
The outlook for fisheries in many marine and freshwater ecosystems is grim. Human-induced changes to ecosystems and the growing demand of a global market have caused widespread reductions in fish populations, leading to dramatic closures and, in many places, the loss of a way of life for fishing communities. In closed fisheries, managers and fishers watch with trepidation to see whether fish stocks will recover. It is in this context that Spencer Apollonio, a marine ecologist and veteran of New England fisheries agencies and commissions, explores the notion that current conservation and management practices are failing and that better options exist.

As a resident of Maine with an avid interest in the ecology and nautical history of this region, Apollonio has chosen to write about his backyard—the Gulf of Maine, a unique geological and ecological component of the North Atlantic coast. This system has a long and complex relationship with the fishers that use it. Apollonio points out that in the 17th century this system was teeming with groundfish, such as Atlantic cod (Gadus morhua), and marine mammals, including whales and seals. Centuries of fishing and, in particular, the technological leaps of the 20th century have reduced these populations to a fraction of their previous abundance.

Although it might be argued that the populations within the Gulf of Maine have declined for lack of regulation and enforcement, I am sure that agencies have expended much effort to stem the tide of overfishing. Traditional fisheries management applied to this ecosystem and others has been practiced only for about a half-century, focusing on population dynamics, relying on deterministic models, and typically assuming that populations are in equilibrium with environmental and fishing effects. Although these management approaches are still taught in many fisheries programs, regularly applied by fisheries agencies, and even mandated by the federal government, they have been widely criticized from within the discipline and beyond. However, they are deeply engrained in fisheries science, primarily because of an adherence to tradition and, probably more typically, a lack of robust alternatives.

Apollonio believes that much deeper mechanisms, not captured by contemporary fisheries management, are at work. Simply reducing exploitation or closing the fishery to rebuild stocks will often fail, because the ecosystem and its resident populations have undergone fundamental structural and functional changes as a function of industrial fishing. Many natural resource managers suspect that this is true and endorse a switch to holistic ecosystem management to better predict fisheries responses and develop policies. Unfortunately, a clear definition of “ecosystem management” in this context is elusive.

I was delighted when Apollonio proposed an alternative to the traditional approaches and provided a framework by which ecosystem management of exploited fisheries can be formally defined and adopted in decisionmaking. He invokes hierarchy theory, a concept currently in vogue in the ecological sciences. In the mid-20th century, when quantitative techniques were being folded into fisheries management, concepts such as hierarchy theory were being developed in other disciplines to address growing concerns about reductionism in science. Complex biological systems, including ecological systems, are typically hierarchical in nature, with higher levels constraining and ordering lower ones.

Ecosystems have emergent properties that are often simpler to describe and understand than their component parts. Hence, ecologists may use a hierarchical approach to find appropriate and manageable organizational scales for predicting how ecosystems work.

This theory, if found to be sufficiently general in its application, has compelling implications for the management of the Gulf of Maine and other complex ecosystems. After introducing hierarchical concepts early in the book, Apollonio describes the Gulf of Maine geology and ecology in great detail, promising to show later how hierarchy theory may be used to simplify and order our grasp of this complex system. I appreciated this primer, finding it critical for the lessons to follow. Relative to other comparable coastal systems, the Gulf of Maine ecosystem is a geologic youngster. Invoking succession spanning the centuries since the last glaciation, Apollonio argues that this ecosystem may have had less time to accumulate species with complex behavior and life histories and thus contains relatively few high-level hierarchical components to constrain and stabilize it. He believes that these constraining factors are stable, long-lived species that integrate the natural variability within ecosystems and typically are highly sought by humans (e.g., marine mammals, sharks, cod). In other words, the geologically young Gulf of Maine is susceptible to the loss of important higher hierarchical levels. And the decline of the historically abundant marine mammals that dominated the ecosystem in centuries past likely compromises the Gulf of Maine’s ecological stability and inherent predictability.

These are powerful ideas that, in my view, have much validity. Apollonio is suggesting that ecosystems have emergent characteristics that may be categorized and scaled to guide policy: It is important to protect those species that constrain and therefore stabilize the ecosystem. Rather than developing ever