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The Baltic Sea at IIFET 2000: Ideas for a multidisciplinary session

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Abstract

Questions of ecosystem approaches to fisheries management are more and more important. To deal with ecological, economical and social sustainability an adequate co-operation between different disciplines is necessary. In a discussion with the organiser of the IIFET 2000 conference we had the idea to make a session on the Baltic Sea to see what are possible areas of interdisciplinary work. What are possible questions we could deal with in such a session ? For introductory purposes I want to describe thoughts about the future of the Baltic Sea fisheries and ecosystems approaches to fisheries management. If there is enough interest within the EAFE for a session in Corvallis, we could decide to invite some sociologists and biologists from around the Baltic Sea to this conference.

Keywords: ecosystem approaches, IIFET 2000 conference, Baltic Sea fisheries management

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Introduction

This paper includes more questions and ideas than results. The main issue is the question whether a special session on the Baltic Sea should be organised at the IIFET 2000 conference or not. Some ideas on an ecosystem management approach in Baltic Sea fisheries are worked out. The idea is to show the necessity of interdisciplinary work on such a theme. With this paper I want to ask European Fisheries Economists to participate in such a session.

The Idea

Approximately ten years ago a new sub-discipline in Economics was founded called 'Ecological Economics'. The main goal of this discipline is the integration of Ecology and Economics to measure sustainable development. "Ecological Economics is a new transdisciplinary field of study that addresses the relationships between ecosystems and economic systems in the broadest sense. [...] One way it does this is by focusing more directly on the problems, rather than the particular intellectual tools and models used to solve them [...]".[1]

During a visit at the Oregon State University last September I talked with Prof. Johnston about his ideas for the IIFET 2000 conference. One point he mentioned was the idea to discuss with experts of other disciplines what they expect from and can contribute to fisheries economics. Another point was where could be future common fields for interdisciplinary work. Along the discussion I developed an idea of the possibility of a session where biologists, economists and sociologists discuss about the future of the Baltic Sea fisheries. To generate the basis for a successful session in Corvallis I want to discuss first between fisheries economists from Europe about possible discussion points and the possible outcome of such a session.

The Baltic Sea Ecosystem

The Baltic Sea could be a very good subject for an interdisciplinary discussion. It is small and few species live in the brackish water. Therefore we know a lot about this ecosystem compared to other ecosystems[2].

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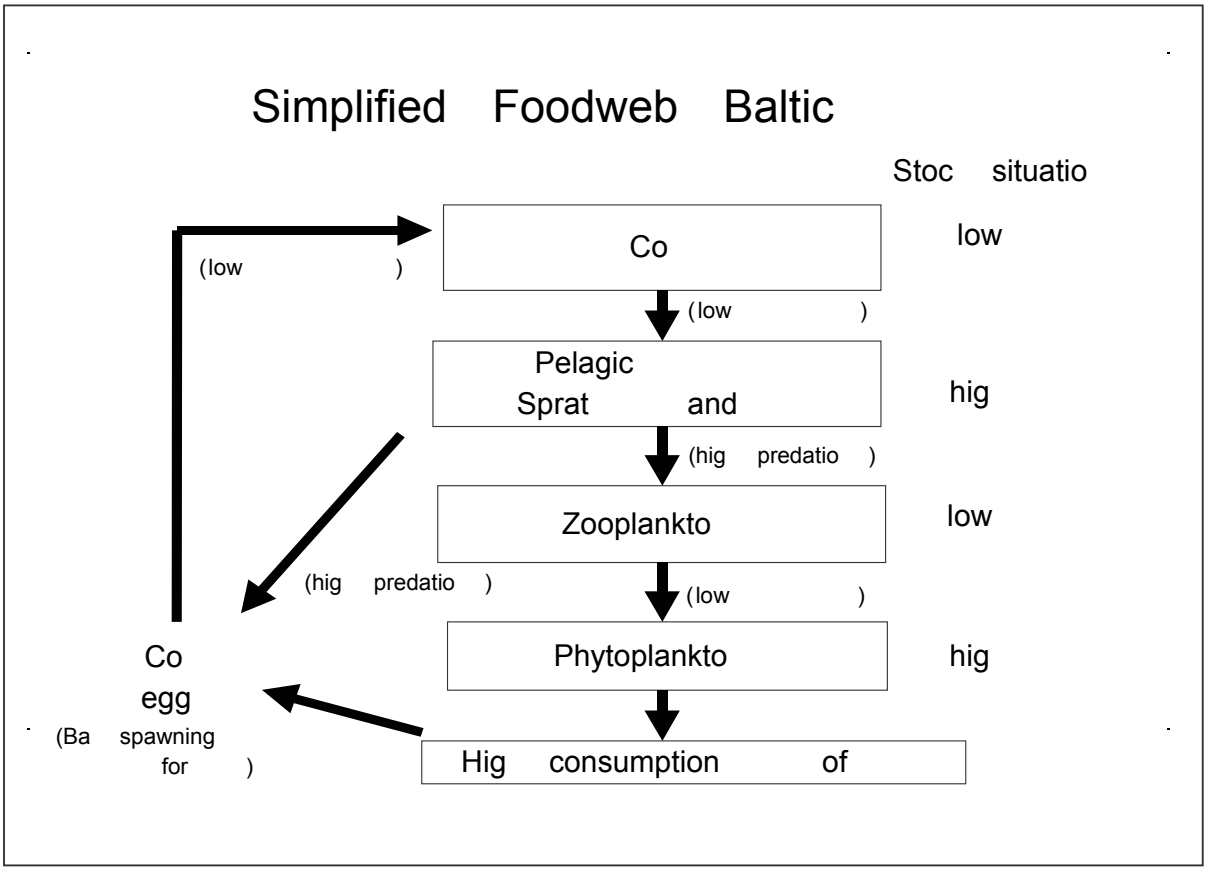
[1] Costanza, R. et.al. (1991), p. 3)
[2] see Hammer, M. et.al. (1993)

An ecosystem management in the future is necessary because fish stocks depend on ecosystem health, decrease because of overfishing etc.. This must lead to different management tools within the Common Fisheries Policy for the Baltic (most of the countries around will be member of the EU in 10 years). This new management tools must be developed now among different stakeholders and scientific groups. Some ideas would be outlined below, but before some additional facts about the ecosystem.

In the Baltic Sea live very few big fish stocks: herring, sprat, cod and some flatfishes as marine species, in coastal regions some fresh water ones like perch, pike-perch, eel etc. The Food Web is well known. Cod for example feed mostly on sprat and herring as an adult. On the other side sprat feed on cod eggs[3]. Biologists describe therefore two equilibria: high cod stocks lead to low sprat stocks and vice versa (see Fig. 1 for a simplified food web of the Baltic Sea (today's situation)).

Figure 1. Simplified food web of the Baltic Sea (today's situation)



[3] A description of a Baltic Sea Multi-Species-Model in: Horbowy, Jan (1996)

Figure 2 Landings of sprat, herring and cod between 1974 and 1996[4]

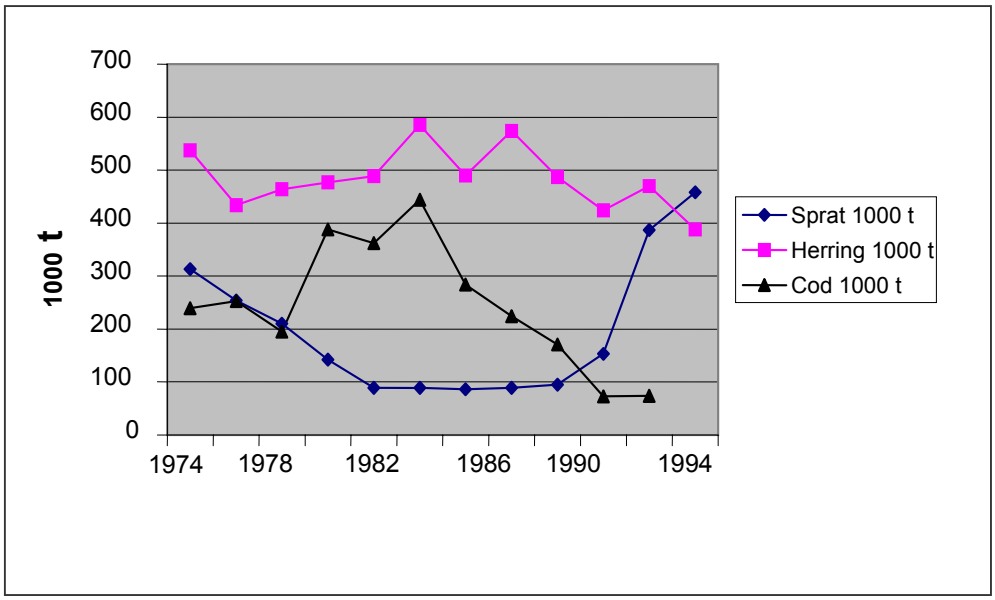


Figure 2 shows catch rates for sprat, herring and cod over the last two decades. The high inflow of freshwater contained high loads of nutrients the last decades as agricultural production increases fast around the Baltic. As outcome of this enrichment of nutrients more phytoplancton was produced and therefore more zooplancton (between 40 – 70% higher primary production in some areas of the Baltic Sea[5]) on which the pelagic fish stocks depend. Studies from other comparable semi-enclosed seas also show that the pelagic fish stocks have now better feeding conditions. As a result the biomass of the pelagic fish stocks increase and feed more on zooplancton which then use fewer phytoplancton. Now more plancton biomass leads to more use of oxygen in the deeper layer. Spawning grounds of cod are in the deeper parts because of oxygen and salt concentrations. Only through heavy north-west storms salt and oxygen rich water could reach the deeper layers and this specific conditions did not on an annual basis during the 1990s occasions did not occur in most years of the 1990s.

In summary we have high pelagic stocks and low cod stocks because of these specific environmental conditions in conjunction with high fishing effort on cod

[4] data from the 'Baltic Sea region statistical database (...)'(1996)
[5] see Elmgren, R. (1989), p. 329

stocks[6]. Catches of herring and sprat are lower over a longer period (sprat catches increase but only used for reduction to fish meal and – oil, but stocks are further high). One opinion at a conference on ecosystem effects of fishing in Montpellier last month was, that cod stocks could break down in such a way that cod could be extinct in the Baltic[7].

Economic considerations

Let us now look on economic considerations and let us further assume for simplification that we have two competing fish species in the Baltic. We use the logistic function to generate a multispecies model (model after Gause[8]). Figure 3 highlights the interactions described in the model.

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right) - \alpha NM \quad (1)$$

N: Fish Stock 1

M: Fish Stock 2

r: growth rate N

K: Carrying Capacity for N

α: competing factor between N and M

$$\frac{dM}{dt} = sM\left(1 - \frac{M}{L}\right) - \beta NM \quad (2)$$

s: growth rate M

L: Carrying Capacity for M

β: competing factor between M and N

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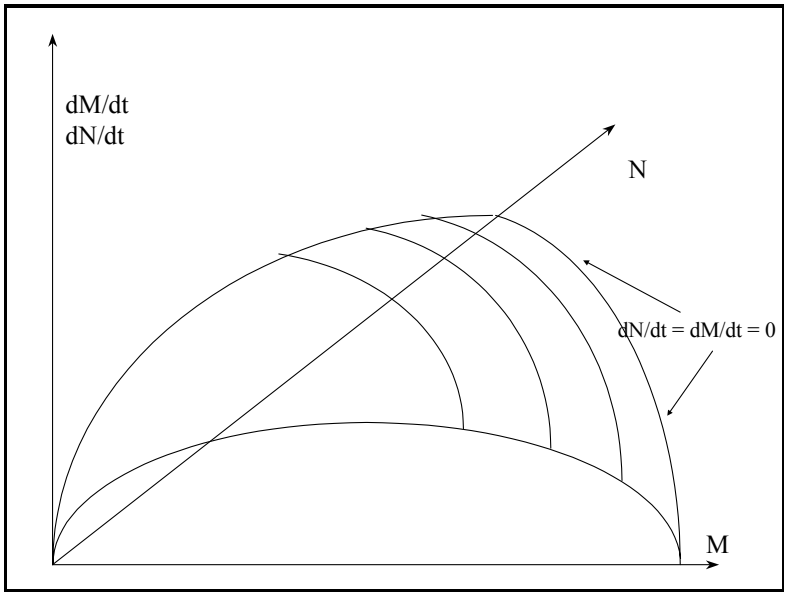
[6] see also Baden, S. P. et al. for discussion of decrease and increase of fish stocks as cause of eutrophication, about the long-term fluctuations of fish stock in the Baltic inform Rechlin, O. and Munch-Petersen, M. (1995).

[7] see John Caddy (1999)

[8] see Clark, C.W. (1990), p. 319

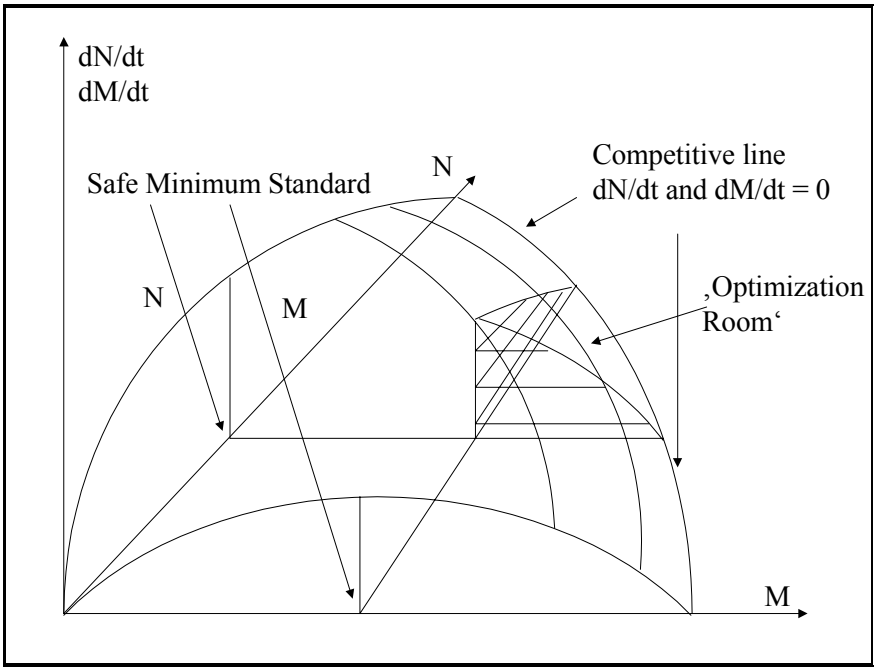
Figure 3 Competition between species N and M



The competition leads to an equilibrium line where both growth rates are zero. Normally both stocks would vary but would not drive out one another. Changing environmental conditions could lead to different stock situations. The anchovies and sardine stocks of the pacific coast of North America can be taken as an example. At present management authorities fix catch quotas for the two species or if only one species is interesting for fisherman for one of them. The other species could then use the lower stocks to grow to higher levels. But we assume here that both stocks are interesting for fisherman. If we want to introduce an ecosystem approach we could ask biologists about the minimum stock levels for both species to guarantee ecosystem stability. Such a 'safe minimum standard' is one of the main discussion points in the field of 'ecological economics' in dealing with questions of renewable resource use[9]. Another management obligation, now official EU-Fisheries-Management goal, is fishing after a precautionary principle with reference points for fishing pressure on stocks. If we integrate such a SMS in our graphic this leads to the following figure:

[9] see as examples: Berrens, R. P. et.al. (1998); Farmer, M.C. (1998) or for the discussion around a precautionary principle Perrings, C. (1991); Berrill, M. (1997)

Figure 4 Introduction of a Safe Minimum Standard



One task for economists could be to consider how to optimise the fishery under given market conditions within this area called ‘optimisation room’.

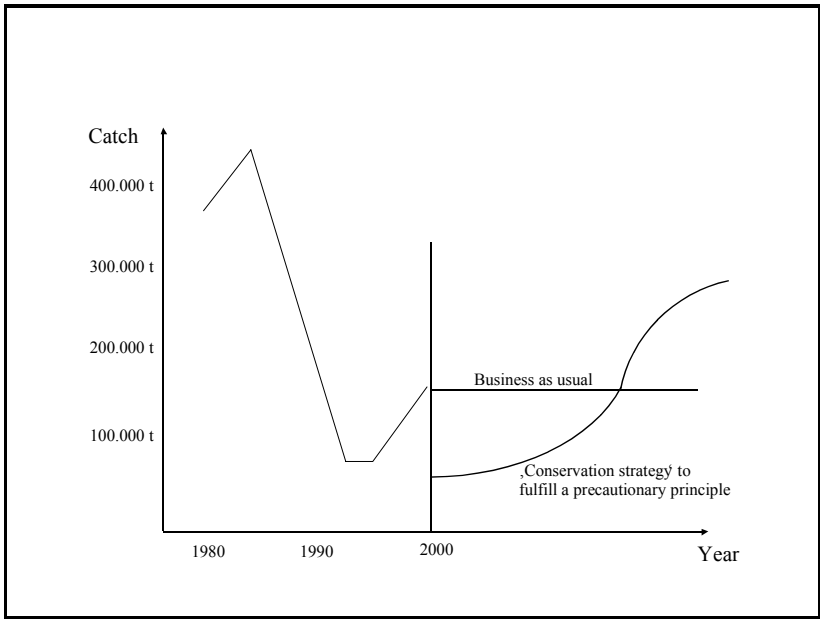
In this figure the Safe Minimum Standard is identical with Maximum Sustainable Yield Stock size.

Situation at the moment in the Baltic Sea:

1) Low prices for sprat and few products (like ‘Kieler Sprotten’) to use it for human consumption: therefore use mostly for reduction
2) Higher prices for cod: a lot of fisherman depend on cod fishing, but stocks are low and sure under SMS

If we accept lower cod quotas to reach the level or a SMS they must be reduced over a longer period (see Fig. 5) to build up the stocks.

Figure 5 Catch strategy to fulfil SMS approach (schematic representation)



But then the predation on sprat would increase and we couldn't catch the same amount of sprat in the future. The discussion point in Corvallis could be, how we can cope with such a situation without bankrupt of a lot of fisherman, destroying of coastal communities etc..

Summary and conclusion

An interdisciplinary session on the IIFET 2000 conference in Corvallis could outline research necessities for different disciplines for an ecosystem approach to Baltic Sea fisheries management. This seems necessary to develop long term sustainable fisheries within a sound ecosystem. Therefore questions of reduction of nutrient inflows must be included as well. Because of its specific ecological conditions the Baltic Sea could be a good example to discuss an ecosystem approach and could make ecosystem management possible. Integration of coastal communities in decisions about future fisheries management because of their knowledge about the ecosystem at 'their' coast could also be a discussion point in Corvallis. This paper should outline possible questions for such a session and should include ideas for further development of approaches in fisheries management like the Safe Minimum

Standard or a precautionary principle in e.g. the future Common Fisheries Policy for the Baltic Sea.

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