

Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

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.

Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

Editorial Board

Dr G. Caughley. Division of Wildlife and Rangelands Research, CSIRO, Australia

Dr S. K. Eltringham. Department of Zoology, University of Cambridge, UK

Dr J. Harwood. Sea Mammal Research Unit, Natural Environment Research Council,
Cambridge, UK

Dr D. Pimentel. Department of Entomology, Cornell University, USA

Dr A. R. E. Sinclair. Institute of Animal Resource Ecology, University of British
Columbia, Canada

Dr M. P. Sissenwine. National Marine Fisheries Service, Maryland, USA

Also in the series

Graeme Caughley, Neil Shepherd & Jeff Short (eds.) *Kangaroos: their ecology and
management in the sheep rangelands of Australia*

Paul Howell, Michael Lock & Stephen Cobb (eds.) *The Jonglei canal: impact and
opportunity*

Robert J. Hudson, K. R. Drew & L. M. Baskin (eds.) *Wildlife production systems:
economic utilization of wild ungulates*

Mark S. Boyce *The Jackson elk herd: intensive wildlife management in North America*

Mark R. Stanley Price *Animal re-introductions; the Arabian oryx in Oman*

R. Sukumar *The Asian elephant: ecology and management*

K. M. Homewood & W. A. Rodgers *Maasailand ecology: pastoralist development and
wildlife conservation in Ngorongoro, Tanzania*

David Pimentel (ed.) *World soil erosion and conservation*

R. J. Scholes & B. H. Walker *An African savanna: synthesis of the Nylsvley study*

Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

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

Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

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

Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

SCALING FISHERIES

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

Tim D. Smith

*National Marine Fisheries Service, Northeast Fisheries Science Center,
Woods Hole, Massachusetts, USA*



Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press

The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9780521390323

© Cambridge University Press 1994

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 1994

This digitally printed version (with corrections) 2007

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing in Publication data

Smith, Tim D. (Tim Denis)

Scaling fisheries : the science of measuring the effects of fishing,
1855–1955 / Tim D. Smith.

p. cm. – (Cambridge studies in applied ecology and resource
management)

Includes bibliographical references (p.) and indexes.

ISBN 0-521-39032-X (hc)

1. Fish stock assessment – History. I. Title. II. Series.

SH329.F56S58 1994

333.95'611'0287 – dc20 93-38292 CIP

ISBN 978-0-521-39032-3 hardback

ISBN 978-0-521-03896-6 paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

Cambridge University Press

978-0-521-03896-6 - Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955

Tim D. Smith

Frontmatter

[More information](#)

*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

<i>Frontispiece</i>	<i>page</i> iv
<i>Acknowledgements</i>	xi
<i>Preface to the Paperback Edition</i>	xii
<i>Units used in the text</i>	xvii
PART I: INTRODUCTION	1
1 Fluctuations, the very essence of ecosystems	8
How catches vary: three patterns	10
Why catches vary: three early scientific investigations	21
PART II: DEVELOPING METHODS, 1855–1940	35
2 Research approaches, 1855–1890	38
The US Fish Commission	39
Birkbeck’s Fishery Exhibition	51
Fish hatching: the beginning of a battle	62
Organizing fisheries research	68
3 Measuring the effect of fishing, 1890–1900	70
The small plaice problem	72
The supply of fish	85
Fish hatching: claims and counter-claims	94
Impoverishment of the sea: reanalysis	96
4 The International Council for the Exploration of the Sea, 1900–1920	110
The ICES scientific program	113
Committee A: ‘Fluctuations of the great fisheries’	124

x	<i>Contents</i>	
	Committee B proposes a fishing experiment	138
	The Great Fishing Experiment	158
5	Predicting fluctuations, 1920–1930	163
	Monitoring year classes	164
	Environmental correlations	173
	The first ninety days of life	176
6	<i>A priori</i> methods, 1930–1940	194
	‘Well-established premises’	197
	Age structure of Pacific halibut	202
	Hjort’s optimum catch	214
	Graham’s Great Law of Fishing	229
	PART III: THREE PARTIAL THEORIES, 1940–1955	237
7	Middling in size	239
	‘Powerful interests have grown up’	241
	The death of a fishery	247
	New directions from the graveyard	254
8	How many parents are enough?	267
	Georges Bank haddock	267
	Fraser River sockeye	276
	The spawner and recruit theory	285
9	Steady state yield	293
	The Second Great Fishing Experiment	294
	‘The conception of instantaneity’	301
	Hulme’s expression for total yield	310
10	Integration: self-regenerating populations and the bionomic ecosystem	324
	The Rome Conference	328
	The bionomic ecosystem	332
	Since the Rome Conference	335
	<i>Notes</i>	337
	<i>References</i>	354
	<i>Index of people</i>	372
	<i>Subject index</i>	376

ACKNOWLEDGEMENTS

Many contributed in fundamental ways to this book: Izadore Barrett gave me time to start looking at things past; Margene Smith gave me continual encouragement and time away from family matters; Rachel Smith gave me the title and cover illustration; Bill Sargent gave me guidance in my writing in the beginning; Sharon Kingsland gave me access to drafts of her historical studies, and her guidance at critical points. My thanks to each of them.

Many scientists responded vigorously and with enthusiasm to my questions, especially Fredrick Bell, Raymond Beverton, Tony Byrd, Douglas Chapman, David Cushing, David Garrod, John Gulland, Richard Hennemuth, William Herrington, Sidney Holt, John Knauss, Arthur Lee, H. Pétard, William Ricker, Michael Sinclair, Per Solemdal and Vera Schwach. Their willingness to share their own experiences and their knowledge of the past is appreciated. Many individuals assisted in the technical aspects of preparing this book, including the library staff of the Marine Biological Laboratory in Woods Hole, Massachusetts, and the staff of the National Marine Fisheries Service, in both the Northeast Fisheries Science Center in Woods Hole, and the Southwest Fisheries Science Center in La Jolla, California. Their assistance is greatly appreciated. Of especial help was Diane Armstrong-Roberts of the Cambridge University Press, whose attention to detail saved this author from more than one substantial and countless minor errors, and greatly improved the writing.

Finally, my thanks to many colleagues who over the years expressed their interest in the history of their field by continuing to ask, long after the delays had made it unseemly to do so, when I would be done; their interest helped when enthusiasm flagged.

Tim D. Smith

Woods Hole, Massachusetts, USA

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.

Preface to the Paperback Edition

xiii

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 *et al.* 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.

Cambridge University Press

978-0-521-03896-6 - *Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955*

Tim D. Smith

Frontmatter

[More information](#)*Preface to the Paperback Edition*

xv

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

References

- Anderson, E. (Ed.). 2002. 100 Years of Science under ICES. *ICES Marine Science Symposia* 215, 610 pp.
- Bolster, W. J. 2006. Opportunities in Marine Environmental History. *Environmental History* 11(1).
<http://www.historycooperative.org/journals/eh/11.3/bolster.html>
- Hubbard, J. M. 2006. *A Science on the Scales: The Rise of Canadian Atlantic Fisheries Biology 1898-1939*. Toronto: University of Toronto Press.
- McEvoy, A. F. 1986. *The Fisherman's Problem: Ecology and the Law in the California Fisheries 1950-1880*. Cambridge: Cambridge University Press.
- Pauly, D. 1995. Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology and Evolution*. 10(10): 430.
- Schrope, M. 2006. The real sea change. 443(12): 622-624.
- Sittert, L. van. 2005. The Other Seven Tenths. *Environmental History* 10(1).
<http://www.historycooperative.org/journals/eh/10.1/sittert.html>
- Smith, T.D. 1998. 'Simultaneous and complementary advances': mid-century expectations of the interaction of fisheries science and management. *Reviews in Fish Biology and Fisheries* 8, 335-348.
- Smith, T. D. and J. Link. 2005. Autopsy your dead...and living: a proposal for fisheries science, fisheries management and fisheries. *Fish and Fisheries* 6:73-87.
- Smith, T.D. 2007. Review of J.M. Hubbard *A Science on the Scales: The Rise of Canadian Atlantic Fisheries Biology 1898-1939*. *Journal of the History of Biology* 40: 196-199.
- Taylor, J. E., III. 1999. *Making Salmon: An environmental history of the northwest fisheries crisis*. U. Washington Press, Seattle, 421 pp.

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
------	----------------------