

Conference reports

On using length-composition data in fishery research

Theory and Application of Length-Based Stock Assessments, *Mazara del Vallo, Sicily, 11-16 February 1985*

Length-based inferences on the growth and mortality of fish and invertebrates – crucial information in fishery research and management – were reported as early as 1891 by the Danish Scientist C. G. J. Petersen, one of the founders of fishery science.¹

The ages of fish in temperate waters, which first emerged as a distinct field of enquiry in fishery biology, can be determined fairly precisely by means of rings ('annuli') on their hard parts, such as scales, bones and especially earbones ('otoliths'), just as trees can. In the first part of the century, ageing of fish by means of hard parts gradually supplanted size-frequency analysis as the routine method for determining the growth of fish, despite rearguard actions such as that fought by D'Arcy Thompson, whose (erroneous!) interpretation of length-frequency data on North Sea herring considerably slowed down fishery research in the period from 1920 to 1930.² The resolution of the controversy between D'Arcy Thompson and his opponents left fishery scientists wary of length-based inferences and the models developed and textbooks written in the period from about 1930 to about 1960 were firmly 'ageist', giving scant attention to the fact that many fish and invertebrates can be reliably 'aged', at least under certain favourable circumstances, by careful analysis of the size composition of catch samples.

Some new trends

Two factors contributed significantly to a change of this situation. One was the emergence in the 1960s of a large number of independent Third World

countries, most of which had a pressing need to develop and manage their aquatic resources. To do this, they needed to apply to tropical fish stocks a theory ('the theory of fishing') whose requirement for information on the ages of fish was extremely hard to fulfil in tropical waters, where the lack of distinct seasons often causes the hard parts of fish to lack annuli, or to produce rings that are often difficult to interpret.

The new Law of the Sea, which requires countries to either exploit their marine resources optimally or to grant foreign fleets access to these resources, has made the need for appropriate stock assessment methods in the tropics even more pressing.

Substantial cost

The second factor, felt in developing countries as well as in the large fishery laboratories of developed countries, is the substantial cost associated with ageing fish, whose hard parts (otoliths usually) must be extracted from fish that often must be *purchased* from the fisherman, cleaned, sectioned or ground, often burned, polished and 'read', and whose estimated ages must be subsequently validated by independent methods and/or research teams.

The high costs associated with ageing single fish can increase substantially when ageing must be based on daily otolith rings, shown by Pannella in 1971 to be ubiquitous in fish and relatively easy to read in short-lived tropical species.³

These two factors led several fishery scientists, especially in the late 1970s to return to length-based approaches to estimate the growth and mortality of fish. This has resulted in a plethora

of sophisticated methods being added to the few relatively simple length-structured models that had been previously available. Therefore, the need emerged to review and classify these methods, to investigate their claims of improved accuracy and precision, and to identify the specific conditions under which they could be expected to perform better and/or to be cheaper to apply than the traditional age-based methods.

Theory and applications of length-based methods

The items mentioned above were the aims of this international conference held at the Istituto di Tecnologia della Pesca e del Pescato (ITPP) in Mazara del Vallo. The conference, which was organized by the International Center for Living Aquatic Resources Management, Manila (ICLARM) and the Kuwait Institute for Scientific Research, Kuwait (KISR), was co-sponsored by the Food and Agriculture Organization of the UN and the Consiglio Nazionale della Ricerca, through ITPP, the host institution.

Eighteen participants and six observers from nine different countries attended the conference, at which 22 different papers (several with appended computer programs) were presented and discussed.

Four working groups were formed, each of which discussed one of the following areas:

- sampling of length-frequency data for stock assessment;
- length-based models available for stock assessment;
- sensitivity of the errors associated with length-based stock assessment models; and
- review of computer programs available for length-based assessments.

Each of these groups produced a report which will be included in the conference proceedings. Although it has been left to J. A. Gulland, the conference chairman, to summarize the key results of the conference for the proceedings, three areas of consensus might be mentioned here:

- Although they can be obtained relatively cheaply, length-frequency data must be obtained through rigorous sampling if they are to form the backbone of an assessment scheme.
- There are a vast number of methods for estimation of growth, mortality, recruitment pattern and other information from length-frequency data. It is, therefore, possible to select the method most applicable to the features of a given set of data. When applying such methods, however, care must be taken to assess the likely errors involved, and to take remedial measures where appropriate.
- The precision and accuracy of length-based methods generally improves considerably when growth information (eg as obtained by reading a few otoliths) is incorporated into an analysis based predominantly on

length-composition data. This suggests that the most cost-effective methods for stock assessment, both in developed temperate and in tropical developing countries, should be 'hybrid' methods, combining length-frequency data with some age information from hard parts.

The proceedings of the conference, to be edited by both of us, will be copublished by ICLARM and KISR in 1986 as a two-volume set. The first volume will contain the chairman's overview, the four group reports and the 22 contributed papers, while the second volume will present users' instructions, listings and test runs of a number of the computer and calculator programs discussed at the conference.

We believe that these two volumes will help increase the output of scientists working in developing countries, while helping reduce the cost associ-

ated, anywhere, with the routine aspects of fisheries research.

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¹C.G.J. Petersen, 'Eine Methode zur Bestimmung des Alters and des Wuchses der Fische', *Mitt. Dtsch. Seefischerei Ver.*, Vol 11, 1981, pp 226-235.

²A.E. Went, 'Seventy year growing: a history of the International Council for the Exploration of the Sea, 1902-1972', *Rapp. P.-V. Réun. Cons. int. Explor. Mer.*, No 165, 1972.

³G. Pannella, 'Fish otoliths: daily growth layers and periodical patterns', *Science*, Vol 137, No 4002, 1971, pp 1124-1127.

Conference governing pioneer investor registration, but the Commission membership had indicated its willingness to accommodate the West Germans if they signed the Convention by the December deadline.¹

The FRG decision not to sign was heavily influenced by the USA. It means that none of the four private multinational mining consortia identified in Resolution II will seek pioneer registration in the near term, and it has given rise to some challenges to the FRG's standing as the seat of the International Tribunal on the Law of the Sea (ITLOS) established by the Convention. The FRG maintains that the Hamburg location is not linked to signing the Convention, but rather ratifying it by the time it enters into force.

Groundwork

The fact that none of the private consortia, as things presently stand, will be available to lay the groundwork for the International Seabed Authority's (ISA) mining arm, the Enterprise, as contemplated in Resolution II, and that three key western mining states have balked at adhering to the Convention have both frus-

Holding pattern or forward motion?

Preparatory Commission for the Law of the Sea Convention, *Kingston, Jamaica, 11 March - 4 April 1985*

By the end of June 1985, the 1982 Law of the Sea Convention had received 19 of the 60 ratifications required to bring it into force. An informal Australian survey of countries attending the spring 1985 session of the Preparatory Commission shows 48 countries ratifying the Convention by the end of 1986, representing 3.34% of UN budget contributions. If the Group of ten states then ratified (Australia, Austria, Canada, Denmark, Finland, Iceland, Ireland, New Zealand, Norway and Sweden) they would add 10% to the UN budget shares, bringing the total represented to 13.34%. Two more states would then have to ratify to bring the Convention over the top at 60 ratifications. The Australians warn, however, that prospective financial burdens under the Convention may slow or deter some of these ratifications. (Annex D, 'Preparatory Commission for the International Seabed Authority and the International Tribunal for the Law of the Sea',

Report of the Australian Delegation.)

The final nations to sign the LOS treaty by the 9 December 1984 deadline, bringing total signatures to 159, were Argentina, Belgium, Bolivia, Botswana, Brunei, Central African Republic, Comoros, El Salvador, Guinea, Italy, Lebanon, Libya, Liechtenstein, Luxembourg, Malawi, Nicaragua, Niue, Qatar, St Christopher and Nevis, Samoa, Saudi Arabia, South Africa, Spain, and Switzerland. The FRG announced that it would not sign on 27 November and the UK on 6 December 1984. Both countries let it be known that they would not block EEC signature, which requires a consensus among member states. The European Economic Community (EEC) signed on 7 December 1984.

Until the last minute, the FRG was expected to sign and to seek registration of a pioneer seabed mining investor through the Preparatory Commission. This would have required a creative 'fix' in Resolution II of the