

A Practical View of Ecosystem Health And the Role of Science

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The concept of Ecosystem health is problematic for me as a scientist. Both parts of the concept, ecosystems and health, are neither arbitrary nor obvious. While they are certainly more than convenient constructs, they cannot be exactly defined or quantified. Neither defines the other. And putting them together seems to more than double the amount of scientific uncertainty. Why?

Part of the explanation is that the concept of ecosystem health evokes a mixture of theories, models, and practices from two very different kinds of science, theoretical ecology and medicine.

Consider medical science. It is steeped in empirical study of the human organism, depends upon practical applications, and has abundant relationships with human value systems. Medical science helps shape our personal expectations, relative to our infirmities. Human health seems to be a notion or gestalt informed by science but relying also upon careful judgement. How do we know we are healthy? My physician scans a clip-board full of scientific measurements that more or less relate to each other and to me, puts a finger to her forehead, and says, "you can go home tomorrow." Even as we age, it seems our health can be restored.

Now consider ecological science. It is steeped in theory about complex interactions within and among species and their habitats, and is relatively independent of human value systems. As the body of ecological theory has been advanced, the ecosystem concept has moved farther from the practical arena of management. While managers might appreciate the ecosystem concept, they can find it difficult to use as a practical template for managing our natural resources. How does a manager budget for travel around a complex adaptive pulsed system

that seems to defy geographic coordinates? The forest supervisor retreats from a scientific presentation on forest ecology and mutters to me over a styrene cup of cold coffee, "I want to manage the forest ecosystem, but I can't figure out where it is and where it isn't, or how much it will cost."

Part of the explanation is also that the emerging concept of ecosystem health has not been designed by scientists, rather it is being forced by public pressure to reverse a perceived chronic decline in natural resource availability. Simply stated, the public, and therefore also the government, want to use science to restore, and perhaps increase, some functions of ecosystems.

The internal conflict within the concept of ecological health is often evident as a semantic debate about ecological restoration. The concerned public who wants to regain ecological functions that have apparently been lost are confronted by scientists who understand that time goes in one direction, and ecosystems can't go backward.

This situation is sociological, in part because our open society does not permit natural resource managers to escape public sentiment. It suggests that neither the problem nor the solution is entirely scientific. Having accepted that, I propose the following definitions to bring the concepts of ecosystem and health together in a practical, useful way.

Ecosystem Health: the state or trend of our ecosystem relative to our shared goals. The sum of ecosystem goals represents ecological wellness, or ecosystem good health.

Based upon these simple definitions, the central questions about ecosystem health and the role of science become self-evident. The central questions are: what is the practical ecosystem, and what do we want it to do? The role of science is not necessarily to answer these questions, but to advance public debate toward the answers.

Why shared goals? Because ecosystem health care is public business. It requires consensus, coordination, and cooperation that cannot be achieved without a common vision or sense of purpose. The goals must be shared by the agencies of government that have major regulatory or operational interests in ecosystem health.

Who sets the goals? People who understand the problem and can anticipate the consequences if the problem isn't solved. Scientific thinking should comprise the core of any effort to develop ecosystem goals. For example, scientists should provide information about ecological resources, past and present, including perhaps which ones are ecologically more important, and scientists should try to explain ecological change. Furthermore, scientists can and should recommend the boundaries of what is achievable, in the context of natural and human controls on ecological functions. But scientists cannot and should not make final judgements about how much of what kinds of ecological functions is enough. Science can describe process and function, but it cannot define good or bad, right or wrong. Such judgements are a matter of policy.

What are the goals? They are quantitative statements of the desired level of ecosystem performance or affordable risk. They can be compliance standards, historical performance levels, or levels of performance that are unprecedented but patently desirable.

After goals are set, then a scientific process of observation and experimentation is required to help set a course of action to achieve the goals, measure progress toward the goals, minimize uncertainty, assess the risks that the goals will not be achieved, and help revise the goals for new understanding. Indicators of performance and risk must minimize the chance of falsely inferring health or illness. The need to prevent the false diagnosis of good health is especially important because it helps protect the ecosystem, and therefore us, from wrong programs and policies. More rigor is required to monitor and assess the ecosystem than to establish ecosystem goals.

The emerging model for ecological health care is elegant: establish scientifically valid ecosystem goals in the context of public expectations and policy; turn government programs into tools to achieve the goals; and monitor progress. According to this model, ecosystem health is the state or trend of the ecosystem relative to our shared goals. Everything that is done to achieve the goals is therefore ecological restoration, meaning the restoration of ecosystem good health.