

FISH STOCK CONSERVATION AND MANAGEMENT

A Submission to the Inquiry by the House of Lords Select Committee on Science and Technology Sub-Committee I.

This submission has been prepared by a group chaired by Dr D. Cushing and comprising Sir David Smith, Professor N. Marshall, Professor R. May, Dr M. Clarke and Dr J. Steele (corresponding member). It has been endorsed by the Council of the Royal Society.

1. We welcome the opportunity to submit evidence to this timely Inquiry. Many fisheries in the waters of advanced nations have collapsed, which would seem to indicate a lack of successful management. Our evidence takes each of the questions posed by the Sub-Committee in turn, commenting on the scientific aspects of fish stock management.
2. The greatest single problem of fisheries is that while we have a basic understanding of how to manage them in a sustainable way, political, economic and social pressures work to promote over-fishing which is very hard to resist. Probably the single most difficult problem is the over-capitalization inherent in almost any fisheries industry. Whether one then tries to regulate the ensuing conflict between sustainability and economic considerations by quotas (either in hours at sea or in fish caught), or by transferable licences, or by royalties, or by any other instrument; problems will remain (and vary in subtle ways from one policy instrument to another, often in a manner which is not easily foreseen). We believe that more research is needed into the interface between biological and economic considerations and into finding ways to resolve the genuine conflicts which can stem from them.

Do you consider the scientific methods and associated data are adequate to provide reliable advice for fish stock management?

3. We consider that the scientific methods used to provide advice as reliable. There are two methods in use, "virtual population analysis" (vpa) and the "production models". J.A. Gulland (1968) provided the first evidence that the science is reliable. This is borne out by independent estimates of stock made frequently by egg survey and by acoustic survey which show a good concordance with vpa estimates.
4. There are three main problems with the data: bycatches (catches not targeted by the skipper); discards (of fish not wanted by the skipper); and misreporting. Throughout the world ocean 27 million tonnes each year (based

on catches from 1988-1990) are discarded (Alverson et al, 1994). In the North Sea bycatches of haddock and whiting are considerable and can be expressed by fishing mortality (Alverson et al, 1994). Solutions to these problems need to be found. In Canadian waters there are observers on all vessels, and discards are set against the quotas of the foreign vessels which reduces inaccuracies and we recommend that this policy should be pursued vigorously throughout the world.

As alternatives to the hunting of fish stocks, what do you consider are the prospects for:

5. (i) **marine aquaculture, in addition to established and potential freshwater practices;**

Marine aquaculture production is limited to coastal zones and can constitute only a small percentage of total production. There is a limit on the profitability of aquaculture which has not yet been ascertained; as production increases the price per tonne falls. Marine aquaculture can also cause unforeseen problems. For example, the increase in red tides has followed the addition of food pellets. Further, old and new diseases may appear with unnaturally high densities of fish. There may also be genetic interchanges between wild and farmed stocks of salmon with possible harmful effects on the wild stocks. The genetic engineering of fish provides new opportunities for increased growth rates and disease resistance and may provide a potential means of increased animal protein in less developed countries.

- (ii) **the exploitation of fisheries in the deeper ocean environment.**

Most deep sea bottom fish grow very slowly, due to a low level of food. Such species should thus be exploited with great care. In midwater, oceanic squids are a very large, untapped, high value, protein resource which several nations are beginning to exploit, even in the North Atlantic. Their importance in food webs involving many oceanic fish, seals, cetaceans and birds makes it essential to monitor, at an early stage, multispecies changes accompanying such exploitation.

Are there scientific aspects that are not being adequately addressed when setting fisheries policy? What recommendations would you make?

- 6 (i) **the investigation of catchability.**

This has three components : the description of technical advance and of different formulations for different gears; the search behaviour of fishermen; and the part played by fish behaviour and abundance in the fisherman's search. One of the factors in the collapse in numbers of the northern cod in the Labrador current and on the Grand Bank was the change in catchability. This has not been explained and the causes need to be addressed.

- (ii) **the science of recruitment.**

- (a) The appearance of a strong recruitment arises approximately once a decade. If exploited heavily such a year class would be taken in a year or so. If the stock were to be taken at a more moderate rate the outstanding year class would last half a decade. Managers would like to know when or if this is likely to occur.

Response of stocks to climatic events (Cushing, 1995). The factors behind the Russell cycle are not fully understood. Between 1930-1935 the ecosystem in the western English Channel switched from one dominated by herring to one in which pilchards were abundant and the switch was reversed between 1968 and 1980. This was part of a profound change dominated by the Greenland high in winter and spring between the thirties and the seventies which affected more than 15 stocks in the North Atlantic. The growth and mortality of fish larvae should be looked at and cheaper ways of so doing developed. Bradford (1992) showed that the major variation in recruitment occurs in the late larval stages and Beverton (1992) stressed the importance of these stages.

Stock recruitment relationship (SRR). Daan et al (1994) show the great increase in North Sea cod catches in the early sixties to be part of the gadoid (cod-like) outburst. Since the mid eighties cod recruitment has decreased as if the gadoid outburst was over. The conclusion is that the combined effects of fishing and of the environment which constitute the SRR are too drastic to be ignored.

Would you consider an Intergovernmental Panel on fish and fisheries to be a useful proposition (as suggested by the UK Government's Panel on Sustainable Development) and, if so, what should be its remit?

- 7 The Intergovernmental Panel on Climate Change has been extremely successful because of the availability of models that can be applied globally. Models of fish stocks are applied in all parts of the world but the forms of management differ. Climate change has a globally pervasive nature, whereas the environments of fish stocks differ at present from region to region. The Group did not consider that fisheries science would be advanced by such an Intergovernmental Panel. However, there would be value in a mechanism for communication among Government advisers on the scientific aspects of fisheries policy.

Is there an adequate science base in the UK and internationally on which policy might be based, and what areas of research still need to be addressed?

- 8 The UK science base is adequate for making simple assessments but quite inadequate to conduct research into the more difficult issues such as recruitment overfishing. We recommend that more resources be devoted to (i) examining the problem of catchability, and (ii) developing the science of recruitment.

Are you satisfied with the present distribution of responsibility for fisheries research between Government Departments and the Research Councils?

9. The responsibility for fisheries research should remain with the relevant Government departments as advice is demanded by ministers directly. It was noted that fisheries research was contracted out on occasions to the research councils, but that NERC, for example, tended to do research into fish rather than fisheries research.
10. We did not canvass the views of other national academies such as those in Spain or Canada; the Subcommittee may feel that it would wish to do so directly.

REFERENCES

- Gulland, J.A. (1968) Recent changes in the North Sea plaice fishery *J. Cons. int. Explor. Mar* 31:305-322.
- Alverson, D.L., Freeburg, M.H., Murawski, S.A. and Pope, J.G. (1994) A global assessment of fisheries bycatch and discards, *FAO Fish. Tech. Paper* 339, 233 pp
- Beverton, R.J.H. (1992) The state of fisheries science, pp 25-44 *In The State of World Fisheries* (ed. Clyde.W Voigtlander) Oxford and ISH Publishing, New Delhi.
- Bradford, M. (1992) Precision of recruitment predictions from early life stages of marine fishes, *Fish. Bull.* 90: 434-453.
- Daan, N., Heessen, H.J.L. and Pope, J.G. (1994) Changes in the North Sea cod stock during the twentieth century, *ICES mar. Sci. Symp.* 198: 229-243.

Miss Ruth A. Cooper
Science Advice Section, Manager
16 August 1995