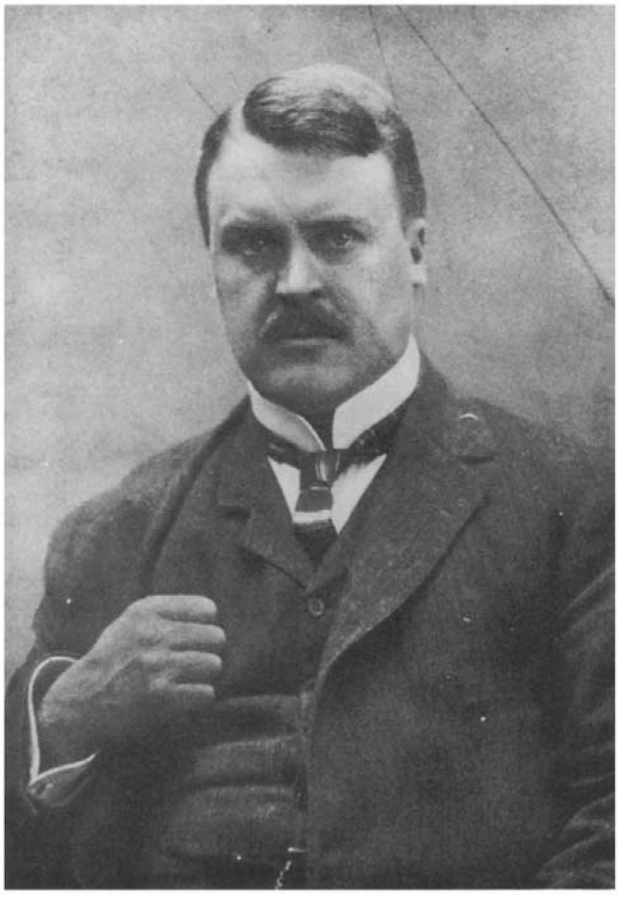
Cambridge Studies in Applied Ecology and Resource Management

The rationale underlying much recent ecological research has been the necessity to understand the dynamics of species and ecosystems in order to predict and minimise the possible consequences of human activities. As the social and economic pressures for development rise, such studies become increasingly relevant, and ecological considerations have come to play a more important role in the management of natural resources. The objective of this series is to demonstrate how ecological research should be applied in the formation of rational management programmes for natural resources, particularly where social, economic or conservation issues are involved. The subject matter will range from single species where conservation or commercial considerations are important to whole ecosystems where massive perturbations like hydro-electric schemes or changes in land-use are proposed. The prime criterion for inclusion will be the relevance of the ecological research to the elucidation of specific, clearly defined management problems, particularly where development programmes generate problems of incompatibility between conservation and commercial interests.

Scaling fisheries: the science of measuring the effects of fishing, 1855–1955



Frontispiece: Johan Hjort: 1869–1948.

A population [of people] can be counted; but who knows how many fishes are in the sea? And yet it appears to me a project big with possibility, to regard the discoveries of fishery research from a similar standpoint to what has been adopted in the science of vital statistics.

Hjort 1907

[T]he numerical value of a year class is apparently determined at a very early stage, and continues in approximately the same relation to that of other year classes throughout the life of the individuals.

Hjort 1914

[I]t would . . . be extremely useful if we could say how large the stock of whales is . . . and estimate the maximum catch that is obtainable from this stock without decimating it.

Hjort 1933

[E]very human activity which is related to animate nature . . . can, therefore, only be understood as an interaction of two different populations; on the one hand the *human* population of hunters [and] fishermen, on the other the *stock* or 'population' of living organisms, the annual renewal of which will always fluctuate . . . depending both on events in Nature and on human activity.

Hjort 1938

SCALING FISHERIES

The Science of Measuring the Effects of Fishing, 1855–1955

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To Jens Knudsen, Gerald Paulik, Douglas Chapman, and John Gulland, each of whom contributed in their own way to my interest in how populations work

CONTENTS

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PREFACE TO THE PAPERBACK EDITION

Scaling Fisheries, the science of measuring the effects of fishing, 1855-1955

When I finished *Scaling Fisheries* in 1994 I did not distinguish the history of fisheries biology from the history of fisheries. However, I was told then by those who seemed to know that I had written a useful first take on the former, but that I had not addressed the latter. Even though I was a scientist rather than a historian, they had assured me that this book would be valuable, if only as a source for real historians of science. As I began receiving reviews, I was watching for an enterprising historian of science to pick up the history for the remainder of the 20th century.

But no such historian appeared, and I was tempted from time to time to apply the approach I had taken in *Scaling Fisheries* to that period. After World War II, the praxis of fisheries biology had coalesced around what was necessary to implement one or the other of three single-species mathematical modeling approaches: surplus production, spawner-recruit and yield per recruit. But at the same time the seeds of expansion beyond fisheries biology into what would become fisheries science were being nurtured. The interesting developments in fisheries science for the last half of the 20th century were in those seeds, not in the many further elaborations of the dominant population models. I could not see how to address those germinating seeds through the approach of *Scaling Fisheries,* and I could not then see outside of that approach.

My difficulty was reflected to a degree in Jennifer M. Hubbard's *A Science on the Scales: The rise of Canadian Atlantic fisheries biology, 1898-1939*. In her long epilog, she attempted to explain the 21st century collapse of the northwestern Atlantic cod fisheries. However, she did this primarily by reference to her history of the first half of the 20th century, the period covered by her book (Smith 2007). While some developments in the last half of the 20th century were important to understanding those collapses, she found that most of the story was in the developments of the first half.

The seeds of expansion beyond the modeling approaches were the many aspects of fish and of fisheries that had been left on the sideline over the decades of the development of the three models. Those seeds included that few fisheries were focused on only one species or population, and that, even when they were, fishing affected other organisms in the ecosystem, and indeed the environment itself. Further, fisheries biology had explicitly excluded accounting for fishing being both an economic and a human enterprise. Management advice that did not also account for these factors was at best incomplete and, at worst, left many fisheries by the beginning of the 21st century either collapsed or vulnerable to collapse.

When I wrote *Scaling Fisheries* I thought I had been trained in a scientific discipline, albeit as I explained then, one that had no sense of its history. Although fisheries biology had been described in the 1930s as promising "to become an important and honored member of the group of natural sciences," this did not in fact come to pass. Rather, the last half of the 20th century was a time of expansion of the basis of fisheries management beyond the narrowness of fisheries biology, as I had suggested in the last chapter of *Scaling Fisheries*. That expansion included adding many disciplines to the study of fisheries, for example ecology, economics, and anthropology. By the end of the 20th century people trained in each of these disciplines were occupying offices around me in the Northeast Fisheries Science Center in Woods Hole, Massachusetts.

That the science necessary for the management of fisheries is something much broader than fisheries biology was reflected in the historical studies that have emerged since this book was first published. Two notable books appeared that took a very different approach from my attempted disciplinary history, drawing on the earlier lead of McEvoy's (1986) *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980*. One book was *Making Salmon: An environmental history of the Northwest fisheries crisis* by Joseph E. Taylor, III. Taylor, as had McEvoy, described the methods of fisheries science in the context of a specific fishery. Similarly, Helen M. Rozwadowski described these methods in her institutional history, *The Sea Knows No Boundaries: A century of marine science under ICES*. Both books work marvelously well at conveying the history of fisheries science.

Their success suggests that the history of fisheries science in the latter half of the 20th century was too intimately tied to fisheries institutions and fisheries themselves to be understandable from a disciplinary perspective. Further, the discipline of history, but not the history of science, is itself now included in the ever-broadening practice of fisheries science. Histori-

cally oriented scientific studies of fisheries had begun to be pursued by the mid-1990s (e.g., Pauly 1995), and by 2002 historians themselves were being lured into fisheries science. This began for me with the Alfred E. Sloan Foundation's development of a project called Census of Marine Life (www.CoML.org). Focused on what is and what will be in the sea, CoML also wanted to focus on the past. To develop the historical part of that project, I was asked along with Poul Holm, a Danish historian, how to answer the question "What was in the sea?" We proposed merging two developing perspectives, marine environmental history and historical marine ecology (Holm *etal.* 2001, Holm 2003). This resulted in a multidisciplinary project called the History of Marine Animal Populations, or HMAP.

Opinions differ on both the wisdom and the success of HMAP (e.g., van Sittert 2005, Bolster 2006, Schrope 2006), especially on the value of collaborations between historians and scientists. The HMAP experience and the approach taken in the above mentioned books suggest that an historical approach to the study of a fishery in their entirety would provide more insight into the development of fisheries science methods than traditional disciplinary approaches of the history of science. Thus, extending the approach of *Scaling Fisheries* from mid-20th century to the present does not now seem worthwhile to me. Rather, I feel that we should explore other approaches to understanding the evolution of fisheries science in the latter part of the 20th century.

Hints about other approaches can be seen in the symposium volume celebrating the centenary of the International Council for the Exploration of the Sea (Anderson 2002). Included there are retrospective articles that reveal the disciplinary breadth that fisheries science has developed and that emphasize the importance of context for understanding the development of fisheries science methods.

Another approach that suggests a way forward, also from a scientific perspective, is what we have termed "fishery autopsies" (Smith 1998, Smith and Link 2005). Taking a perspective that individual fisheries are in fact the objects of study by fisheries science, we suggested that such autopsies would involve conducting comprehensive examinations of individual fisheries aimed at determining the success (or not) of fisheries science and of fisheries management. We noted the importance of including a range of disciplines in conducting an autopsy. However, despite our advocacy within HMAP of the value of collaborations between historians and scientists, we failed to recognize the potentially valuable role of the discipline of history in the autopsy process.

Based on these experiences, it now appears to me that the history of fisheries science could better be approached by a combination of the historical approaches of McEvoy, Taylor and Rozwadowski and the scientific approach of fisheries autopsies. This would more adequately reveal the history of the methods of fisheries science by placing them squarely in the context of the development and management of the fisheries themselves. Thus, I would encourage those who might consider completing the history of fisheries science in the 20th century to consider doing so in a wider context than I did in *Scaling Fisheries*. Combining fishery autopsies and integrative historical studies of fisheries will prove more useful for the study of the history of the methods of fisheries science.

Tim D Smith
April 2007
Redding, California

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UNITS USED IN THE TEXT

Many measurement systems have been and continue to be used in fisheries; these have been used here to be consistent with the original sources. The metric equivalents are given below.

billion = thousand million = 10^9

Units of length

inch (in)	= 2.54 cm
foot (ft)	= 30.48 cm
yard (yd)	= 0.91 m
fathom	= 1.83 m
mile	= 1.61 km
nautical mile (n mile)	= 1.85 km

Units of mass

ounce (oz)	= 28.35 g
pound (lb)	= 453.59 g
hundredweight (cwt)	= 50.80 kg
ton, UK	= 1.02 metric ton (tonne, t)

Units of volume

cran = 0.17 m^3