

The North Sea herring: a case study for single species fisheries management

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History. The North Sea herring is a good example for the potentially destructive influence of commercial fishing on single fish stocks. This stock supports, in terms of turnover of the fishing industry, one of the most valuable fisheries for human consumption purposes in European waters. It is believed to have had a spawning stock biomass (SSB) of more than 2 million tonnes before large-scale fishing started in the 50s of this century.

Heavy exploitation led to a collapse of the stock in the late 70s. The closure of the (directed) herring fishery for 4 years, accompanied by years of good recruitment led to a recovery of the North Sea herring. After the reopening of the fishery in 1981, a simple total allowable catch (TAC) applicable on adult fish for human consumption was adopted to avoid detrimental stock depletion in the future. However, the stock showed another rapid decline in the mid 90s, mainly due to two factors: a significant exceeding of TACs and, even more important, greater amounts of juvenile herring were caught as bycatch in the increasing reduction (industrial) fishery for fish meal and oil production, targeting on sprat.

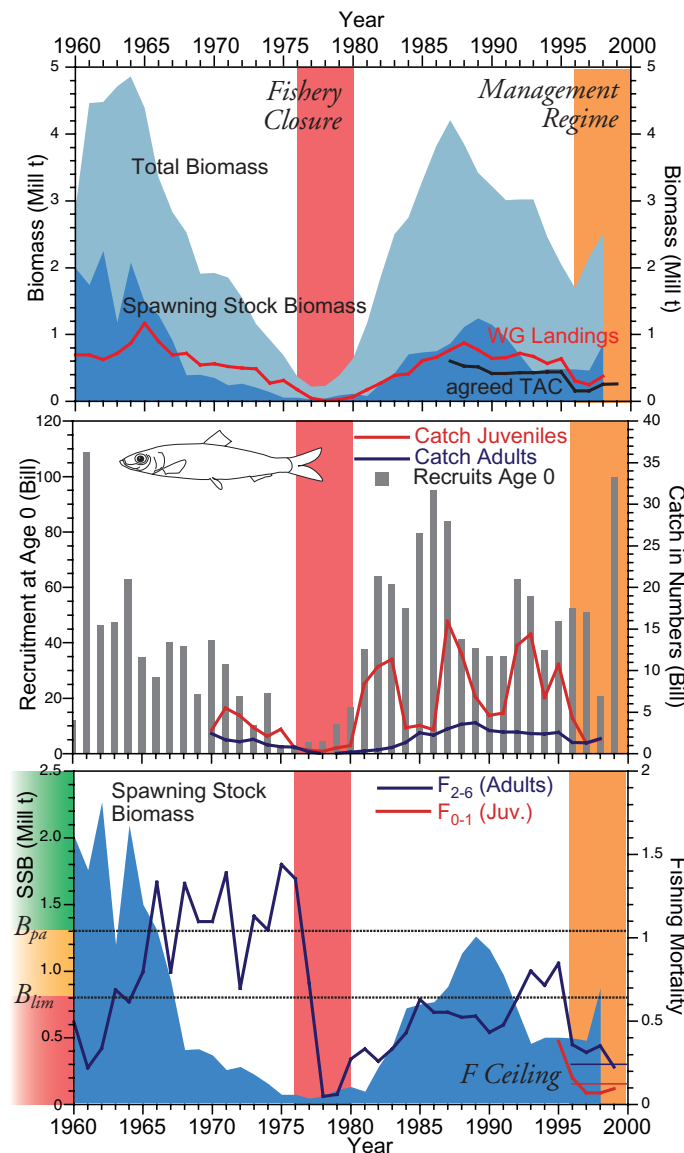
Current Management. Based on these negative experiences, the North Sea herring became the first stock to be managed according to the precautionary approach in the North Sea. The threatening collapse of the stock in 1996 had demonstrated the insufficiency of a simple, adult-based TAC system. Therefore, an intermediate emergency plan and later a management regime were developed. The new management was finally adopted by the European Union (EU) and Norway in December 1997.

The emergency plan restricts catches on adults and juveniles to allow for a fast rebuilding of the stock as soon as the SSB falls below the agreed reference points. Equally important, a new control system was implemented in July 1996 by the Danish authorities to effectively limit the bycatch of juveniles in the industrial fishery.

The management plan is based on different biomass reference points, which are in accordance with the precautionary approach and enforce different immediate actions when being reached. They are based on the observed stock recruit relationship (SRR), which is now available over a wide range of SSBs and gives sufficient evidence for the reference points.

- The lower biomass reference point, of 800'000 t, previously called the minimum biological acceptable level (MBAL), is now accepted as limit reference point B_{lim} . Below this point, there is an increased risk of low recruitment, the SSB is in "the red phase" and the emergency plan is automatically in force until the upper reference point is reached again.

- The upper reference point, B_{pa} is set to 1.3 million t SSB. The phase between the two points is referred to as the "yellow phase".
- Above a SSB of 1.3 mill. t, the stock is in the "green phase" and the fishing mortality is allowed to reach $F=0.25$ for adults and $F=0.12$ for juveniles. All bycatches are subtracted from the respective quota, and the reduction fishery is closed as soon as the bycatch ceiling is reached. Within the limits set by the F values, there is some liberty for fishery managers to decide on the proportion of the total catch to be attributed to different fleets. These currently four fleets are separated by fishing area, target species and mesh size used.



Figs: (1) North Sea herring (autumn spawners): Total Biomass, Spawning Stock biomass (SSB), landings and agreed TAC, (2) Recruitment at age 0 and catch of juveniles and adults in numbers, (3) Fishing mortalities (F ; adult and juvenile) and management regime. The phase of the fishery closure and the management regime are indicated.

ment a fast rebuilding of the stock took place. As an immediate measure already in the first year, F was halved for the adults and reduced by 75% for the juveniles. Since then fishing mortalities are limited to $F_{2-6}=0.2$ and $F_{juv}<0.1$. As a result, the SSB was estimated to reach 878'000 t in beginning of 1998 (ICES 1999a). According to the short-term forecast, it can be expected that a *status quo* fishing in 1999 will lead to an SSB of 1.2 mill. t in 1999.

Scientific advice on the North Sea herring stock is provided by the

International Council for the Exploration of the Sea (ICES). The biomass estimates are updated yearly, based on assessments calculated by the respective working group and the Advisory Committee on Fisheries Management (ACFM).

A variety of different input data build the basis for the assessment. The national institutes provide landings and sampling data. Landing figures are usually taken from official reports of the fishermen and port authorities. Sampling of commercial catches is part of the national responsibility of the ICES member states and usually not internationally co-ordinated. However, the regularly conducted scientific surveys are truly international and co-ordinated in detail by a number of different planning groups. Fishery-independent are larvae surveys, surveys on juveniles (International Bottom Trawl survey in two different seasons), and hydroacoustic surveys. The fishery-independent data derived from the surveys are needed, because commercial data are partly unreliable. Based on the results of the surveys, different indices for adult and juvenile herring are derived and used for tuning of the ICA.

Problems and benefits. The North Sea herring has some biological peculiarities, which ease the management. Its recruitment did not seem to be strongly dependent on environmental or climatic fluctuations (at least as compared to fisheries activities). This is very different *e.g.* for the Atlanto-scandian herring complex; the recruitment for the latter is therefore hardly predictable. Furthermore, due to the repeated rapid decline of the stock, sufficient data for establishing a stock recruit relationship are available over a wide range of stock situations, and reliable reference points can therefore be derived. For most other fish stocks, reference points based on sufficient knowledge on the biological peculiarities of the species or stock still have to be developed. The currently conducted herring assessment is a single species assessment that profits from the fact that there is little species mixing in the directed herring fishery. However, there are also some severe problems involved with the management. From a biological point of view the impossibility of differentiating stocks or stock components within the North Sea stock complex remains. Heavy fishing on small populations, *e.g.* the Downs herring, on their very limited spawning grounds may lead to the collapse of such stock components even under the current management regime. Further, the mixture of (western baltic) spring- and autumn spawners in some areas covered by the North Sea management requires some effort to calculate splitting factors and complicated (and thus error-prone) models.

Other problems do exist with regard to the quality of the input data. Sampling of the commercial catches is often not adequate. This could be solved by a co-ordination of the national sampling schemes, especially as the fleets increasingly loose their national confinements. Nowadays, most of the German, Belgian, Dutch and English pelagic trawlers are owned by big Dutch companies and handled similarly. Parallel sampling on these ships by different nations could be reduced in favour of a complete spatial and temporal sampling. Further, part of the sampling is already financed by the EU. In this context, a coordinating European fisheries institute could be useful.

The last big issue, that should be mentioned here, regards the misreporting and exceeding of TACs by the fishing industry. There is reliable information that landings in the last years overshoot the TACs by up to 30% (ICES 1999a). This introduces a significant (and avoidable) uncertainty to the assessment, and is finally to the detriment of the fishermen. Legal authorities obviously failed to remedy such abuse of the resource.

Future perspective. The North Sea herring management is now increasingly taken as example for the way how European fish stocks can be managed. The EU and Norway will most likely agree upon management regimes for six other North Sea stocks within this year. The aim is to regulate all commercially exploited stocks in such a way to effectively avoid stock depletion and keep commercial landings on a stable level. However, there are serious limitations in transferability of the herring single species regime to multispecies fisheries, which include almost all North Sea demersal fisheries. For a sensible management of these stocks, progress in multispecies modelling is needed within the next years, which requires a significant increase of our knowledge of ecosystem mechanisms. This can only be achieved if on a regular basis far more basic biological data are collected and modelled than nowadays for the single species assessments. It is implicit, however, that such substantial increase in data acquisition will only be possible with an accordingly substantial increase in targeted research effort.

References

- ICES 1999a: Extract of the Report of the Advisory Committee on Fisheries Management, May 1999: Herring in Sub-area. IV, Division VIIId and Division IIIa (autumn spawners).
 ICES 1999b: Report of the Herring Assessment Working Group for the Area South of 62°N. ICES CM 1999/ACFM:12.)