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BOOK REVIEW

REVIEW OF "CLIMATE CHANGE AND THE ECONOMICS OF THE WORLD'S FISHERIES. EXAMPLES OF SMALL PELAGIC STOCKS"*

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Climatic changes can be regarded as global because they affect all the interactions between the physical, chemical, and biological systems which control life on Earth. Climate change can cause environmental adjustments such as: changes in precipitation patterns and in atmospheric carbon dioxide concentration; increase in temperature/chemical reaction rates affecting aquatic production; and changes in wind and ocean circulation patterns. Particularly sensitive to environmental fluctuation is plankton; the biomass of small pelagics, which are usually short-lived plankton feeders, is therefore strongly influenced by climate change.

Research on global changes in the marine ecosystems, focusing strongly on climatic effects, is a new scientific discipline. In 1999, the Scientific Committee on Oceanic Research (SCOR) established a number of programmes, including the Global Ocean Ecosystem Dynamics (GLOBEC). GLOBEC in turn spawned several national and international (regional) programmes, the Small Pelagic Fish and Climate Change Programme (SPACC) being one of the latter. Its objective was to predict how, in the long-term perspective, climatic change effects on the ocean will affect productivity of small pelagic fish (anchovy, sardine, herring, etc.) in the major world's ocean areas; another objective was to assess the consequences of those effects on the economics of the small pelagic fisheries. As the relevant studies had been fragmentary only, a workshop aimed at reviewing the existing knowledge was held at the Centre for the Economics and Management of Aquatic Resources (CEMARE) at the University of Portsmouth, UK.

Eleven very diverse papers presented at the workshop were put together in the proceedings volume that is being reviewed here. The papers point to the need for a more coordinated and more focused studies on climatic change effects on the economics of the world fisheries and, broadly speaking, on the fisheries management. The papers were written by various authors, namely:

1. **Arnason R.** Global warming, small pelagic fisheries and risk
2. **Lorentzen T., Hannesson R.** The collapse of the Norwegian herring fisheries in the 1960s and 1970s: crisis, adaptation and recovery
3. **Hannesson R.** Sharing the herring: fish migrations, strategic advantage and climate change
4. **Hamilton L., Otterstad O., Ögmundardóttir H.** Rise and fall of the herring towns: impacts of climate and human teleconnections
5. **Herrick jr. S.F., Hill K., Reiss C.** An optimal harvest policy for the recently renewed United States Pacific sardine fishery
6. **De Oliveira J.** Long-term harvest strategies for small pelagic fisheries under regime shifts: the South African fishery for pilchard and anchovy
7. **Sumaila U.R., Stephanus K.** Declines in Namibia's pilchard catch: the reasons and consequences
8. **Briones R., Garces L., Ahmed M.** Climate change and small pelagic fisheries in developing Asia: the economic impact on fish producers and consumers
9. **McKelvey R., Golubtsov P., Miller K., Cripe G.** Bi-national management of a transboundary marine fishery: modelling the destabilizing impacts of erratic climatic shifts
10. **Mullon C., Fréon P.** Prototype of an integrated model of the world wide system of small pelagic fisheries
11. **Hannesson R., Herrick jr. S.F., Barange M.** In the consequences of climate change in pelagic fish populations: a conclusion

Some of the papers stress the need of counteracting the decline in pelagic fish catches which may occur as a consequence of climate warming. On the other hand, one of the papers (Paper 3, pp. 85, 86) assumes an increase of the

*Hannesson R., Barange M., Herrick jr. S.F. (eds.) 2006. Climate change and the economics of the world's fisheries. Examples of small pelagic stocks. SERIES: New horizons in environmental economics. Edward Elgar Publishing, Cheltenham (In association with GLOBEC) 328 pp., hardback ISBN-10: 1845424476.

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herring population in the ocean north and east of Iceland, some of the stock potentially migrating into the Exclusive Economic Zone (EEZ) of Norway.

The authors of Paper 9 made an attempt to model marine transboundary fisheries under destabilising effects of climatic shifts on fish resources. The authors presented and developed a number of versions of the split-stream model.

The authors of Paper 10 developed a prototype of an integrated model of the world-wide fisheries for small pelagic fish, the model meriting a brief discussion. The model covers 13 fishing areas, 15 national and regional fisheries, and 40 fish product markets. The model integrates (i) the dynamic processes, that is, biological (population dynamics) and economic (evolution of investment, activity, demand), and (ii) behavioural processes, that is, fisheries behaviour (distribution of effort in several marine areas and the yield in several markets). At each time-step:

• The states of marine areas, fisheries and markets evolve according to deterministic rules;

• The behaviour of fisheries is related to how they select marine areas in which to fish and markets in which to sell. The result of the equilibrium between supply and demand is a consequence of their competition.

The model has been designed to simulate scenarios that result from various hypotheses concerning the future of marine areas (for example their productivity, in relationship to climate change), the future of fisheries (for example their investment behaviour), and the future of the markets for fish products (for example demand). In the present implementation of the model, simulations are based on the parameters listed in the following sections: Marine Areas, Fisheries, Markets, Access to Marine Areas, Access to Markets.

The simulations, covering the next 15 years, are to be developed annually.

A scenario involves setting the above parameters to given values. These values are the same for all steps of a given simulation, and are the same for all entities.

The model allows sensitivity analysis. A role-playing game needs a set of 12–20 players gathered around a table, with several computers between them, and a game leader to guide them. The players are:

- Representatives of fishing industries for a given economic area, that is, West Asia, East Asia, North America, South America, North Atlantic and South Atlantic, who set an investment behaviour for their principals, accepting or refusing quotas. Their goal is to ensure a positive annual income from the fisheries they represent;
- Representatives of fish product industries, for example canned fish, fishmeal, fish oil and transformed fish. They reorientate the demand function in the markets, so modifying the cost of access to markets. Their goal is to generate a sufficient supply of fish product from the markets each year;
- Representatives of conservation societies for the extended marine areas North Pacific, South Pacific, North Atlantic, South Atlantic and Indian Ocean. They pressurize governments to implement appropriate quotas and ensure that stock levels remain above sustainability thresholds;
- Representatives of governments, in the political zones Europe, America, East Asia, Asian developing countries and so on. They implement quotas and define taxes. Their goal is to ensure sufficient income and supply, and to avoid stock collapses in the region they manage.

A rough but testing data set is constructed with existing data when they are easily available, and with reconstructed data from very general hypotheses when this is not the case.

The model allows scenarios to be simulated and quantitative views of the resulting dynamics of pelagic fisheries to be generated. The results of two contrasting scenarios and a sensitivity analysis can be presented. However, in the model's current state, with non-validated data and with an algorithm that has not been fully checked, the results are simply indicative and caution must be applied to their interpretation. However, they do provide information on the model's dynamic behaviour, its plasticity and its sensitivity. The resultant individual dynamics (of marine areas, fisheries and markets) have to be interpreted in a speculative context.

In Paper 11, Hannesson et al. formulated the conclusions of the workshop. According to them, "…global warming notwithstanding, climate variability in the ocean is, and has long been, a real issue. This variability can have, and has had, major economic consequences, and it is of major interest to deal with them and thus to avoid their most serious consequences, if possible. It is our impression that this aspect of fisheries management and economics has received too little attention. We hope that this volume will stimulate further activity along those lines".

Regardless of the variety of approaches to the assessment of climatic change effects on the world's pelagic fisheries, and particularly despite the fact that the authors restricted themselves to selected aspects and examples, thus rendering the volume not particularly coherent, the volume itself is worth reading. It presents an attempt to come to grips with a very difficult and important problem of climatic change (global warming) effects on the stocks of small pelagic fish and the adaptive human activities. The volume also indicates that further studies on the problems tackled by the workshop proceedings are necessary.

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