

Environmental Science

Reinhard A. Klenke · Irene Ring
Andreas Kranz · Niels Jepsen
Felix Rauschmayer · Klaus Henle *Editors*

Human-Wildlife Conflicts in Europe

Fisheries and Fish-eating
Vertebrates as a Model Case

 Springer

Environmental Science and Engineering

Environmental Science

Series Editors

Rod Allan
Ulrich Förstner
Wim Salomons

For further volumes:
<http://www.springer.com/series/3234>

Reinhard A. Klenke · Irene Ring
Andreas Kranz · Niels Jepsen
Felix Rauschmayer · Klaus Henle
Editors

Human-Wildlife Conflicts in Europe

Fisheries and Fish-eating Vertebrates
as a Model Case

Editors

Reinhard A. Klenke
Klaus Henle
Department of Conservation Biology
UFZ—Helmholtz Centre for Environmental
Research
Leipzig
Germany

Irene Ring
Department of Economics
UFZ—Helmholtz Centre
for Environmental Research
Leipzig
Germany

Andreas Kranz
Institute of Wildlife Biology and Game
Management
University of Natural Resources
and Life Sciences
Vienna
Austria

Niels Jepsen
Section of Freshwater Fisheries Ecology
National Institute of Aquatic Resources
Technical University of Denmark
Silkeborg
Denmark

Felix Rauschmayer
Department of Environmental Politics
UFZ—Helmholtz Centre for Environmental
Research
Leipzig
Germany

ISSN 1431-6250

ISBN 978-3-540-34788-0 ISBN 978-3-540-34789-7 (eBook)

DOI 10.1007/978-3-540-34789-7

Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2012950854

© Springer-Verlag Berlin Heidelberg 2013

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law. The use of general descriptive names, registered names, trademarks, service marks, 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.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

The background of this book and the FRAP project concept is presented in great detail elsewhere in this book, so I will concentrate on the contents of the book and the policy that lay behind it.

The book analyses three animal species groups—cormorants, otters and seals—that by their ecological interaction with human activities cause challenges of human/wildlife conflict reconciliation. The book further focuses on conflicts between the three fish-eating species groups and fisheries and aquaculture activities. The species studied are slowly increasing in number and distribution in parts of Europe, as a consequence of changes in human attitude and successful conservation measures, which also augment the need for reconciliation activities. In the words of the introductory policy brief of the book “we need ecologically effective, economically efficient, and socially acceptable means” to manage these conflicts and reconcile them. This book fulfils these challenges using a case-by-case approach, because reconciliation measures differ greatly among conflicts and countries, and it is shown that there is simply no basic solution to all problems encountered even at the species level.

The book gives an excellent overview of the conflicts at a European level, and proposes a framework for the development of conflict reconciliation action plans and analyses of the conflicts at a local, national or European level. Diet and damage assessment is a central theme, because knowledge of the amount of fish consumed is an important argument in the reconciliation process. Superimposed on that information is the analysis of regional economics, policy and stakeholder positions and of course the ecological mitigation measures. Another “module” screens viability and management of the target species and how this knowledge can be used in monitoring and modelling.

At the end of the book there are numerous conclusions, recommendations and consequences for the reconciliation process.

Finally, there is a section on the evaluation of policy instruments and conclusions and recommendations regarding the different conflict management strategies and how participatory decision strategies should be designed.

Suffice it to say, that this book is indispensable for anyone interested in human/wildlife interaction problems and how these problems may and should be tackled

to bring about reconciliation between various stakeholders and the target species. It will help wildlife managers and other decision makers, scientists and laymen alike to design an appropriate approach to this participatory process, and thereby mitigate the problems that will arise as a consequence of expanding animal species that compete with humans for the fishes caught or farmed in European waters.

It has been a privilege to write a foreword and recommend this book, not only because of the concrete virtues of the book but also because I was given the task to give advice on the FRAP process at an early stage. I can only congratulate the FRAP team on this formidable accomplishment, where numerous obstacles would have to be tackled and equally numerous other problems be solved.

Dr. Lennart Nyman
Royal Swedish Academy of Agriculture and Forestry (KSLA)
Tranebergs strand 35
16740, Bromma
Sweden

Contents

Policy Brief	1
Klaus Henle, Andreas Kranz, Reinhard A. Klenke and Irene Ring	
Introduction	5
Klaus Henle, Irene Ring, Reinhard A. Klenke, Andreas Kranz, Niels Jepsen and Felix Rauschmayer	
Part I Lessons Learned from the Analysis of Model Conflicts	
Baltic Seal Reconciliation in Practice	15
Karl Bruckmeier, Håkan Westerberg and Riku Varjopuro	
Reconciliation of the Conflict Between Otters and Fish Farmers	49
Margarida Santos-Reis, Rui Santos, Paula Antunes, Teresa Sales-Luís, Jorge Gomes, Dália Freitas and Luisa Madruga	
Otters Causing Conflicts	81
Kateřina Poledníková, Andreas Kranz, Lukáš Poledník and Jaroslav Myšiak	
Otters in Saxony: A Story of Successful Conflict Resolution	107
Reinhard A. Klenke, Irene Ring, Kathleen Schwerdtner Máñez, Randi Habighorst, Vivien Weiss, Heidi Wittmer, Bernd Gruber, Simone Lampa and Klaus Henle	
Comparative Analysis of the Conflicts Between Carp Pond Farming and the Protection of Otters (<i>Lutra lutra</i>) in Upper Lusatia and South Bohemia	141
Jaroslav Myšiak, Kathleen Schwerdtner Máñez and Irene Ring	

Cormorants in Denmark	165
Niels Jepsen and Thomas Olesen	
Screening the Cormorant Conflict on the European Level	183
Felix Rauschmayer and Vivien Weiss	
The Golden Eagle Compensation Scheme in Finland as an Example of Incentive Measures.	201
Leila Suvantola	
Part II A Generic Framework for the Development of Conflict Reconciliation Action Plans	
Module 1: Screening of the Conflict	221
Andreas Kranz, Felix Rauschmayer and Irene Ring	
Module 2: Wildlife Abundance and Habitat	231
Margarida Santos-Reis, Reinhard A. Klenke and Klaus Henle	
Module 3: Diet and Damage Assessment	241
Håkan Westerberg and Klaus Henle	
Module 4: Legal and Institutional Framework	251
Jukka Similä, Riku Varjopuro, Randi Habighorst and Irene Ring	
Module 5: Regional Economics and Policy Analysis	261
Rui Santos, Paula Antunes and Irene Ring	
Module 6: Stakeholder Analysis.	271
Douglas Clyde Kongshøj Wilson	
Module 7: Ecological Mitigation	281
Andreas Kranz	
Module 8: Management and Viability of Target Species: Modeling and Monitoring	293
Karin Frank, Peter M. Alberti, Klaus Henle and Reinhard A. Klenke	
Module 9: Development of Policy Instruments	305
Irene Ring, Kathleen Schwerdtner Mániez and Rui Santos	

Module 10: Designing Participatory Decision Strategies	315
Felix Rauschmayer	
Editors Biography	323
Index	325

Contributors

Peter Alberti Department of Ecological Modelling, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany;
Present Address: Department of Building Services and Power Engineering, University of Applied Sciences, Altonaer Straße 25, 99085 Erfurt, Germany, e-mail: alberti@fh-erfurt.de

Paula Antunes Centre for Environmental and Sustainability Research, New University of Lisbon, Campus da Caparica 2829-516 Caparica, Portugal, e-mail: mpa@fct.unl.pt

Karl Bruckmeier School of Global Studies Human Ecology, University of Gothenburg, Box 700, 40530 Gothenburg, Sweden, e-mail: karl.bruckmeier@globalstudies.gu.se

Karin Frank Department of Ecological Modelling, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: karin.frank@ufz.de

Dália Freitas Departamento de Biologia Animal Faculdade de Ciências, Centro de Biologia Ambiental, Universidade de Lisboa, Bloco C2-5º Piso, Campo Grande 1749-016 Lisboa, Portugal, e-mail: difreitas@fc.ul.pt

Jorge Gomes Centre for Environmental and Sustainability Research, New University of Lisbon, Campus da Caparica 2829-516 Caparica, Portugal, e-mail: jvg@fct.unl.pt

Bernd Gruber Department of Conservation Biology, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany;
Present Address: Spatial Analysis and Ecological Modelling, University of Canberra, Bruce, ACT 2601, Australia, e-mail: bernd.gruber@canberra.edu.au

Randi Habighorst Department of Environmental and Planning Law, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany; *Present Address:* Zur Krumke 11, 49326 Melle, Germany, e-mail: randi.habighorst@gmx.de

Klaus Henle Department of Conservation Biology, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: klaus.henle@ufz.de

Niels Jepsen Section of Freshwater Fisheries Ecology, National Institute of Aquatic Resources, Technical University of Denmark, Vejlssøvej 39, 8600 Silkeborg, Denmark, e-mail: nj@aqua.dtu.dk

Reinhard A. Klenke Department of Conservation Biology, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: reinhard.klenke@ufz.de

Andreas Kranz Institute of Wildlife Biology and Game Management, University of Natural Resources and Life Sciences, Gregor Mendel Str. 33, 1180 Vienna, Austria; *Present Address:* alka-kranz, Consulting Engineers, Wildlife Ecology and Nature Conservation, Am Waldgrund 25, 8044 Graz, Austria, e-mail: andreas.kranz@aon.at

Luísa Madruga Centre for Environmental and Sustainability Research, New University of Lisbon, Campus da Caparica 2829-516 Caparica, Portugal, e-mail: lmcm@fct.unl.pt

Jaroslav Myšiak Department of Economics, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany; *Present Address:* Fondazione Eni Enrico Mattei and Euro-Mediterranean Center for Climate Change, Castello 5252, 30122 Venezia, Italy, e-mail: jaroslav.mysiak@cmcc.it

Carsten Neßhöver Department of Conservation Biology, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: carsten.nesshoever@ufz.de

Lennart Nyman Royal Swedish Academy of Agriculture and Forestry (KSLA), World Wide Fund for Nature, Ulriksdals Slott, 170 81 Solna, Sweden; *Present Address:* Tranebergs strand 35, SE 167 40 Bromma, Sweden, e-mail: lennart.nyman@manandwater.com

Thomas Olesen Institute for Fisheries Management and Coastal Community Development, Willemoesvej 5, 9850 Hirtshals, Denmark; *Present Address:* Udviklingskonsulent Regional Udvikling Region Midtjylland, Tingvej 15, 8800 Viborg, Denmark, e-mail: c/o dw@ifm.aau.dk

Lukáš Poledník Institute of Wildlife Biology and Game Management, University of Natural Resources and Life Sciences, Gregor Mendel Str. 33, 1180 Vienna, Austria;

Present Address: ALKA Wildlife, o.p.s., Liděřovice 62, 38001 Dačice, Czech Republic, e-mail: lukas.polednik@alkawildlife.eu

Kateřina Poledníková Institute of Wildlife Biology and Game Management, University of Natural Resources and Life Sciences, Gregor Mendel Str. 33, 1180 Vienna, Austria;

Present Address: ALKA Wildlife, o.p.s., Liděřovice 62, 38001 Dačice, Czech Republic, e-mail: katerina.polednikova@alkawildlife.eu

Felix Rauschmayer Department of Environmental Politics, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: felix.rauschmayer@ufz.de

Irene Ring Department of Economics, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: irene.ring@ufz.de

Teresa Sales-Luís Departamento de Biologia Animal Faculdade de Ciências, Centro de Biologia Ambiental, Universidade de Lisboa, Bloco C2–5° Piso, Campo Grande 1749-016 Lisboa, Portugal, e-mail: tsl@fc.ul.pt

Rui Santos Centre for Environmental and Sustainability Research, New University of Lisbon, Campus da Caparica 2829-516 Caparica, Portugal, e-mail: rfs@fct.unl.pt

Margarida Santos-Reis Departamento de Biologia Animal Faculdade de Ciências, Centro de Biologia Ambiental, Universidade de Lisboa, Bloco C2–5° Piso, Campo Grande 1749-016 Lisboa, Portugal, e-mail: mmreis@fc.ul.pt

Kathleen Schwerdtner Máñez Department of Economics, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany;

Present Address: Department of Social Sciences, Leibniz Center for Tropical Marine Ecology, Fahrenheitstr. 6, 28359 Bremen, Germany, e-mail: kathleen.schwerdtner@zmt-bremen.de

Jukka Similä Environmental Policy Centre, Finnish Environment Institute (SYKE), Box 140, 00251 Helsinki, Finland, e-mail: jukka.simila@ymparisto.fi

Leila Suvantola Department of Law, University of Eastern Finland Joensuu campus, P.Box 111, 80101 Joensuu, Finland;

Present Address: Heikinpohjantie 22, 57100 Savonlinna, Finland, e-mail: leila.suvantola@suursaimaa.com

Riku Varjopuro Environmental Policy Centre, Finnish Environment Institute (SYKE), Box 140, 00251 Helsinki, Finland, e-mail: riku.varjopuro@ymparisto.fi

Vivien Weiss Department of Urban and Environmental Sociology, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: vivien.weiss@ufz.de

Håkan Westerberg Department of Research and Development, Swedish Board of Fisheries, Box 423, 40126 Gothenburg;
Present Address: Påskvägen 32, 426 53 Västra Frölunda, Sweden, e-mail: hakan.westerberg@slu.se

Douglas Clyde Kongshøj Wilson Professor MSO Fisheries Sociology, Department of Development and Planning, Innovative Fisheries Management, Aalborg University Research Centre, Nybrogade 14, 9000 Aalborg, Denmark, e-mail: dw@ifm.aau.dk

Heidi Wittmer Department of Environmental Politics, Helmholtz Centre for Environmental Research, Permoserstraße 15, 04318 Leipzig, Germany, e-mail: heidi.wittmer@ufz.de

Policy Brief

Meeting the Challenges of Human-Wildlife Conflict Reconciliation

**Klaus Henle, Andreas Kranz, Reinhard A. Klenke
and Irene Ring**

Conflicts arising from the competition of humans and wildlife for biological resources are as old as humankind. Changes in civil society's attitudes towards wildlife and the success of conservation management have resulted in wildlife prospering again and returning to areas from where they had disappeared and even spreading to new habitats. This is reigniting old conflicts between humans and wildlife.

To reconcile such conflicts, we need ecologically effective, economically efficient, and socially acceptable means to manage human-wildlife conflicts. It is an arduous task that requires time, commitment, and knowledge. It is most successful if management and policy have adequate tools in place well before a conflict becomes virulent.

K. Henle (✉) · R. A. Klenke
Department of Conservation Biology,
UFZ—Helmholtz Centre for Environmental Research,
Permoserstraße 15, 04318 Leipzig, Germany
e-mail: klaus.henle@ufz.de

A. Kranz
Institute of Wildlife Biology and Game Management,
University of Natural Resources and Life Sciences,
Gregor Mendel Street 33, 1180 Vienna, Austria
e-mail: andreas.kranz@aon.at

R. A. Klenke
e-mail: reinhard.klenke@ufz.de

I. Ring
Department of Economics,
UFZ—Helmholtz Centre for Environmental Research,
Permoserstraße 15, 04318 Leipzig, Germany
e-mail: irene.ring@ufz.de

Human-wildlife conflicts often differ strongly, depending on the species concerned and the regionally specific social contexts for a single species. They can range from no conflict to escalation at local, regional, or international level. Attempts to reconcile conflicts are usually developed on a case-by-case approach. As a consequence, reconciliation activities differ greatly among conflicts and among countries, both in approaches followed and in their successes and failures.

Against this background, researchers from the natural and social sciences from nine European countries have joined in a project to develop a generic framework for the reconciliation of human-wildlife conflicts using fisheries and fish-eating vertebrates (grey seal, Eurasian otter, and great cormorant) as model cases.

This policy brief summarizes important messages learned in the development of the generic framework. Above all, successful conflict management requires interdisciplinary and participatory approaches, among these an identification of the ecological, socio-economic, and cultural factors that play a key role in the conflict. We recommend using a conflict manager, who coordinates these activities. Such a person must be accepted by all stakeholders.

In the past, assessments of conflicts focused on the consumption of contested resources and almost always neglected landscape factors. However, the presence of conflicting wildlife and the potential for conflicts is not evenly distributed across the landscape or the sea. For example, the impact of cormorants on fish depends on the distance to major breeding colonies. While diet studies are comparably straightforward in well-delimited environments, such as inland fish ponds, they pose major challenges in open systems, such as coastal areas or the open sea.

Conflict perceptions by stakeholders can differ immensely from country to country, even in the presence of comparable policy instruments (e.g., damage compensation schemes). Similarly, the perceptions of the same conflict can vary widely among stakeholders depending on their specific interests in the conflict. A systematic description of the facts, values, and interests of the different stakeholder groups is essential for successful conflict reconciliation. It is important to realize that EU state aid rules inhibited in some countries the application of policy instruments that are effectively used for conflict resolution in other countries. Structural funds provided by the EU could be better used to reduce the conflicts and are under-utilized in most countries.

Classic ecological mitigation strategies in wildlife management, such as lethal and fertility control, wildlife translocation, or repellents, usually work only under restricted conditions. Typical conflict species tend to be highly adaptable, skilful, and clever and thereby counteract the efficacy of the chosen mitigation strategy. Moreover, any manipulation of the wildlife species to reduce its impact on the competed resource can have adverse effects on the species. Thus, monitoring must be implemented as an integral part of human-wildlife conflict management. Modeling the effects of management alternatives on the viability of the wildlife species can greatly help to evaluate alternative management options.

Single instruments are rarely adequate to solve conflicts. Rather, a combination of different instruments is usually asked for and their selection must be based on the key factors identified in the assessment of the ecological and socio-economic

basis of the conflict. Suitable instruments must be ecologically effective, economically efficient, and socially acceptable. They help to distribute, more equally, the benefits and costs among various stakeholder groups. In addition, one must take into account that civil-society action is an essential ingredient of socially acceptable conflict management. Participatory approaches are particularly asked for when there is a need to shift from species conservation to species management, when new actors emerge in the conflict, or when the conflict escalates due to environmental change or changing human and/or animal behavior.

In summary, if human-wildlife conflict reconciliation strategies are to work, they must avoid simplified views and use truly interdisciplinary approaches instead, involving all relevant stakeholders, engaging some coordinator (conflict manager), and being based on sound scientific principles. Reconciliation takes time to achieve, is a permanent process, and needs research that combines different governmental levels and ecological scales from local to international. Reconciliation approaches are most successful if they are already in place before a conflict becomes salient.

Acknowledgments This work was financed by the EU 5th Framework Program (5th FP) Project “FRAP” (Development of a procedural Framework for Action Plans to Reconcile conflicts between large vertebrate conservation and the use of biological resources: fisheries and fish-eating vertebrates as a model case), contract number EVK 2-CT-2002-00142-FRAP.

Introduction

**Klaus Henle, Irene Ring, Reinhard A. Klenke, Andreas Kranz,
Niels Jepsen and Felix Rauschmayer**

Wildlife captures the imagination of humans. The image of wildlife and human-wildlife conflicts differs among people. Therefore, it is essential in a book that addresses human-wildlife conflicts to first clarify what we understand by “wildlife” and “human-wildlife conflicts”. In the broadest sense, all wild,

K. Henle (✉) · R. A. Klenke
Department of Conservation Biology,
UFZ—Helmholtz Centre for Environmental Research,
Permoserstraße 15, 04318 Leipzig, Germany
e-mail: klaus.henle@ufz.de

I. Ring
Department of Economics,
UFZ—Helmholtz Centre for Environmental Research,
Permoserstraße 15, 04318 Leipzig, Germany
e-mail: irene.ring@ufz.de

R. A. Klenke
e-mail: reinhard.klenke@ufz.de

A. Kranz
Institute of Wildlife Biology and Game Management,
University of Natural Resources and Life Sciences,
Gregor Mendel Street 33, 1180 Vienna, Austria
e-mail: andreas.kranz@aon.at

N. Jepsen
Section of Freshwater Fisheries Ecology, National Institute of Aquatic Resources,
Technical University of Denmark, Vejlsøvej 39, 8600 Silkeborg, Denmark
e-mail: nj@aqu.dtu.dk

F. Rauschmayer
Department of Environmental Politics,
UFZ—Helmholtz Centre for Environmental Research,
Permoserstraße 15, 04318 Leipzig, Germany
e-mail: felix.rauschmayer@ufz.de

undomesticated animals and plants belong to wildlife but most frequently the term refers to medium to large-sized terrestrial vertebrates that are hunted by humans as a resource, trophy, or because they compete with humans for food or space. This is particularly the case when talking about human-wildlife conflicts and we use the word wildlife in this sense throughout this book.

Wildlife is a conspicuous component of the diversity of life, which in our modern days usually is called biodiversity (Wilson 1988; Reaka-Kudla et al. 1997). Throughout evolution humans have had a wide and complex interrelationship with biodiversity as our species *Homo sapiens* is an integral part of the global ecosystem. Humans depend on the “ecosystem services” provided by animals, plants, microorganisms, and genes and their natural products (MEA 2005). We use biodiversity for food, medicine, and construction material, and we compete with some species for space or natural resources. Growing human populations, expanding to almost every corner of the earth, and growing individual resource demands exert increasing pressures on biodiversity and natural resources. Species loss and habitat destruction have been highlighted for several decades and even further back (e.g., Kleinschmidt 1937; Leopold 1949; Carson 1962). The scale and potential consequences of this loss has led to action to combat it, notably the Convention on Biological Diversity (<http://www.cbd.int>) and the commitment of the European Union to protect and restore habitats and to halt the loss of biodiversity by 2010 (EC 2006).

Wild animal species have always played an important role in human exploitation of nature, both as resources and as competitors for food and space. Hence, the need for and ways to their protection are particular.

Given their importance for humans, wildlife figured prominently in human imagination and considerably contributed to the shaping of human culture as witnessed by the oldest documents of art, the elaborate cave drawings of our ancestors. Despite increasing detachment from nature, these influences still continue in modern times, albeit often less consciously, for example, in the widespread use of wildlife species names for human products, characters, and esteems. Notwithstanding the positive values attached to these names, human attitudes to wildlife have often been at odds (Brown 2009).

For thousands of years humans responded to damage caused by wildlife species by protecting their resources and by prosecuting these competitors (Conover 2002). With human population growth and modern societies demanding ever increasing amounts of resources, wildlife dwindled and regionally went extinct. Concomitantly, an increasing part of society was no longer affected by wildlife causing damage. The traditional dualistic view of “good” and “bad” species lost significance and was increasingly replaced by an ecological, and in some sectors of society even romantic, view emerging after World War II (Callicot 1998; Kruuk 2002; Konold 2004). People increasingly developed interest in preserving wildlife species, because they enjoyed their presence and because they identified a set of positive values associated with such species. Last but not the least the modern mass media like cinema and broadcast have brought imaginations about wildlife even to citizens in the largest cities. Who in Europe was not impressed by

Bernhard Grzimeck's "Serengeti shall not die" or Sir David F. Attenborough's amazing series on BBC? Both television series were only representatives for a whole genre that has shaped the perception of nature by people throughout the last decades.

Decision makers and politicians—on behalf of a majority of people not directly affected by wildlife damage—adopted legal and institutional frameworks in order to protect wildlife and prevent it from going extinct. In Europe, the Habitats Directive and the Birds Directive are the most relevant legal regulations in this area, and national laws have to conform to these Directives. These changes in civil society's attitudes towards wildlife and the success of conservation management have enabled some wildlife populations to prosper again and return to areas from where they had disappeared and even spread to new habitats (e.g., Enserink and Vogel 2006).

When wildlife returns, divergent beliefs and interests trigger and exacerbate conflicts among humans (White et al. 2009). While society at large enjoys the presence of wildlife, rural resource holders often have to carry the burden of wildlife damage unless the conflicts are well managed. The consequence is a polarization of the society into urban versus rural residents and local development versus national conservation interests (Conover 2002) that can lead to severe conflict among stakeholder groups. Thus, the need to reconcile such conflicts is the logical consequence of the change of fundamental paradigms in human-wildlife relationships from a purely utilitarian view to a perspective that includes non-utilitarian values of nature and wildlife. If reconciliation fails, either local resource holders loose, wildlife looses since their fate is still in the hands of the local habitants or both of them loose. The challenge in wildlife management is to convert such a *lose-lose* scenario into a *win-win* situation (Woodroffe et al. 2005).

Human-wildlife conflicts encompass two main aspects. The first, more material-based aspect deals with the conflicting "interests" of humans and wildlife competing for the same resources. The second aspect refers to intra-societal or stakeholder relations; protectors of wildlife species, in particular larger vertebrates, are in conflict with the human competitors for the resource who do not want to accept the damage caused by wildlife.

Various species and types of resources can be involved in human-wildlife conflicts depending on conditions and human perspectives. Typical "conflict species" are large carnivores, fish eaters, raptors (eagles etc.), large herbivores, bears, beavers, large owls, and some corvids (e.g., Common raven *Corvus corax* etc.) (Woodroffe et al. 2005). Typical resources involved in human-wildlife conflicts are livestock and game species, farmed and wild fish, but also crops and fruits (Conover 2002).

In this book we do not cover abundant, non-protected species causing damage to crops or forests, such as wild boar (*Sus scrofa*), deers, rodents, and European starling (*Sturnus vulgaris*). These species are not involved in the type of conflict that is the topic of this book. There is a widely-shared consensus that they may be managed and controlled or even eradicated in the most effective way or by means,

which conform to a general ethics of animal rights (Caughley and Sinclair 1994). Rare and protected species suffering from habitat destruction (e.g., Baier et al. 2006) or any kind of human resource exploitation, such as by-catch of marine turtles, birds, or mammals (Piatt and Nettleship 1987; Lutcavage et al. 1997; Read et al. 2006), are also not the target of this book, although they also frequently cause conflicts between stakeholders. Nevertheless, some of the principles developed in this book may be applied to such conflicts as well.

So, what is this book about? The book is dedicated to the reconciliation of conflicts rising from the protection of species and the use of biological resources by humans. Next to presenting a number of illustrative case studies, the major objective of this book is to provide a generic framework for human-wildlife conflict reconciliation. In this way, our objective clearly is to move beyond a case-by-case approach. For successful human-wildlife conflict reconciliation, integrative biodiversity research is required, involving interdisciplinary and applied approaches (Jentsch et al. 2003). Conflicts evolve between people: between individual actors or stakeholder groups that hold different views, values, and interests. Hence, for successful biodiversity conflict reconciliation, (1) ecologists and social scientists need to closely collaborate and (2) societal actors and stakeholders need to be involved in participatory research. In short, the human dimensions of wildlife management become essential, especially when dealing with human-wildlife conflicts (Ring 2009).

Thus, this book is about damages caused by protected vertebrates and their management causing considerable conflicts within society. It is about key features of typical conflict species, about economics, attitudes, and positive or negative emotions. Such, often strong, emotions arise when animal species are regarded as good or bad: charismatic and cute or blood thirsty beasts. Such conflict-species are often adaptable and elusive and therefore difficult to manage.

In North America there is a long-standing tradition in the human dimensions research related to wildlife management, and dealing with human-wildlife conflicts (e.g., Arner and Dubose 1982; Hygnstrom et al. 1994; Hadidian et al. 1997; Conover 2002; Treves et al. 2006; Brown 2009; Unsworth and Petersen undated). Within this tradition, the U.S. Fish and Wildlife Service was established as a governmental authority to deal with damage and conflicts due to wildlife. It was also here that the focus in wildlife management gradually shifted from wildlife itself towards better considering the human dimensions: Wildlife management is people management (Leopold 1933; Maehr et al. 2001; Westley and Miller 2003; Fascione et al. 2004; Manfredo et al. 2009). It is therefore crucial to focus on humans, their behavior and attitudes, in order to reconcile such conflicts (Conover 2002).

In Europe, there is no central authority dealing with the management of damage and the reconciliation of conflicts caused by wildlife. As in most other parts of the world, human-wildlife conflicts are usually addressed in a case-by-case approach, which may differ considerably among and within countries. Generic approaches based on experience from other, similar conflicts have not yet been developed though recently White et al. (2009) developed a framework for assessing and understanding human-wildlife conflicts. Lessons learned from case studies and

generic approaches could greatly improve our capacity to reconcile conflicts because conflict reconciliation is an arduous task that requires time, commitment, and knowledge (Conover 2002). It is most successful, if management and policy have adequate tools in place well before a conflict becomes virulent, as was well illustrated by the highly publicized story of the “problem” brown bear (*Ursus arctos*) Bruno in Germany (Anonymus 2006; Enserink and Vogel 2006).

Against this background, researchers from the natural and social sciences from nine European countries joined in a project to develop a generic framework for the reconciliation of human-wildlife conflicts consistent across national boundaries. The project’s acronym was named FRAP, standing for Framework for Biodiversity Reconciliation Action Plans. FRAP was funded by the EU and used fisheries and larger fish-eating vertebrates (Baltic grey seal *Halichoerus grypus*, Eurasian otter *Lutra lutra*, and great cormorant *Phalacrocorax carbo sinensis*) as model cases to evaluate and illustrate successful (and less successful) approaches for conflict reconciliation (<http://www.frap-project.net>). As for many other human-wildlife conflicts the relationships between fisheries and the conservation of these vertebrates differ strongly across Europe and among species, ranging from no conflict at all to escalations on a local, regional, or even international level. This is well illustrated by the case studies presented in this book.

In the first part of the book we present case studies of human-wildlife conflicts in Europe and the various practical approaches used for conflict reconciliation. The case studies focus mainly on fish-eating vertebrates and fisheries, with a chapter on the golden eagle (*Aquila chrysaetos*) and reindeer (*Rangifer tarandus*) husbandry broadening this scope. As far as possible, the presentation of the cases follows the structure of the generic framework for conflict reconciliation, as presented in the book’s second part. Thus, our framework is illustrated with examples from the conflicts between the conservation of seals, otters, respectively cormorants and fisheries. We evaluated existing information and studied the conflicts for regions that differ either in the ecological basis of the conflict or in the use of socio-economic mitigation strategies. The major regional comparisons are Denmark versus Italy for cormorants, Central Europe versus Portugal for otters and Finland versus Sweden for grey seals. The case studies conclude with lessons learned, be it from failures or success stories, and recommendations for improved conflict reconciliation.

In the second part of the book we draw on the experience from the case studies and the multi-disciplinary background of the FRAP team. We present a generic framework for the development of reconciliation action plans that adequately considers the human dimensions of such conflicts and the need for participatory research. The generic framework provides guidelines on how to analyze and assess the ecological and socio-economic basis of conflicts. It continues with evaluating and developing successful mitigation strategies, including technical mitigation, monitoring and population viability modeling, and mixes of policy instruments. It concludes with the design of participatory decision strategies and recommendations for effective stakeholder interactions.

While this generic framework was written from an EU perspective, many of its principles can be directly applied to other European countries not involved in FRAP

or with little modifications to human-wildlife conflicts in other parts of the world as well. When the framework is transferred beyond the EU context, national regulations, institutional and cultural differences will certainly become more relevant (Ring 2009). In low-income regions, where poorer people are affected by human-wildlife conflicts, sustainable livelihood issues need to be properly integrated into conflict management strategies (Woodroffe et al. 2005; Johannesen 2007). Transferring the framework to wildlife endangering human life itself [such as wolf (*Canis lupus*) and brown bear (*Ursus arctos*)] might need a more explicit recognition of the emotional aspects of the conflict by psychological or anthropological research.

Last, but not least we hope that our integrative approach to biodiversity conflict reconciliation helps to improve our capacity to reconcile such conflicts in order to facilitate a sustained and acceptable coexistence of humans and wildlife.

Acknowledgments This work was financed by the EU 5th Framework Program (5th FP) Project “FRAP” (Development of a procedural Framework for Action Plans to Reconcile conflicts between large vertebrate conservation and the use of biological resources: fisheries and fish-eating vertebrates as a model case), contract number EVK 2-CT-2002-00142-FRAP.

References

- Anonymus (2006) Godspeed Bruno: brown bear meets a tragic end. www.spiegel.de/international/0,1518,423629,00.html. Accessed 01 Dec 2008
- Arner DH, Dubose JS (1982) The impact of the beaver on the environment and economics in southeastern United States. *Trans Int Congr Game Biol* 14:241–247
- Baier H, Erdmann F, Holz R, Waterstraat A (2006) *Freiraum und naturschutz. Die Wirkungen von Störungen und Zerschneidungen in der Landschaft*, Springer, Berlin
- Brown PJ (2009) Introduction: perspectives on the past and future of human dimensions of fish and wildlife. In: Manfredi MJ, Vaske JJ, Brown PJ, Decker DJ, Duke EA (eds) *Wildlife and society—the science of human dimensions*. Island Press, Washington, pp 1–13
- Callicott JB (1998) *The great new wilderness debate*. University of Georgia Press, Athens. <http://www.ugapress.uga.edu/082031983X.html>. Accessed 18 Feb 2009
- Carson RL (1962) *Silent spring*. Riverside Press, Cambridge
- Caughley G, Sinclair ARE (1994) *Wildlife ecology and management*. Blackwell Science, Cambridge
- Conover M (2002) *Resolving human-wildlife conflicts: the science of wildlife damage management*. Lewis Publishers (CRC Press LLC), Boca Raton
- EC (European Commission) (2006) *Communication from the commission: halting the loss of biodiversity by 2010—and beyond. Sustaining ecosystem services for human well-being. COM/2006/216 final*, Brussels, 22 May 2006. http://ec.europa.eu/environment/nature/biodiversity/comm2006/bap_2006.htm. Accessed 14 Dec 2008
- Enserink M, Vogel G (2006) *Wildlife conservation: the carnivore comeback*. *Science* 314(5800):746–749. doi:10.1126/science.314.5800.746
- Fascione N, Delach A, Smith M (2004) *People and predators—from conflict to coexistence*. Island Press, Washington
- Hadidian J, Hodge G, Grandy J (eds) (1997) *Wild neighbors: the humane approach to living with wildlife*. The Humane Society of the United States and Fulcrum Publishing, Washington
- Hygnstrom SE, Timm RM, Larson GE (eds) (1994) *Prevention and control of wildlife damage*. Univ Nebr Coop, Extension, USDA-APHIS-Animal damage control, and great plains

- agricultural council wildlife committee. Nebraska Cooperative Extension, University of Nebraska, Lincoln, vol 2. p 822. <http://digitalcommons.unl.edu/icwdmhandbook/> or <http://icwdm.org/handbook/index.asp#om>. Accessed 14 Dec 2008
- Jentsch A, Wittmer H, Jax K, Ring I, Henle K (2003) Biodiversity. Emerging issues for linking natural and social sciences. *GAIA* 12(2):121–128
- Johannesen AB (2007) Protected area, wildlife conservation, and local welfare. *Ecol Econ* 62:126–135
- Kleinschmidt O (1937) *Die singvögel der heimat*. Quelle & Meyer, Leipzig
- Konold W (2004) Traditionen und trends im naturschutz. *Ber ANL* 28:5–15
- Kruuk H (2002) *Hunter and hunted. Relationships between carnivores and people*. Cambridge University Press, Cambridge
- Leopold AA (1933) *Game management*. Charles Scribner's, New York
- Leopold AA (1949) *A sand county almanac*. Oxford University Press, Oxford
- Lutcavage ME, Plotkin P, Witherington B, Lutz PL (1997) Human impact on sea turtle survival. In: Lutz PL, Musick JA (eds) *The biology of sea turtles*. CRC Press, Boca Raton, pp 387–409
- MEA (Millennium Ecosystem Assessment) (2005) *Ecosystems and human well-being: synthesis*. Island Press, Washington
- Manfredo MJ, Vaske JJ, Brown PJ, Decker DJ, Duke EA (2009) *Wildlife and society—the science of human dimensions*. Island Press, Washington
- Maehr D, Noss R, Larkin J (2001) *Large mammal restoration—ecological and sociological challenges in the 21st century*. Island Press, Washington
- Piatt JF, Nettleship DN (1987) Incidental catch of marine birds and mammals in fishing nets off Newfoundland, Canada. *Mar Pollut Bull* 18:344–349
- Reaka-Kudla ML, Wilson DE, Wilson EO (eds) (1997) *Biodiversity II: understanding and protecting our biological resources*. Joseph Henry Press, Washington
- Read AJ, Drinker P, Northridge S (2006) Bycatch of marine mammals in U.S. and global fisheries. *Cons Biol* 20:163–169
- Ring I (2009) Toward a framework for integrating human dimensions in wildlife management. In: Manfredo MJ, Vaske JJ, Brown PJ, Decker DJ, Duke EA (eds) *Wildlife and society—the science of human dimensions*. Island Press, Washington, pp 90–103
- Treves A, Wallace RB, Naughton-Treves L, Morales A (2006) Co-managing human-wildlife conflicts: a review. *Hum Dimen Wildlife* 11:383–396
- Unsworth RE, Petersen TB (not dated) *A manual for conducting natural resource damage assessment: the role of economics*. Industrial Economics Inc., Cambridge, MA. <http://www.fws.gov/policy/NRDAIndex.html>. Accessed 13 Dec 2008
- Westley F, Miller P (2003) *Experiments in consilience—integrating social and scientific responses to save endangered species*. Island Press, Washington
- White RM, Fischer A, Marshall K, Travis JMJ, Webb TJ, di Falco S, Redpath SM, van der Wal R (2009) Developing an integrated conceptual framework to understand biodiversity conflicts. *Land Use Policy* 26(2):242–253
- Wilson EO (ed) (1988) *Biodiversity*. National Academy of Sciences/Smithsonian Institution, Washington
- Woodroffe R, Thirgood S, Rabinowitz A (2005) *People and wildlife. Conflict or coexistence?* Cambridge University Press, Cambridge

Part I

Lessons Learned from the Analysis of Model Conflicts



Grey seal (*Halochoerus grypus*) in Hel, Poland. Photo: Mateusz Włodarczyk

Baltic Seal Reconciliation in Practice

The Seal Conflict and its Mitigation in Sweden and Finland

Karl Bruckmeier, Håkan Westerberg and Riku Varjopuro

Abstract This chapter presents the results of case studies on human-wildlife conflicts conducted in Sweden and Finland. In both cases the conflict is between the conservation of the grey seal (*Halichoerus grypus*) and small-scale coastal fishing. The characteristics of the conflict between grey seal protection and fishery can be shown by way of a systematic comparison between the two countries and model regions as done here. Thus one can also better see what can be learned from the comparison of the cases. The main messages from both case studies in the Baltic Sea are formulated with regard to the significance of coastal fishery (as resource manager, not only resource user), with regard to single conflict mitigation measures, such as seal hunting and technical solutions to the conflict, and with regard to a combination of measures and overall approaches to conflict management. All these messages converge to the conclusion that much more can be learned from the management of the seal conflict than the resolution of that specific conflict: one by one the lessons learnt turn out to be steps of a more encompassing strategy of sustainable resource management in the coastal zone.

K. Bruckmeier (✉)

School of Global Studies, Human Ecology, University of Gothenburg,
Box 700 40530, Gothenburg, Sweden
e-mail: karl.bruckmeier@globalstudies.gu.se

H. Westerberg

Department of Research and Development, Swedish Board of Fisheries,
Box 423 40126, Gothenburg, Sweden
e-mail: hakan.westerberg@slu.se

R. Varjopuro

Environmental Policy Centre, Finnish Environment Institute (SYKE),
Box 140 00251, Helsinki, Finland
e-mail: riku.varjopuro@ymparisto.fi

1 History and State of the Conflict

1.1 Emergence of the Grey Seal Problem in the Baltic Sea

The number of grey seals in the Baltic declined during most of the twentieth century for several reasons (Härkönen and Hårding 2001). The Baltic grey seal is protected on the basis of the Convention on the Protection of the Marine Environment of the Baltic Sea (HELCOM) and the EU Habitats Directive. Due to the rapid growth of the seal population since the early 1980s the conflict with coastal fishermen has increased in Finnish and Swedish coastal waters because of damage to gear and loss of catch by seals. In the model regions, like in the whole Baltic Sea the number of seals is growing. In both countries the conflict has gained a lot of attention even though it is only one of several environment-related conflicts threatening coastal fishery. It can be seen as the last in a long chain of problems and conflicts. The coastal fishery is in decline because of its competitive disadvantages compared with the large-scale industrialized fisheries, but also because of the deteriorating quality of coastal waters and less availability of fish.

The problem with grey seals in the Baltic includes several aspects that successively have come into focus:

- *A problem of nature or species protection* Due to a combination of high hunting pressure and environmental toxins, such as DDT (Olsson et al. 1994; Hårding and Härkönen 1999; Nyman et al. 2003), the grey seal became endangered during the 1960–70s and was protected. However, the rapid recovery of the population since the 1980s has caused new conflicts and controversies about the continued necessity of protection.
- *A problem of resource use.* Seals, as a consequence of their growing number and changing behavior, compete with the coastal fishermen for the same resource.

International discussions and negotiations have taken place especially between HELCOM parties, resulting in a recommendation for protection of seals in 1988. In Finland, hunting became more and more restricted since 1975 until a total ban on hunting came into force in 1982, whereas the seal reserves were designated as late as in 2001. In Sweden the hunting of grey seal was banned in 1967 in Skagerrak and Kattegatt and from 1975 onwards in the Baltic, with the exception of protective hunting at fishing gear. Protective hunting was completely stopped in 1988. Parallel to the ban of seal hunting a number of seal reserves were established in the 1970s in Sweden.

The latest turn in protection has been that the ban of hunting begins to be modified—although still valid, the door is open for gradually increasing the number of seals hunted. (Protective) hunting of the grey seal has been allowed again since 1997 in Finland and 2001 in Sweden. The seal hunting can be understood in different ways and different interpretations prevail in the Swedish and Finnish model regions. It can be interpreted as still in accordance with the HELCOM rules by following an exemption introduced in 1995 under which

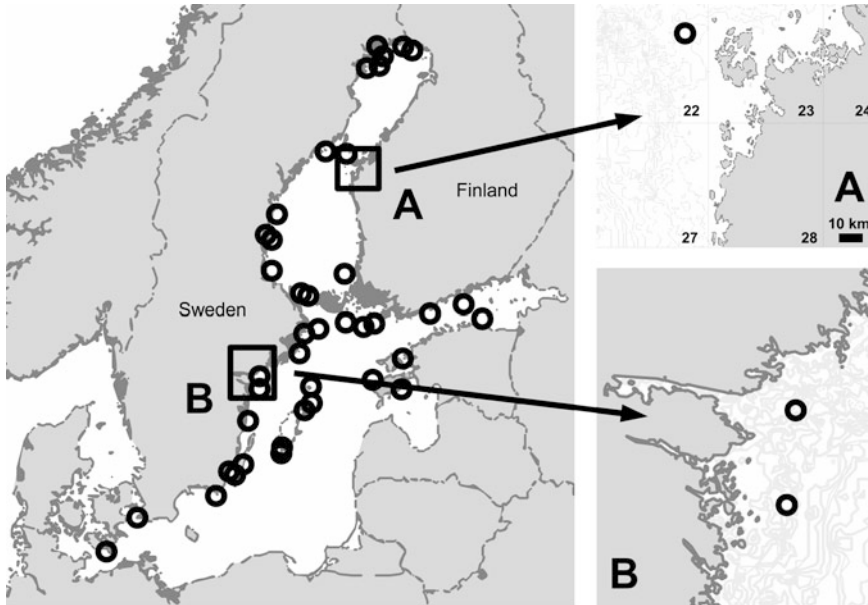


Fig. 1 The Baltic sea model regions and the major haul-out sites of Baltic grey seals (marked with circles; data from the Biomad database, Museum of natural history, Sweden, and RKTL, Finland). The 10 m depth contours are shown in the model region inserts A and B. Sources: Modified version from Wahlberg et al. (2003)

limited hunting is allowed for specific purposes or it can be understood as a gradual return to a practice of free hunting as it has been until the 1970s.

1.2 The Case Studies: How to Reconcile an Increasing Conflict?

For comparative conflict analysis two model regions were chosen, one in each country. The choice of the model regions is based on areas representing a characteristic example for the conflicts in each of the countries, and, for the Swedish region, also due to an increasing conflict with the southward expansion of the seal population. The Swedish region covers the archipelago of county Södermanland and Östergötland. In Finland the region called Kvarken is on the west coast in a narrow sea area between Sweden and Finland (see Fig. 1).

The case studies are presented together for several reasons among which the main one is, that the ecological features of the conflict are the same (see below). How the conflict is mitigated reflects the ecological peculiarities of the species-specific conflict and furthermore the socio-economic peculiarity of small-scale coastal fishery as the main economic sector affected. The mitigation measures

generated so far have, according to their technical character, been similar for both countries, targeting the stakeholder group of coastal fishermen. However, there are also remarkable differences in the conflict management approaches with regard to the managerial coordination of the conflict and the approaches to involve stakeholders.

2 The Seals' Interaction with Coastal Fisheries

The resource competition between seals and the fishery is both direct and indirect. The direct competition takes place in a form of damage to fishery:

- Loss of catch—removal of fish from nets or damaged fish; escaped fish from damaged gear,
- physical damage on nets, and
- the extra work necessary to repair damaged gear or to empty the gear more frequently to decrease the risk of seal damages.

Indirect effects are the spreading of parasites from seals to fish, making the fish unfit for consumption, and a widespread loss of fishing grounds where the level of damage makes fishing impossible. Below we concentrate mostly on the direct damages, because that has been the main topic in debates and the only reason for mitigation activities in both countries.

2.1 Development of the Grey Seal Population

The historic maximum of the grey seal population was around the turn of the nineteenth century, when the total number was 88,000–100,000 animals (Hårding and Härkönen 1999). A combination of bounties and more efficient hunting weapons caused a steady decrease during most of the twentieth century. In addition the burden of polychlorinated toxins in the Baltic decreased the condition and reproductive capacity of the seals from the 1950s and onwards (Olsson et al. 1994; Nyman et al. 2003), which led to a minimum population of probably just a few thousand animals in the mid 1970s. The Baltic grey seals are counted yearly from aircrafts and boats within Swedish, Finnish, and Estonian monitoring programs (Fig. 2). The major field efforts take place in March to count the number of newborn pups on the ice and during molt in late May, when the majority of grey seals are hauling out (Helander and Karlsson 2003). Since the early 2000s, monitoring has been coordinated between the Baltic countries to avoid double counts. The population has increased throughout the 1990s with an annual growth of 8.7 % (Helander and Karlsson 2003) except of the southern part of the Baltic Proper, where the growth is about 5.8 %. The development is illustrated in Fig. 3.



Fig. 2 An aerial photograph of a grey seal islet, taken on a counting flight on 9th June 2005. *Photo: Riku Lumiaro, SYKE*

A major uncertainty with the monitoring program is to estimate how large the fraction of the population is, which is in the water and thus is uncounted during the census. By taking pictures of seals and analyzing a catalogue of identified individuals during a number of years, as was done in Sweden 1998–2002, an independent estimate can be made of the total population size. This shows that the counted number is at least 20 % below the actual population size. The seal combined count in 2004 was 17,640 seals, which means that the estimated amount of grey seals exceed 20,000 (Halkka et al. 2005).

The total number of seals is not the only relevant aspect in relation to interactions with coastal fishing, since the seals do not stay in one place during the year. The grey seal hauls out on rocky islands in the Swedish and Finnish archipelago. During the molting period in late May to early June the largest aggregations of grey seals are found on land and ice (Bonner 1981; Curry-Lindahl 1970). Compared to the extent of the vast archipelagos in the Baltic Sea, the present number of preferred haul-out sites (see Fig. 1) is surprisingly low (Sjöberg 1999). Satellite telemetry studies have shown that even though the movements of individual grey seals may extend throughout the entire Baltic Sea, most seals prefer to confine their movements to within 50 km of their favorite haul-out sites (Sjöberg and Ball 2000; Dietz et al. 2003). Grey seals of the Gulf of Bothnia prefer to forage in daytime and haul out at night (Sjöberg et al. 1999). Because seals move in such a large area their numbers in the model regions vary a lot.

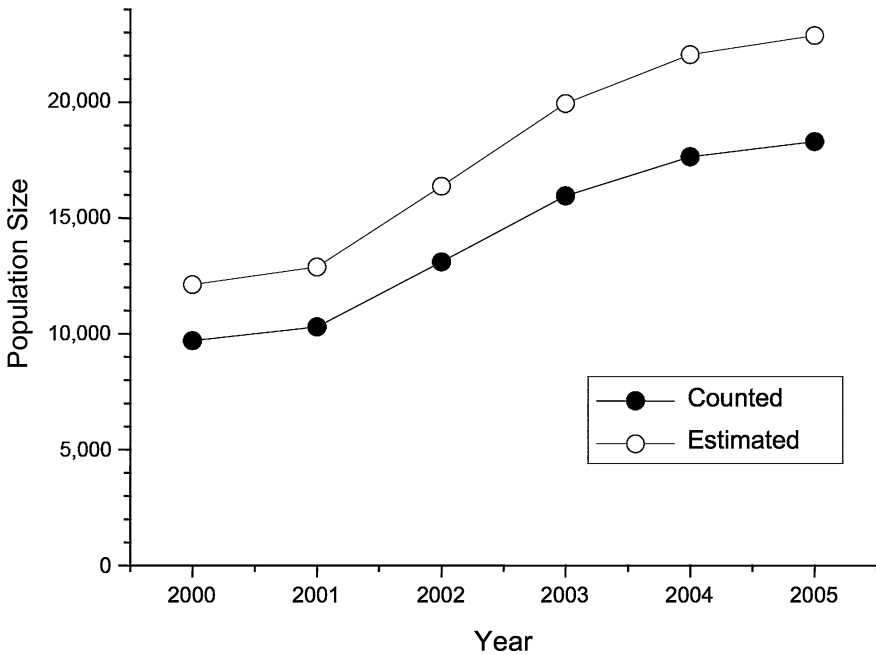


Fig. 3 Development of the grey seal population between 2000 and 2005, the period when monitoring in the Baltic has been coordinated and using comparable methods. The estimate is based on a correction derived from the individual photographic identification project (Hiby et al. 2006)

2.2 Damage Assessment Relating to Diet of Seals

In order to assess the loss of commercially important fish from predation by seals the diet composition and consumption rate has to be known. For the model regions in the Baltic grey seal case such data were lacking and a comprehensive study was conducted to quantify the present diet of the seals (for more details see Lundström et al. 2006). The digestive tract contents from 145 grey seals collected between 2001 and 2004 in the Baltic Sea were examined. By using additional hard-part structures other than otoliths, and species-specific size and numerical correction factors biases introduced by erosion of otoliths was compensated for. In the absence of numerical correction factors based on feeding experiments for some species, correction factors based on a relationship between otolith recovery rate and otolith width was used. A total of 24 prey taxa were identified but only a few species contributed substantially to the diet. The estimated diet composition was, independently of the prey number estimation method and diet composition estimation model used, dominated by herring (*Clupea harengus*), both by numbers and biomass. In addition to herring (*Clupea harengus*), common whitefish (*Coregonus lavaretus*) and sprat (*Sprattus sprattus*) were important prey, but cyprinids (*Cyprinidae*), eelpout (*Zoarces viviparus*), flounder (*Platichthys flesus*)