

reader curious about perception, because it presents the original scientific reports in all of their technical detail. But for neuroscientists interested in vision, it is a gem in the history of the field and a core resource for understanding the roots of what we now know about the mammalian visual system.

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MARINE ECOLOGY

Toward Ecosystems Oceanography

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In ecology, stimulating fields of research can emerge from observed patterns. Analyzing the very irregular numbers of young herring and cod in the North Atlantic, the Norwegian marine biologist Johan Hjort noted that “the renewal of the [fish] stock... must depend upon highly variable natural conditions” (1). With those words in 1914, fisheries oceanography was born. Since then, the discipline has made considerable progress in relating environmental processes, and the spatial scales at which they act, to fish recruitment and the success or failure of fisheries. In their summary chapter in *Marine Ecosystems and Climate Variation*, the Norwegian ecologists Nils Chr. Stenseth and Geir Ottersen remark that “although the variation in North Atlantic cod stocks throughout the last decades is reasonably well known, the possibly major indirect community effects of the varying abundance of cod have not been studied with equal intensity.” Their statement reflects the book’s ambitious objective: to explore a wide range of ecological patterns in the North Atlantic driven by climate and involving phytoplankton, zooplankton, benthos, and seabirds as well as fish.

Disentangling the consequences of climate variation at an ecosystem level is not a simple task. We lack a general ecological theory that can adequately elucidate the functioning of marine ecosystems. But we ecologists can track patterns and processes. The book presents numerous examples that highlight apparent links between climate and marine ecology. It also elaborates con-

cepts, models, and statistical and simulation techniques for quantifying species interactions. Readers are treated to an overview of what happened in the North Atlantic during the last decades of the 20th century and of our current understanding of the causes of those changes. (The authors also include insights from the Pacific as well as from freshwater and terrestrial perspectives.)

The volume contains 16 chapters, with contributions from 40 authors. One might therefore worry about a lack of homogeneity in both presentation style and content, but the editors and authors have succeeded in producing a coherent, integrated treatment rather than a collection of disjointed chapters. An introduction effectively links the chapters to one another, and a unified conceptual framework structures the entire volume.

This structure is grounded in the argument that large-scale climate indices (e.g., the North Atlantic Oscillation or NAO) may serve as simplified proxies that capture the essence of the overall physical variability better than the complex of local observational details—the “package of weather” sensu Stenseth (2).

Nature is intricate. The effects of climate fluctuations on ecology may be nonlinear, can act with time lags that are difficult to detect, and may have both direct effects on



The fish that changed marine ecology. Atlantic cod (*Gadus morhua*).

life history traits and indirect effects through the food web. The contributors disentangle many ecological interactions in rather simple and convincing ways, producing what I consider to be ecological enlightenment.

The book focuses quite naturally on cod, a key predator species that has a central role in the ecosystem dynamics of the North Atlantic. The authors show how a given NAO pattern can correspond to varying levels of cod recruitment (good or poor) in different areas, which yield apparently contradictory results. Comparative analysis of the factors (e.g., air and water temperatures, ice cover, and winds) that appear to control cod recruitment at an ecosystem level among the different environmental settings of the Barents Sea, the North Sea, and Canadian waters offers an

elegant approach to unraveling this paradox. The chapters on phytoplankton, birds, and benthos offer intriguing insights into the subtle balances among direct and indirect environmental effects on species abundance.

The approach elaborated in the book supports the idea that the environment exerts significant controls on ecosystem dynamics. On the other hand, it is also abundantly clear that by greatly reducing the abundance of large predators such as cod, fisheries can have major direct effects on the structure and functioning of ecosystems—the resulting ecological patterns of such “top-down control” can be found in Daniel Pauly and Jay Maclean’s recent book (3). I believe that future work on the North Atlantic will benefit from a synthesis of these two viewpoints (climate change and overexploitation), presented as a unified treatment and not separately. However, the present book certainly kick-starts the process.

Recently the world ocean was subdivided into 64 large marine ecosystems (www.edc.uri.edu/lme), and the book’s conceptual framework should help stimulate research in these ecosystems. The book should also contribute to the efforts of several current international programs that address ecosystem integration (e.g., Global Ocean Ecosystem Dynamics and the European Network of Excellence for Ocean Ecosystems Analysis). In addition, the book provides a comprehensive approach to acknowledging ecological interactions between exploited and nonexploited species in the context of climate change. This is an important step, particularly given the recognized need to move toward an ecosystem approach to fisheries (4).

Will the book’s ecosystem oceanography become a new field of research? Time will tell. What can definitely be said is that *Marine Ecosystems and Climate Variation* excellently illustrates the issues of controls in marine ecosystems, addressing them in a convincing and organized manner. “Who controls whom” in marine ecosystems is a stubborn and intricate issue, but potentially solvable. At least that is the message of the Norwegian scientists and their colleagues.

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Marine Ecosystems and Climate Variation

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