North American Tallgrass Prairie," *BioScience* 49 (January): 39-50.