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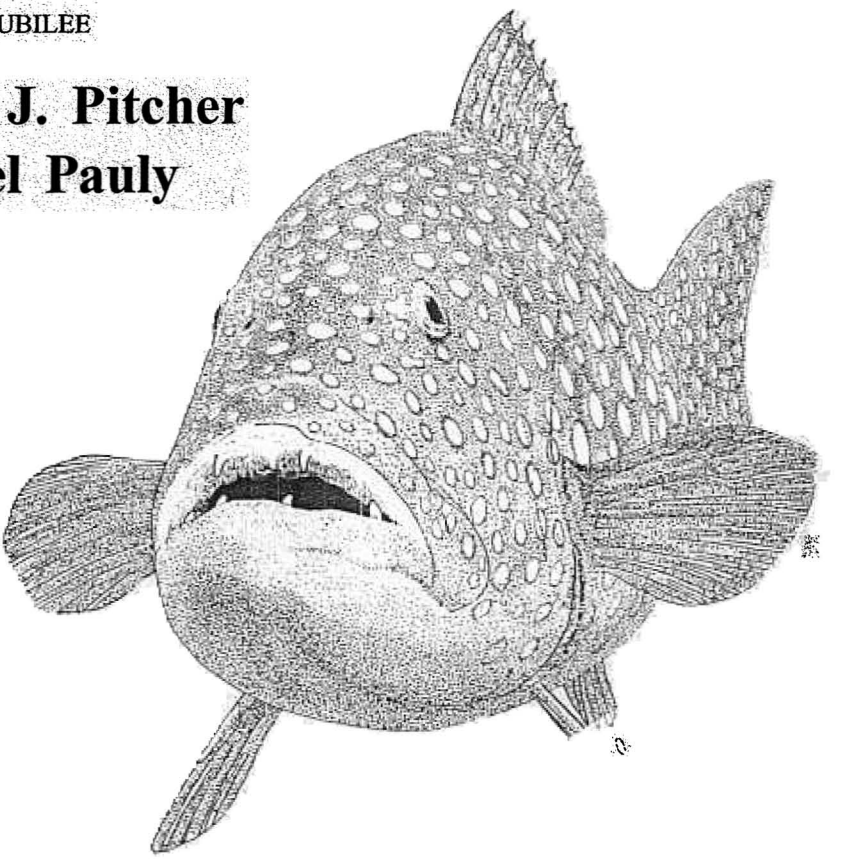
SPECIAL ISSUE
BEVERTON AND HOLT JUBILEE

Editors **Tony J. Pitcher**
Daniel Pauly



CHAPMAN & HALL

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Editorial: The Beverton and Holt Jubilee Issue, 1947–1997

Fifty years ago, Hulme *et al.* published a brief paper in *Nature*, not cited much today, but which ushered a new era in fisheries science. The discipline, then about 50 years old, had identified many of its current research themes: the distribution and growth of resource species, their reproductive seasons and areas, the fate of their larvae, and their selection by fishing gear. Fisheries science, however, still lacked a quantitative framework to interpret the data collected by its practitioners: the early seeds planted by F. I. Baranov had not taken root, and the conceptual understanding of overfishing achieved by B. C. Russell and Michael Graham had not yet been translated into working models. Ten years later, the '*et al.*' of the 1947 paper had become a famous person – Bevertonandholt – who had authored classics such as 'Methods for estimating mortality rates in fish populations', and 'The life-spans and mortality rates of fish in nature'. Then there is the book of 1957, often and for good reasons referred to as the 'bible' (see Pitcher, this volume). Like its capitalized counterpart, the 'bible' has a central message ('Thou shalt estimate growth, mortality and related parameters, and plug them into the yield-per-recruit equation'), a number of peripheral themes (e.g. 'plots of recruitment vs. parent stocks are flat topped'), and parts that are never read, but somehow kept for inspiration when all else fails.

We admit that this Jubilee Special Issue of *Reviews in Fish Biology and Fisheries* was timed to appear 50 years after Hulme *et al.*, although pedants will note that it is 40 years since the 1957 'bible' appeared, so it could equally well be called a 'ruby' issue. (Actually we have slipped by a year, and readers will discover one reason why by looking at Ray Beverton's own paper.) However, what we present here is not a hagiographic 'Festschrift'. Rather, the contributions present critical evaluations of the work and impact of Ray Beverton and Sidney Holt. We are particularly pleased to have been able to include contributions by these two pioneers, the former optimistic, though unfortunately posthumous, the latter quite critical of the entire approach and its applications.

Sylvie Guénette, Tim Lauck and Colin Clark, from the University of British Columbia, review Beverton and Holt's 1957 analysis of the efficacy of marine reserves (no-take areas). Beverton and Holt, based on an age-structured model, judged no-take areas unhelpful in management because of the diluting effect of fish movements. This view, coupled with the seemingly inevitable concentration of fishing power in the area left open to fishing, has had great influence among fisheries scientists. This is one reason why marine reserves have not been widely established in the face of repeated fishery disasters. Guénette *et al.* review alternative numerical models for reserves and evaluate benefits that are not estimable with classic, age-structured single-species models. One result is that, because reserves act as a hedge against uncertainty, Beverton and Holt's view has to be challenged.

Ray Hilborn and Martin Liermann, from the University of Washington in Seattle, boldly put themselves on Beverton and Holt's shoulders. Thus able to see further, they

strive to make stock assessment methods incorporate experience in more explicit ways than hitherto, and, like the alchemists of yore, to turn rotten data into Bayesian gold. Bayesian meta-analysis uses information from many previous stock assessments to constrain uncertainty and tune estimates for important parameters such as natural mortality. The authors discuss clever ways of generalizing parameter estimates from previous work and introduce the powerful concept of 'transportable parameters'. Problems in adopting Bayesian meta-analysis are considered to be whether databases are extensive or representative enough and whether priors may be so powerful as to falsely override exceptional results. This is still a new approach, which promises to become a hot topic as more generalizations are sought from the, rather sad, past record of fisheries management. This promise applies also to the analysis, by Ram Myers, from Dalhousie University in Canada, of the large database of recruitment time series which he has painstakingly assembled from the published record. Using this database, in this paper he examines the links between recruitment volatility and potential environmental determinants, finding that statistical correlations exist only for species right on the edge of their geographical range, thus revisiting a major issue in the Beverton and Holt 'bible'.

Daniel Pauly, from the University of British Columbia, and formerly with the International Center for Living Aquatic Resources (ICLARM) in Manila, traces the history of Beverton and Holt's yield equation, and shows how he and others were forced to modify the basic age-based theory to deal with tropical species that are difficult to age. This attempt turned out to become a major foundation of the whole field of length-based fisheries assessment. Pauly's techniques found a vacant niche in the developing world, which had long been struggling with inappropriate methods and training from temperate latitudes. The methods, aided by the beginnings of the cheap PC revolution, were spread around the world's tropics through numerous workshops sponsored by FAO, ICLARM and other institutions, and a flurry of publications throughout the 1980s. Also, the methods reviewed in Daniel Pauly's paper became the stock in trade of members of ICLARM's Network of Tropical Fisheries Scientists, with much of their work published, to a high standard, in a widespread journal (*Fishbyte*; now incorporated in *Naga, the ICLARM Quarterly*). This was probably the last thing that Beverton and Holt expected to come from their work on such resolutely un-tropical species as North Sea haddock, but both of them are known to have commented favourably on the development. It is encouraging that nowadays, those who owe their training to either the tropical or temperate traditions are beginning to work together in the new fisheries science.

Beverton and Holt concluded their 1957 'bible' with a vision of fisheries optimized through a synergy between science and management. Tim Smith from the USA National Marine Fisheries Service in Woods Hole examines seven reasons why this utopian goal has not been achieved and why we have seen a "perverse persistence in a policy that is demonstrably unworkable". These reasons are: the inevitability of human folly through self-deception, the irreducible uncertainty of data, the inadequacy of single-species models to explain ecosystem changes, the chaotically unpredictable behaviour of complex ecosystems, the lack of ownership of marine resources, the frailty of human institutions, and the political overriding of management advice (the latter also known as human greed). Smith suggests that we learn from the experience of the International Whaling Commission and take into account all aspects of the human endeavour that comprises a fishery system, because we have tended 'to omit that which

needs to be understood'. He also thinks we will have to become interdisciplinary as well as multidisciplinary. The editors, and, we presume, the readers, look forward to a follow-up article in which he will tell us exactly how to do this.

Bill de la Mare, from the Australian Antarctic Division in Tasmania, reckons that Beverton and Holt were on the right track in devising practical goals for fisheries management and inventing methods to deal with them. But they lacked tools for system analysis. He introduces the concept of the 'management-orientated paradigm' (MOP) that sweeps away the boundaries of traditional fisheries scientific, economic and policy research. MOPs entail formulating management objectives that are measurable, specifying sets of decision rules for management procedures, assessing fisheries using specific data and methods, and evaluating the whole system using objective performance measures. Like Tim Smith, Bill de la Mare puts value on considering the whole fishery system, i.e. "using a new MOP means that fisheries management problems are tackled as a whole, rather than piecemeal. A MOP focuses on the required outcomes and provides a means for taking uncertainty into account." But de la Mare warns that handling uncertainty is not the same as quantifying uncertainty. Excessive reliance on the latter may lead to paralysis.

Beverton and Holt's principal legacy is often considered to be yield-per-recruit analysis. However, both Sidney Holt and Ray Beverton's own papers in this Special Issue disavow this view, and single out the little-known self-regenerating yield curve model from their 1957 book, as one of their most important developments. In retrospect, they both think this was undervalued and undersold. Tony Pitcher, from the University of British Columbia, traces the development of the self-regenerating model, and shows that it was far in advance of its time. Thus, a key output from the model is a parameter that expresses the amount of fishing that would cause local extinction. It is symptomatic of a fisheries science in flux, and on the verge of its first major conceptual shift since Beverton and Holt's work, that the extinction concept is divisive of the community of fishery scientists today. Extinctions of marine fishes caused by fishing are considered by some to be impossible, while the others consider them unavoidable, given present practices.

This Special Issue, while not intended as a 'Festschrift', is nevertheless a tribute to the impact of Beverton and Holt's contribution to fisheries science. In these reviews, we find a remarkably wide range of methods invented and concepts solidified as a consequence of their work. Ray Beverton and Sidney Holt helped to found the discipline 50 years ago, yet in both of their own contributions to the volume, fresh insights are provided. The editors think that this is symptomatic of the new way of doing fisheries science that is currently emerging from the apparent chaos pervading our discipline. The contributions in this Special Issue aim to consolidate what has been learned in the past while paving the way for the future.

TONY J. PITCHER
DANIEL PAULY
Vancouver, BC, 1998