

## BOOK REVIEW

**S.R. Carpenter, Regime shifts in lake ecosystems, pattern and variation. In O. Kinne (Ed.), Excellence in ecology (Vol. 15). International Ecology Institute Oldendorf, Germany, ISSN 0932-2205 (199pp., 52 figures, €40.00).**

Some 300 years ago the people of Easter Island, a remote and isolated place in the Southern Pacific, became victims of a catastrophe. Whatever the particular reasons might have been, it turned out in general that within a relatively short period of time human activities, in concert with natural factors, caused a significant drop in the island's primary productivity. Starvation, violence and massive mortality were the results leading to a dramatic decrease in population density. From an ecological point of view a "regime shift" had happened, and the new status of the ecosystem is likely to be irreversible. It is this kind of rapid change with long-term consequences in ecosystem organisation and feed-back that S. Carpenter's volume on regime shifts in lakes is concerned with.

The book is structured into eight related chapters supplemented by a section on Bayesian statistics. The author is addressing four major questions about regime shifts in lakes: (1) How to understand regime shifts? (2) How to anticipate regime shifts? (3) How to react to regime shifts? (4) What can be learned from management with respect to regime shifts?

Although these issues are highly interesting both from a scientific point of view and with respect to management activities, answers may not be found easily because there are three tricky problems to be tackled. First of all, regime shifts are rare occasions. Second, they are difficult to predict because the thresholds between two attractors are rarely known. Finally, experiments are hard to justify because to conduct them experimental ecosystems have to be sacrificed for the sake of rigor in scientific and management progress.

To ease this situation, Carpenter suggests three useful and complementary concepts: (1) analysis of long-term data records, (2) the application of ecological models and finally (3) whole-lake experiments.

There is certainly no doubt concerning the use of long-term data as one of the pillars of ecological research. They can provide much information on external drivers and internal feed-backs and how these may impact the structure and function of a given lake

ecosystem including regime shifts. This is especially true for phosphorus loading and the rapid shift of lakes from clear to turbid, plankton-dominated waters. Ecosystem modelling has also become an indispensable tool in limnological research and water management. By carefully studying this book, both ecologists and managers may benefit greatly from Carpenter's excellent skills in ecological modelling. Nevertheless, as indicated by the author, even the best long-term records and most sophisticated ecosystem models may not prevent two specific problems from emerging.

Concerning management activities, a conflict between several groups of stakeholders might be encountered. Farmers, fishermen, water managers and tourists, just to mention a few, do not necessarily agree on what might be considered "good water quality". Conflicts like this may have a significant impact on management strategies and on how to deal with the danger of sliding into a regime shift.

Furthermore, there is a conflict between water managers and scientists. For lake managers it is a mandatory task to do everything they can to stay away from thresholds and in this way to prevent lake ecosystems from regime shifts. For these managers, taking chances might not be appealing. Scientists, however, have a different approach. They are trying to learn as much as they can in order to understand structure and functioning of lake ecosystems.

Both long-term records and models have been demonstrated to mitigate this contradiction. Unfortunately, it is the very nature of thresholds in regime shifts that we cannot be sure as long as no experiments have been conducted. Carpenter's recommendation is to act carefully, to look at long-term records and to test different models. Finally, however, there is no way to avoid whole-lake experiments. He concludes: "*In situations where ecosystems are numerous [...] experimentation should be used [...] to explore [...] ecosystem behavior. [...] It is irresponsible to do otherwise [...] the manager who is not experimenting on a few ecosystems is putting all the other ecosystems at risk*". Although this conclusion sounds totally logical from a cognitive point of view, it might be hard to grasp emotionally considering the bond connecting ordinary people (including scientists) to "their" lakes. Of course, Carpenter is well aware of this aspect. His continues

that “*A merger of ecology with social sciences such as political science and economics is needed to address this challenge.*”

Nevertheless, if we are willing to use all available sources of information on regime shifts in lakes, including this book, we will “[...] *understand that surprises are coming, [but] we are more likely to adapt and dance onward*”.

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