

Ecological Studies, Vol. 103

Analysis and Synthesis

Edited by

O.L. Lange, Würzburg, FRG
H.A. Mooney, Stanford, USA
H. Remmert, Marburg, FRG

Ecological Studies

Volumes published since 1989 are listed at the end of this book.

W. Roy Siegfried (Ed.)

Rocky Shores: Exploitation in Chile and South Africa

With 39 Figures



Springer-Verlag
Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona
Budapest

Prof. Dr. W. Roy Siegfried
Percy FitzPatrick Institute of African Ornithology
University of Cape Town
Rondebosch 7700
South Africa

ISBN-13:978-3-642-78285-5 e-ISBN-13:978-3-642-78283-1
DOI: 10.1007/978-3-642-78283-1

Library of Congress Cataloging-in-Publication Data. Rocky shores: Exploitation in Chile and South Africa / W. Roy Siegfried (ed.). p. cm. – (Ecological studies: vol. 103) Includes bibliographical references and indexes. ISBN-13:978-3-642-78285-5 1. Seafood gathering – Economic aspects – Chile. 2. Seafood gathering – Economic aspects – South Africa. 3. Food supply – Chile. 4. Food supply – South Africa. 5. Fishery management – Chile. 6. Fishery management – South Africa. I. Siegfried, W. R. II. Series: Ecological studies; v. 103. SH400.8.C5R63 1993 333.95'213'0983 – dc20 93-26020

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1994
Softcover reprint of the hardcover 1st edition 1994

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Typesetting: Thomson Press (I) Ltd., New Delhi
31/3145/SPS – 5 4 3 2 1 0 – Printed on acid-free paper

Preface

It seems almost trite to introduce this book by saying that man has been exploiting the intertidal zone for food for a long time. Just how long nobody knows for sure but the prehistoric inhabitants of Terra Amata, on the Mediterranean coast near Nice, ate marine intertidal animals at least 300 000 years ago. Similar impressive evidence, going back to at least 100 000 years, exists for prehistoric man's consumption of intertidal animals along the South African coast. However, early man's dependence on intertidal resources probably goes back much further in time.

During the last 2 million or so years temperate Eurasia experienced some 20 glaciations interspersed by warm equable periods. Different modes of life were open to man in colonizing the northern temperate zone. One was to become a "big-game" hunter, specializing, for example, on mammoths, the other to exploit marine intertidal resources. Of the two, probably the shoreline offered an easier environment for an original scavenging food-gatherer.

Today, there are few human populations that depend on intertidal resources for a significant part of their subsistence. Such groups occur in South America, Australasia, southern Africa, and some oceanic islands (e.g. the Azores). There are relatively few countries in the world where it is possible to study both modern commercial and recreational, and traditional subsistence exploitation of intertidal resources: Chile and South Africa are two of these countries. In these and in several other areas there has been a recent upsurge in the commercial exploitation of intertidal resources. In the case of both subsistence and commercial exploitation, there is an urgent need for advice to facilitate sound management. This advice should be based on scientific studies of the resources, their environments and their exploiters. Effective management of the exploitation of a natural resource involves regulating the behaviour of the people whose activities affect that resource. To date, few studies have focused on the behaviour of man as an exploiter of intertidal resources.

The other major omission in the pool of knowledge available for managers of exploiters of intertidal resources relates to recruitment processes, described in current trendy terms as "supply-side ecology".

The importance of these processes in determining resource abundance and distribution is hardly novel to open-ocean fisheries scientists. Yet, for various reasons, intertidal ecologists, until very recently, have been slow to recognize the links between the dynamics of intertidal communities and those of offshore communities. Some modern studies, however, have shown that the rate of space occupancy in some intertidal biotic assemblages is determined mainly by external factors.

This book deals with ecological and socio-economic aspects of the exploitation of inter- and subtidal food resources, excluding fish, by man in rocky-shore marine ecosystems. The term "man" is used here in the generic sense, not least because most of the exploiting is done by women in southern Africa. In contrast, among the prehistorical Chinchorro Indians of the northern coast of Chile, it appears that the men collected and the women prepared the intertidal organisms on which this society depended for food. Throughout, the term "shellfish" is used in a broad sense, to encompass not only molluscs and crustaceans, but also other exploited marine invertebrates, such as sea urchins.

South Africa and Chile are the geographical foci of this book, for several interrelated reasons: prehistoric and modern methods of exploitation and their impacts can be assessed; comparable, yet different, biogeographical zones (e.g. eastern boundary-current, rocky-shore ecosystems) are involved; probably more is known about man's exploitation of these ecosystems than about similar or contrasting ones elsewhere; both Chile and South Africa support modern schools of natural scientists, economists and resource managers active in the field; the resources concerned are of significant importance to commerce and subsistence in both regions; and, both regions are developing ones, requiring scientific information to guide the management of the exploitation of their marine resources. On the other hand, there are differences between the countries. Virtually the whole of the southern African coastline is subject to high-energy wave action; it has few sheltered bays and lagoons. It is tectonically stable and ancient. Its resources have been exploited traditionally for tens of thousands of years. The Chilean coast, by contrast, is youthful, tectonically unstable, and its resources have been exploited for no more than 15 000 years; there are relatively many bays, lagoons and other areas of sheltered water. There are major functional differences between the biotic assemblages of the two areas; the lack of a diverse assemblage of large generalist predatory invertebrates in South Africa being one example. Some Chilean and South African rocky-shore ecosystems have been substantially degraded as food sources for man, as a consequence of both subsistence and commercial exploitation.

These factors have promoted several exchanges of scientists between the two regions in the last 10 years or so. The contents of this book are based on the discussions of these scientists, complemented and

supplemented by as much recent and relevant international information as possible. The book starts with introductory accounts of the prehistoric, historical and modern exploitation by man of the littoral and subtidal food resources of Chile and South Africa. Thereafter, several chapters deal with the ecological properties of producers and consumers, and the interactions between them, in rocky-shore ecosystems. The final two chapters treat key ecological and socio-economic features that should be considered in planning and executing management of the exploitation of the resources. To a greater or lesser extent, each of the chapters is a self-contained unit. Consequently, some overlap and repetition of subject matter is unavoidable.

The resources concerned here are the basis of an international industry with an annual "turnover" worth millions of US dollars, providing jobs for thousands of workers. In Chile alone, for example, more than 20% of the total labour force engaged in the national fisheries sector of the economy is involved in the exploitation of seaweed. There exists a serious concern over the long-term viability of these resources, in terms of their ecological and economic sustainability by subsistence, recreational and commercial users. On the other hand, with the development of both national and international legislation aimed at preserving a maximum amount of the world's biological diversity, there is increasing pressure for the protection of intertidal organisms. Profound socio-economic changes are occurring rapidly in both countries. In Chile, for example, recent accelerated privatization of conventional common-property intertidal seaweed resources has had significant effects on small-scale fishermen.

It is clear that both the managers and the exploiters of intertidal resources will be called upon to walk difficult paths of negotiation and compromise in the future. Consequently, a principal objective of this book is to provide a comprehensible narrative for scientists, managers and exploiters. The use of intertidal marine organisms as food by man is almost as old as man himself. There is every reason for keeping this age-old tradition alive for as long as possible.

Finally, I am grateful to the many reviewers who contributed significantly towards improving the quality of the manuscripts for the chapters of this book. Prof. Branch and Dr. Hockey provided much encouragement and editorial support. Mesdames Thomas, Davies and Richard Brooke assisted with technical matters.

Contents

1	The Exploitation of Intertidal and Subtidal Biotic Resources of Rocky Shores in Chile and South Africa – An Overview	
	W. R. Siegfried, P. A. R. Hockey, and G. M. Branch . . .	1
1.1	Introduction	1
1.2	Prehistorical and Historical Exploitation	2
1.3	Scope of Modern Exploitation	9
	References	13
2	Man as a Component of the Littoral Predator Spectrum: A Conceptual Overview	
	P. A. R. Hockey	17
2.1	Introduction	17
2.2	Stability and Equilibria in Natural Systems	19
2.3	Co-evolution, Adaptation and Exaptation as Variables in Intertidal Predator–Prey Interactions	20
2.4	Characteristics of Human Predation in the Intertidal Zone	22
2.5	Consequences of Human Predation in the Intertidal Zone	23
2.6	Conclusions	25
	References	26
3	Seaweeds as Resources	
	B. Santelices and C. L. Griffiths	33
3.1	Introduction	33
3.2	The Nature and Historical Development of Seaweed Industries	34
3.3	Ecological Effects of Seaweed Removal	41
3.4	General Patterns	49
	References	53

4	Intertidal and Subtidal Filter-Feeders in Southern Africa A. H. Dye, M. H. Schleyer, G. Lambert, and T. A. Lasiak	57
4.1	Introduction	57
4.2	The Principal Filter-Feeders	58
	References	73
5	Intertidal and Subtidal Grazers G. M. Branch and C. A. Moreno	75
5.1	Introduction	75
5.2	The History of Modern Exploitation	75
5.3	Target Species	76
5.4	Direct Effects of Human Exploitation on the Target Species	80
5.5	The Value of Reserves	81
5.6	Changes in Density, Size and Intrinsic Attributes of Grazers	82
5.7	Indirect Interspecific Effects of Exploitation	85
5.8	Ripple Effects and Multispecies Fisheries	90
5.9	Overall Comparisons Between South Africa and Chile	94
	References	96
6	Exploitation of Two Critical Predators: The Gastropod <i>Concholepas concholepas</i> and the Rock Lobster <i>Jasus lalandii</i> J. C. Castilla, G. M. Branch, and A. Barkai	101
6.1	Introduction	101
6.2	Biology of the Loco	102
6.3	The Loco Fishery	105
6.4	Biology of the Rock Lobster	106
6.5	The Rock Lobster Fishery	109
6.6	The Effects of the Loco on Its Biotic Community	112
6.7	The Effects of the Rock Lobster on Its Biotic Community	115
6.8	Comparisons Between the Loco and the Rock Lobster	120
6.9	Alternative Stable States	122
	References	125
7	Biological Options for the Management of the Exploitation of Intertidal and Subtidal Resources A. H. Dye, G. M. Branch, J. C. Castilla, and B. A. Bennett	131

Contents	XI
7.1 Introduction	131
7.2 The Vulnerability of Different Species	133
7.3 Objectives of Management	136
7.4 Techniques for Management	138
7.5 Problems Attending Management Methods	142
7.6 Functions of Reserves	144
7.7 Selection Criteria for Reserves	148
References	152
8 Socio-Economic Options for the Management of the Exploitation of Intertidal and Subtidal Resources	
F. J. Odendaal, M. O. Bergh, and G. M. Branch	155
8.1 Introduction	155
8.2 The Problem of Managing Intertidal Resources Through Legislation	157
8.3 Common-Property Exploitation in the Intertidal: A Certain Recipe for Disaster	158
8.4 From Common Property to Private Ownership: The Focus Shifts to Fewer Individuals	159
8.5 The Co-operative Option: Can Social Feedback Lead to Mutual Coercion and Self-Restraint?	160
8.6 Can a Co-operative Management Structure Lead to the Protection of Coastal Resources by Social Feedback?	160
8.7 Private Incentive in the Co-operative System	162
8.8 A Gentle Harvest	163
8.9 Coastal Marine Reserves	164
8.10 The Efficacy of Co-operatives	164
8.11 Conclusions	165
References	165
Index of Scientific Names	169
Locality Index	173
Subject Index	175