Concepts of Sustainable Fisheries

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Abstract: The number of discussions about sustainable fisheries is increasing world-wide. The crisis in a lot of big fisheries, e.g. cod fishery on the Grand Banks, salmon fisheries along the pacific coast of the USA and Canada, must lead to different management regimes.
In the paper I describe different concepts for sustainable fisheries and economic models which deal with them. Some ideas about the development of ecosystem models or multi-species fisheries models and whether they are possible solutions are included. In the opposite there are management concepts like the safe minimum standard or the precautionary principle to create sustainable fisheries. In 1999 the European Union introduced the precautionary principle in fisheries management but it takes time to fulfil all necessary criteria. As an example for this new management regime the Baltic Sea fisheries are described and what must be done in the future to implement a precautionary principle.

Keywords: Sustainable fisheries, Ecosystem and Multi-Species-Models, Precautionary Principle, Baltic Sea fisheries

Introduction

As discussions about sustainable fisheries increase over the last decade definitions increase too. Today there is a huge amount of them and a lot of people argue that now sustainability means everything and nothing.
Because of this it is important to clarify first which components may be necessary for a sustainable fishery. The paper starts therefor with some general reflections on the debate around a sustainable resource use over the last decade, starting with the Agenda 21. After that an own concept is outlined with the integration of ecological, economic and social subsystems.
In Fisheries Economics, namely economic modeling, and fisheries management there are some results which show what might be elements for sustainable fisheries. To make this clear results from three models, a multi-species-model, a by-catch and a multi-cohort-model, are outlined. In addition four concepts in fisheries management will be discussed.
After that the concrete situation in the Baltic Cod Fishery and the changes in the management system to reach sustainability will be described.

Sustainable Fisheries – some general reflections

The publication of the Report of the World Commission on Sustainable Development (Our Common Future 1987) on the concept of Sustainability determined the world-wide debate about future development. Five years later the Agenda 21 – objectives for sustainable use and conservation of marine living resources of the high seas (Chapter 17 - Article 17.46) were as follows:
'States commit themselves to the conservation and sustainable use of marine living resources on the high seas. To this end, it is necessary to:
(...)
(b) Maintain or restore population of marine species at levels that can produce the maximum sustainable yield as qualified by relevant environmental and economic factors, taking into account consideration relationship among species;
(c) Promote the development and use of selective fishing gear and practices that minimise waste in the catch of target species and minimise by-catch of non-target species;
(...)
(f) Preserve habitats and other ecological sensitive areas;
(...)'

In fisheries economics the concept of a Maximum Sustainable Yield was introduced by GORDON (1954) in his famous article. From that time on the MSY was aim of fisheries management. Today the precautionary principle replaces it (e.g. in the EU fisheries management) because of the complexity of ecosystems and the problems to define a MSY. Another interesting statement is the second sentence in (b) of the Agenda 21 definition. There are interdependencies between different fish species. So today we must discuss the concept of sustainability more under the question of use of a complex ecosystem than single stocks. The following article of the UN Agreement on Straddling Fish Stocks and highly migratory fish stocks is the latest and very broad definition:

"..States shall take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities on non-target and associated or dependent species, as well as existing and predicted oceanic, environmental and socio-economic conditions" (Article 6 (3c) UN Agreement on Straddling Fish Stocks and highly migratory fish stocks).

For the concrete management the Canadian Department of Fish and Oceans defines:

„Sustainable Fisheries may be defined as the stewardship of the fisheries resources so as to provide economic and social benefits for the present while conserving the renewable resource base for future generations" (Canadian Department of Fish and Oceans [1]).

All these definitions show one of the problems of the concept of sustainability: the integration of three different areas. Normally we speak about a social, ecological and economical subsystem which must be integrated. The following Fig. 1 brings these three areas together:

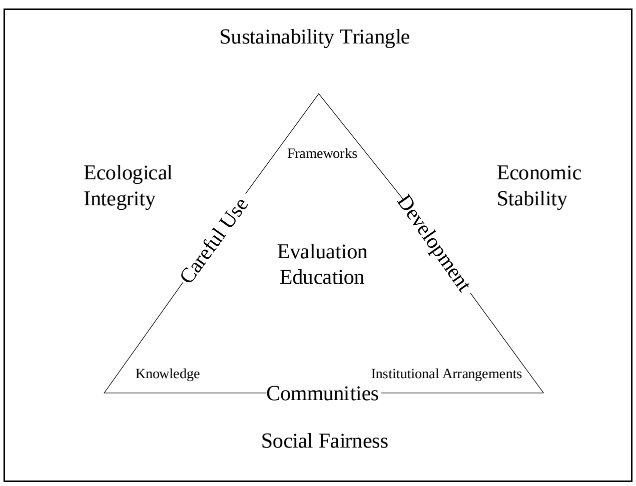

Fig. 1: Sustainability triangle[2]

But, what does this mean for fisheries management ? Some points can be outlined:

- If frameworks for the use of complex ecological and economic systems shall be defined and Fishing Communities get more competence in dealing with these systems (because of their good knowledge of local ecosystems and positive incentives for keeping rules of the management authorities (DÖRING 2000a, BROMLEY 1992 and OSTROM 1990), then management rules should only be arranged for small areas.
- Institutional Arrangements must be outlined for the long term because of the necessity of calculation of opportunity costs by fishermen.
- This concept of sustainability is anthropocentric because of the establishing of the integrity of ecosystems to supply natural resources for human welfare.

How far this is included in bioeconomic models and the real fisheries management is shown in the following chapters.

Fisheries Economics and sustainable use

The question of Property Rights had a great importance in fisheries economics. Already in his article from 1954 GORDON discuss that 'everybody's Property is nobody's Property'. It is to be emphasised that Gordon analysed a situation of open access. Only one year later SCOTT (1955) introduced a sole owner as solution for this situation.

With HARDIN'S article "The Tragedy of the Commons" 1968 a false paradigm was introduced in fisheries economics: that the fish stock as a Common-Property-Resource would be overused if there are no well-defined individual Property Rights. Instead of this statement the discussion today shows that it is not the status as Common-Property-Resource which leads to an overuse of the resource but the lack of clear rules for users. Many coastal areas world-wide were fished by local communities who have been using this part of the ocean sustainably over hundreds of years till today. Similar to a sole ownership the community defines collectively individual rights for the members for parts of the resource base.

The assumption in most of the economic models today that there exist individual use rights and therefor individuals calculate long-term opportunity costs is also correct more or less for fishing communities. For that reason it is not per se the sole owner which alone guarantees that the overuse of stocks ended. The opposite is correct. If we assume that there are complex ecosystems, a lot of uncertainty and lack of information, then there is no real chance for a sole owner of being more sustainable than the state authorities today. Instead of that the communities have very good local knowledge about ecological interdependencies in their local coastal ecosystem, and they have, in this case, better information also in opposite to the state authorities.

[1] cit. after CHRISTIE (1993: 100)
[2] see DÖRING 2000a

I started with this discussion because of its importance for the development of models in fisheries economics. Economists developed even more and more complex models for the use of fish stocks over the last decades, mostly with this assumption of Individual Property rights.
It is not possible here to show this development therefor I choose three different model types to show how far the discussion is about sustainable resource use in fisheries economics.

$$\dot{Q}_N = -\frac{1}{\eta_N} Q_N \left[\frac{\left(i - \frac{\delta F}{\delta Q_N} \right) + \frac{1}{\lambda} c_N^{'}(N) F(N,M) - \frac{\gamma}{\lambda} \frac{\delta G}{\delta Q_N}}{1 + \frac{1}{\lambda} c_N^{'}(N)} \right] \qquad (1)$$

With rearrangements we have a solution for the interest rate i.

$$i = \frac{\delta F}{\delta Q_N} - \frac{1}{\lambda} c_N^{'}(N) F(N,M) + \frac{\gamma}{\lambda} \frac{\delta G}{\delta Q_N} \qquad (2)$$

Both equations show how complex such a result is if we introduce interaction between species in the models.
The first term of equation (2) is the partial differentiation of the growth function of N (prey species) with respect to the use of N Q_N. The following term comprises the cost of fishing and the last part the influence of the use of the prey species for the predator species M. This is included through the growth function G of the predator species M.

1) Multi-Species-Models

Let us have a look on a predator-prey-model of STRÖBELE and WACKER from 1995. The authors use a linear growth function for the two stocks to make the biological component of the model easy and look closer on the outcome if both stocks should be used. For the prey species they found the following result.

In a Single-Species-Model we only get a very short result for i:

$$i = F'(N) \qquad (3)$$

The interest rate must be corresponding to the internal rate of return of the stock. To give a better idea of this result we can use a phase diagram (see Fig. 2).

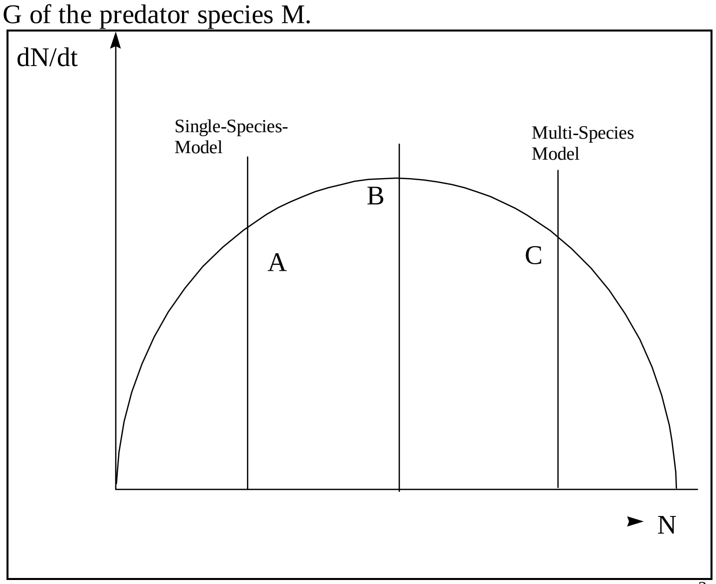

Fig. 2: Phase diagram for the Model of STRÖBELE and WACKER[3]

[3] STRÖBELE und WACKER 1995: 79

In a Single-Species-Model (e.g. CLARK 1990, HAMPICKE 1992) it is optimal to fish on the left side of MSY (because of a positive discount rate), and the introduction of interaction in the model lets us reach the right side, the more safe side, of MSY.
This shows that the consideration of interaction must lead to a more careful use strategy than is usual if we only look on single species management.

2) Multi-Cohort-Models

In the assessment of fish stocks biologists normally use year-class-models. Because of their complexity they were rarely used in bioeconomic models. Nevertheless the results of a lot of these models show that a very selective fishing technique leads to the best result with respect to yield in time and individuals. To have an idea of this result the following figure combines the result of a model for multiple cohorts and a selective fishing gear.

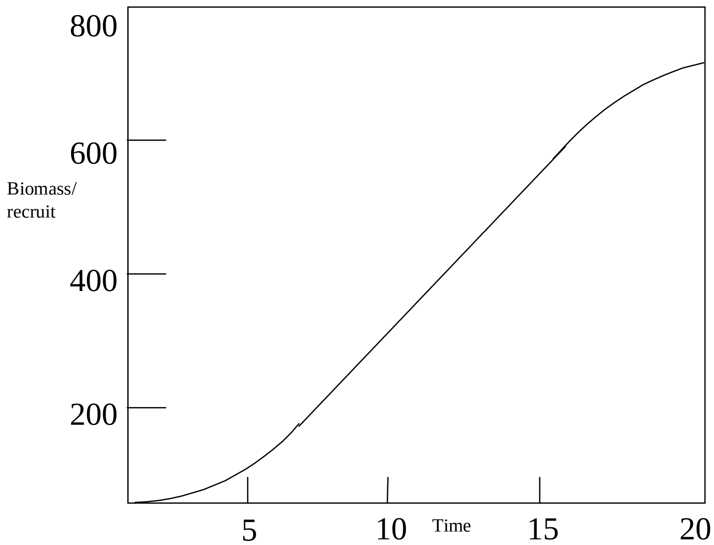

Fig. 3: Optimal Rotation in a multi-cohort-model (CLARK 1990: 295)

In addition Tab. 1 belongs to these results with respect to different discount rates.

Tab. 1: Time of rotation and influence of discount rate (CLARK 1990: 327)

Discount Rate	0	0.01	0.03	0.05	0.10	0.15	0.20	∞
Rotation T (yr)	15.0	14.4	11.5	10.2	6.4	3.0	2.5	1
Average Yield per Recruit (g)	372.8	372.3	363.0	353.9	304.7	230.7	217.0	177.0

If we assume a discount rate of $\delta = 0$ then the time of one rotation is fifteen years and the average weight 372,8 g. With a discount rate of 5% we have a rotation time of 10 years and an average weight of 353,9 g. If it is possible to use fishing gear with a high selectivity so that the fish in the catch is always a certain amount of age then this fishing gear should be used in the future. This gives us an indicator for one of the main problem of the fishing sector today – the catch of too many juveniles. Fishermen loose a lot of future potential catch.

3) Bycatch problems

Besides the problem of bycatch of juveniles there were a lot of international debates about the bycatch of marine mammals and birds (e.g. dolphins and albatross) over the last years. A model from HOAGLAND and JIN (1997) describes the problem of changing fishing practice if the bycatch leads to economic losses. They use for their model the problem of dolphin bycatch in the tuna fisheries. For a long time fishermen saw (and some see) dolphins as competitors and therefor let them drown in their nets. For other people this was a scandal and they argue against this practice. Today we can postulate that living dolphins have a value also for the fishermen because tuna without a dolphin safe logo and the security of very few bycatch is not marketable on markets. We can speak of an existence value of people for living dolphins. We can see something like that also for the case of the whale watching industry. Today income from travel tours to the living whales is much higher than that of whale hunting.

For their model HOAGLAND and JIN developed the following solution for the tuna fishing effort:

$$Q(E) = \frac{\partial B}{\partial E} - \frac{\partial D}{\partial E} - c - \lambda_N q_N N - \lambda_M q_M M = 0$$

(5 ?)

Fig. 6 illustrates the result of this model. It is economically efficient to stop fishing if the loss from bycatch is higher than the income.

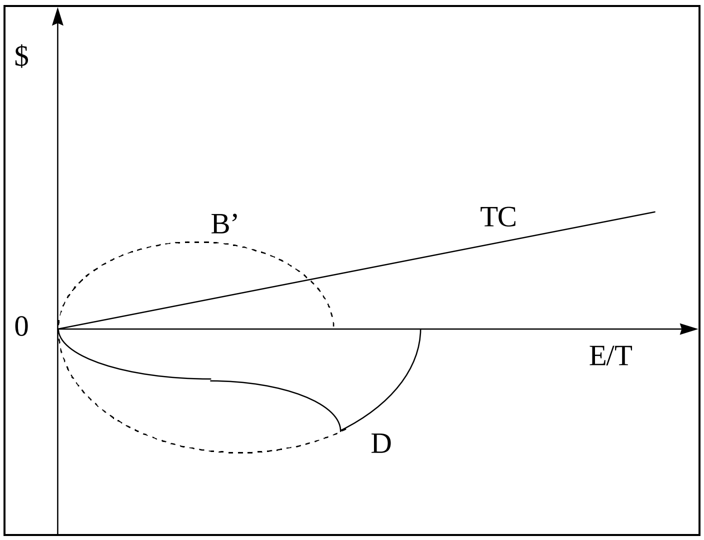

Fig. 6: Model scenario for discontinuation of fishing (HOAGLAND and JIN 1997: 14)

Additionally another outcome is imaginable: continuation of fishing and extermination of the stock of marine mammals. But this seems only to be a theoretical economic calculation and hopefully won't happen in reality.

The aim of such a model calculation is to find out an optimal fishing effort so that the second term on the right side (dD/dE) will be minimized. For that it is optimal to use a fishing technique which leads to very few bycatch. In the tuna industry the escape of dolphins out of the encircling gear is more or less guaranteed today. The public pressure on the fishing industry had achieved this. We can state this as a value for living dolphins.

All three models give us an idea that in theory there are arguments for a sustainable use of fish stocks. They are very complex and not directly practicable in real fisheries management. We do not discuss the assumptions behind the models which are simplified. Nevertheless the outcome is a clear call for a more careful strategy in fisheries.

Management objectives

In fisheries management the question of a sustainable use of the fish stocks is more and more at the centre of the debate. Most recently with the collapse of the northern cod stocks on the Grand Banks and the consequences for Newfoundland it is in mind of the participants in the system that failure in fisheries management could lead to heavy economic losses. It is now undisputed that there were indicators for the decline of the stocks but the reaction and the reduction of fishing effort came too late (SINCLAIR and MURAWSKI 1997)

In the following chapter I want to discuss four concepts to deal with the uncertainty in the system, which are in the debate at the moment or in the past: Safe Minimum Standard, Precautionary Approach, Marine Protected Areas and Ecosystem Management. Afterwards some ideas for a sustainable fishery are outlined, however, for every area we may have different ideas about what is sustainable.

1) Safe Minimum Standard

The concept of a Safe Minimum Standard was developed by S.-V. CIRIACY-WANTRUP in 1952. At the beginning this concept deals more with the problem of inflow of harmful substances which accumulate in sediments, animals and plants. A certain amount of harmful substances in animals or plants were fixed to avoid damages. For a renewable resource it is possible to define an upper threshold to guarantee the survival of the species and their functionality in the ecosystem. Only if this leads to unacceptably high costs it is possible to ignore it. But the biggest problem is the fixing of these thresholds because of the uncertainty in stock assessment and the role of the species within the ecosystem.

2) Precautionary Approach

This problem of uncertainty leads to the development of a different management objective. In fisheries management this was the precautionary approach. In 1997 the EU-commission engaged the ICES to give advice for the next fishing quotas with respect to this approach. The concept includes the following points:

- stock specific reference points
- restriction of fishing because of declining stocks
- reconstruction programmes for overused stocks

Three reference points must be fixed. First step is the definition of 'Frontier Reference Points' where stocks would collapse. Afterwards 'Alarm Points' were introduced. If the stock reaches these points a cut down of fishing activities follows. This comes in without additional discussions or political decisions. Before the introduction of these 'Alarm Points' these measures were discussed between the involved parties so that they are clear for all participants. The third form of reference points are 'Objective Reference Points' with the 'Alarm or Frontier Reference Points' as lowest level. These points lay beyond the other points if uncertainty of stock parameters is high and we must introduce a more careful management. Also the gap between frontier and alarm reference points is much greater if the data basis is very uncertain. The main point is that "uncertainty in scientific statements or ignorance of the stock situation can not be used as an excuse for not lowering the fishing effort or something else"[4].

3) Marine Protected Areas

The two concepts above are only dealing more or less with the use of single stocks. With the establishment of Marine Protected Areas (MPA) habitats and ecosystems should be preserved.

At the moment there is a broader discussion about the advantages and disadvantages of MPA's. The supporter of this idea argues with positive outcomes for fisheries because parts of fish stocks can live undisturbed with better reproduction which support the stocks outside.[5] The protection of fragile habitats (coastal zones are the nursery area of most of the fish stocks) will have positive long term effects for the protection of biological diversity.[6]

The opponents of protected areas doubt the positive effects if the fishing effort increases outside the area to compensate the economic losses.[7] Damage of parts of the ecosystem through some sort of fishing gear were denied as well. But the closure of fishing grounds with northern corals last year in Norwegian waters made clear that there is a change in this point in management agencies.

4) Ecosystem Management

The newest approach in the international debate is the ecosystem management. Science published an article about another main problem of today's fishing practice.

„It may be argued, however, that the global crisis is mainly one of economics or of governance, whereas the global resource base itself fluctuates naturally. Contradicting this more optimistic view, we show here that landings from global fisheries have shifted in the last 45 years from large piscivorous fishes towards smaller invertebrates and planctivorous fishes, especially in the Northern Hemisphere. This may imply major changes in the structure of marine food webs" (PAULY et al. 1998: 860).

[4] Own translation of CORNUS (1997: 96). See also PERRINGS (1991), COSTANZA et al. (1997: 146 f.) und PERRINGS et al. (1995)

[5] For an economic analysis and simulations see HOLLAND and BRAZEE (1996). Their results are that fisheries will have advantages out of the higher reproduction possibilities within the MPA (individuals become older) and the restocking outside the area. The size and success of an MPA depend on the discount rate. For overused stocks the MPA will have advantages in any case while they won't for stocks with low fishing effort.

[6] FORROW (1996) discusses the economic background mainly use and non-use values of a protected area.

[7] HANNESSON (1998) shows with a model that in an open access situation the fishing effort increases outside the protected area and there is no real difference for stocks. Therefor additional management rules must be introduced to reduce the fishing effort as a whole. Protected areas alone are not sufficient to protect stocks from overfishing.

The composition of global fish catches has changed dramatically over the last 50 years. The authors of this article give species a value which depends on their position in fish communities. For primary producers like algae and plankton they give a one and for the big predator species the highest value. The snapper (family Lutjanidae) reach the highest level with a 4,6. The outcome of the project was that the level of the catches world wide has sunk from 3,4 to 3,1. This means that today's catches include less predators and more prey species than some decades ago. The following figure shows a simplified food web of the Baltic Sea with a special attention toward a predator species.

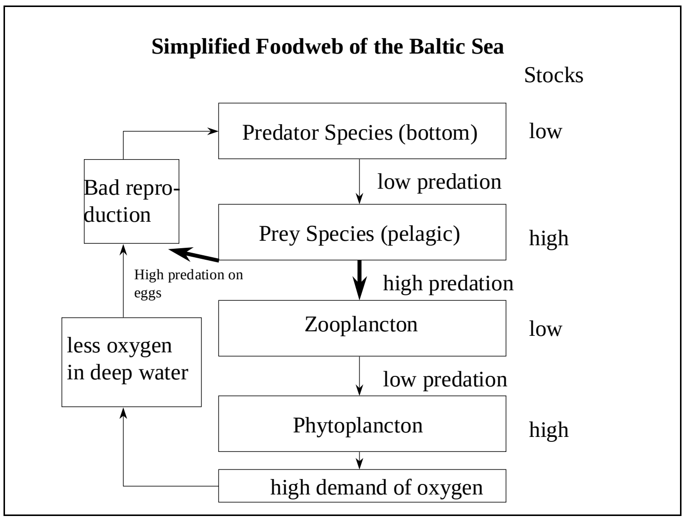

Fig. 7: Simplified foodweb of the Baltic Sea (DÖRING 1999)

If the fishing effort is concentrated on the predator species the pelagic, zoo-plankton feeding species increase. Afterwards increasing stocks may give the false signal to the fisheries management that a higher fishing effort is possible. The now greater pelagic stocks feed more on zoo-plankton and the spawn of the predator species as well and deepen the negative influence on the predator stock (SCHNACK 1995: 268). In addition the now lower stocks of zoo-plankton feed less on algae stocks which increase too. These higher stocks of algae need more oxygen for decomposition and therefor the amount of oxygen in deeper layers (and spawning grounds of the predator stock) decreases. Another bad influence on the predator stock.

For the pelagic fish stocks a higher stock level was calculated which was usable for the fishermen. This may be one reason for the change of the landing statistics of the FAO. If these species are not valuable for human consumption and there is only little fishing, then it is possible that the stocks of algae increase very much and parts of marine ecosystems collapse. Regions of less oxygen in the deeper layer can be the result. In these parts of the ecosystem no reproduction is possible. This takes place in the deep parts of the Baltic Sea. In some regions hydrogen sulphide dominates. For all these reasons a rebuilding program for the predator fish stocks and all other stocks of the food chain is necessary. The use must reach an ecologically acceptable level.

There is no accepted definition of an Ecosystem Approach till today. It is clear that fish stocks depend on their environment. In addition they live in a very complex system of interactions. One aim of future fisheries management must be a balanced use of all usable stocks and the consideration of interdependencies. Within the debate around an Ecosystem Approach the preservation of biodiversity plays a bigger role. [8]. Here additional use potentials are discussed. Beside so called Non-Use-Values [9], e.g. Option and Existence Values, the Use Values get a bigger role in the process (see whale watching). The bioeconomic models develop from single-species to multi-species models and now integrate further other use options. Also processes within ecosystems were introduced in the maximization vector. The following table shows this development:

Tab.3.6: Development from single-spezies to ecosystem-models (GUDMUNDSSON and SUTINEN 1998: 80)

single species-Modelle	multi-species-Modelle	Ecosystem-models
$F^i(x_i)$ =>	$F^i(x_1, x_2, ...x_n$ =>	$F^i(x_1, x_2, ...x_n, Q, \sigma)$

Beside of a clear definition of an Ecosystem Approach we can see the necessity of a differentiated management

[8] A detailed description of marine biodiversity by THORNE-MILLER (1999) and NORSE (1993). The coastal zones could be destroyed as fast as the tropical rain forests (see RAY 1988: 36).
[9] Meanwhile there are a lot of studies about use- and non-use values. Exemplary see FERRARA and MISSIOS (1998), also GRONEMANN und HAMPICKE (1997) (here concrete project results were also discussed).

system in the future. Selective fishing practices and a balanced use are necessary.

5) Sustainable Fisheries – the way ahead

There are concepts for a different fisheries management and the results from model theory give reasons for sustainable fisheries and concrete measures. The following results can be outlined:

- selective fishing gear are necessary in the future to minimize bycatch of too small individuals of wanted and bycatch of unwanted other species.
- In the long run catch quotas should be replaced by a limit of fishing capacity because of the uncertainty about stock assessment and the predictions derived from it.
- With introduction of interaction between fish stocks within our models a more careful use strategy is to demand.
- In fisheries management the precautionary approach must be introduced and reference points defined for all stocks.
- Additionally a net of marine protected areas in very valuable marine ecosystems must be developed. It is possible that they are only introduced at times or that selective fishery is permitted.
- In the long run we must come from the management of single stocks to a management of ecosystems.

A sustainable fishery may be as follows:

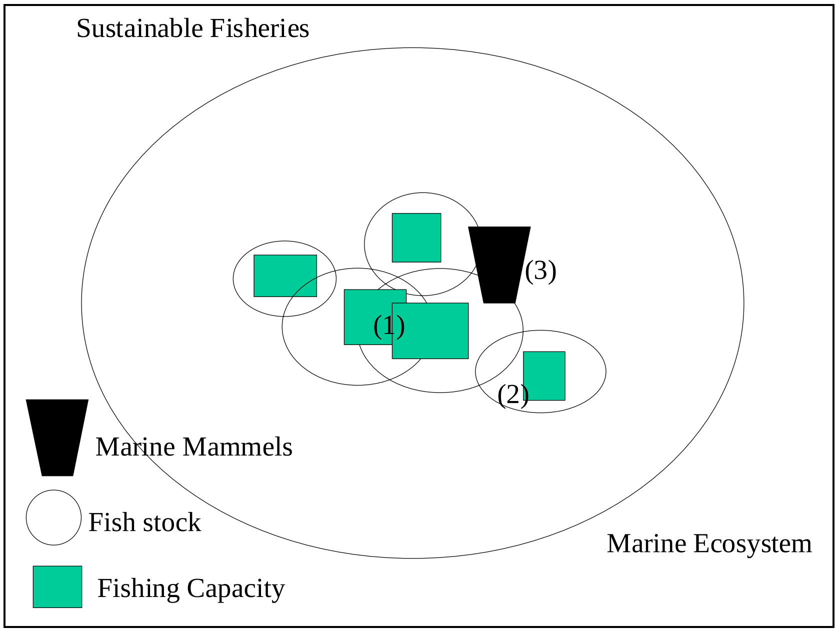

Fig. 8: Sustainable Fisheries (DÖRING 2000b)

There are interactions between fish stocks, and the fishing technique is not selective enough to avoid all bycatch (1). Fishermen then must have a permit or quota for both species so that they must land and sell all their catch. This is necessary to have better data about the total catch in the future. The fishing capacity certainly lies below the maximum use potential so that no fish stock is under threat from fishing (2). The bycatch of marine mammals is excluded.

It must be the goal of future research, especially in the area of fishing techniques, to implement such a fishery. A big part of this would be the definition of an optimal capacity of a selective fishing practice. Then a sustainable use also of the big fish stocks is possible. The additional part of research is then to find ways to optimize the social and economic subsystem of sustainability in such a way that fishermen survive with this new structure with adaptation of ecological conditions. How this might work out for the cod fishery at the German Baltic Sea coast outlined the following chapter.

Baltic Sea Fisheries

The German Cod fishery in the Baltic Sea faces great problems at the moment. Stocks are heavily overfished, ICES recommended lower catch quotas, and realistically fishery ought to stop so the stocks have a chance to recover. What's outlined more generally in the above part about ecosystem management is the actual situation for the cod stock. The conditions for reproduction are very bad at the moment because the spawning grounds are in the deeper layer. What is to do to reach a sustainable fishery ?

- Start of a recovery program for the stock which leads to very low catch quotas or shut down the fishery for a while.
- Introduction of a more selective bottom trawl to avoid bycatch of undersized cod soon and switch to longlines and gill nets in the long run. Research is necessary to find ways to avoid bycatch of marine mammals (pingers may work).
- Limiting of fishing capacity (only available fishing time fix fishing) on today's level; because of higher stocks in the future this seems a sustainable level.

In an EU funded research project about selectivity of bottom trawls in the Baltic Cod fishery one goal was to calculate the economic losses if such a gear type were introduced in the future (ERNST et al 2000). First of all fishermen must accept lower catches. The result was that the scientist can predict losses for four years and then higher catches than before. To reach a sustainable level governments should help the fishermen to invest in this new fishing gear, help them with loans over the period of lower catches and then the need for assistance ends. The better income afterwards allows the fishermen to pay back the loans. We can see this type of 'waiting for recovery' as an investment in natural capital.
The experiences with subsidizing of the fishing sector are bad. Do we really see a sustainable fishery after a recovery program ? A change in management structures is also necessary (see Fig. 9 for an example of a future management structure in the EU).

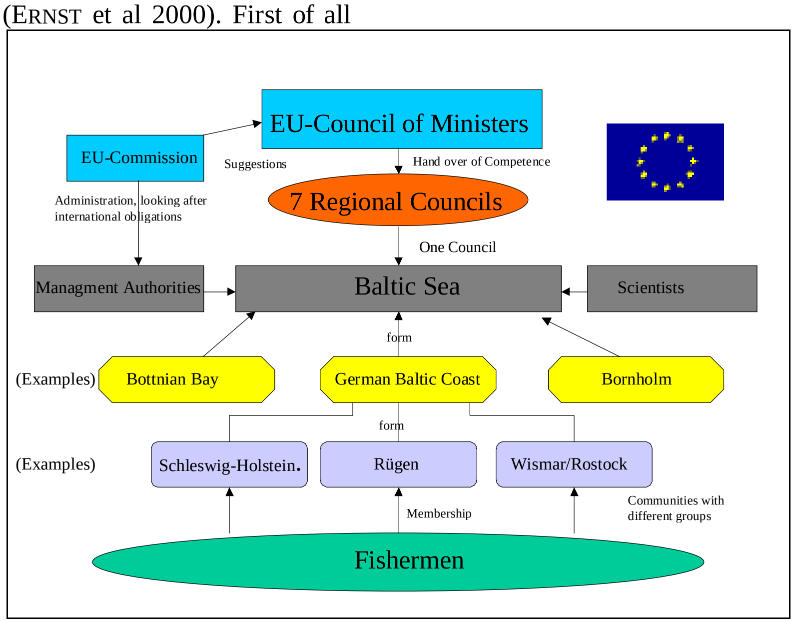

Fig. 9: Proposal for a future management structure in the Baltic Sea (DÖRING 2000a)

After the program fishing capacity must be fixed on today's level. No additional fishing boats, as happened in the 80ies because of high stocks, must be allowed in the Baltic. In the International Baltic Sea Fisheries Commission fishermen should be allowed to participate. In the long run fishermen must be included on every level of fisheries management because given of the problems of acceptance of rules today, rules in the future should be developed with their participation. Experiences with Community based Management Systems show that fishermen themselves bring their colleagues to accept rules. So if they are part of the management system the social control is higher to accept the rules (see discussion about Property Rights in a previous chapter).
But in the long run a switch to longlines and gill nets because of their higher selectivity may be the best way. It is also possible to use them in sensitive habitats instead of the bottom trawls to avoid damages on the bottom. Coastal fishermen use longlines and gill nets at the moment but costs are higher and there is no separated market for cod catches out of longlining or gill netting as it is in Denmark. In the future fishermen should organize a different market for this better quality of cod out of fisheries with passive gear (see markets for organic food and ecolabelling). Such fishing techniques depend on the abundance of fish in the area and therefor higher stocks

mean higher catches and vice versa. In a model for the cod fishery (DÖRING 2000b) the result was that

- ♦ It is economically efficient at the beginning (with the low stocks at the moment) to invest in the stock and lower the catch to recover the stock. This depends on a long term perspective for the fishermen (see institutional arrangements in the sustainability triangle). Discount rates are low and fishermen calculate long term opportunity costs.
- ♦ A fixing of fishing capacity at a sustainable level may be possible.

The fixing of fishing capacity would offer the following great opportunity. We can avoid catch quotas in the future which depend on calculation of stocks with its great uncertainties. The fishermen are not in the position with a fixed number of hooks and nets to overuse the stock anymore but with changing environmental conditions we must be careful anyhow. Examples of successful community based management systems show that this might work functionable. Fishing communities fix fishing capacity and use normally ecologically sound fishing practices as well.

And all this without any the "scientific knowledge" we feel so dependent on for stock assessment. They accumulated their knowledge over hundreds of years sometimes.

Summary

The paper outlined some arguments around sustainable fisheries. It was shown that in model theory, e.g. the new models including interdependencies between different fish stocks, and fisheries management, see the precautionary approach, there are arguments for a different management and what must be changed to reach the goal of sustainable fisheries. The question which fishing technique might be ecologically acceptable in the future plays a bigger role in the discussion. It should be more selective on one side and avoid damages on the ecosystem as a whole on the other side. The example of the Baltic Sea cod fishery showed how this can work in the future to avoid overuse of stocks and damages. It is now in the hands of fisheries management how far such a concept may be introduced in the future.

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