NAMMCO

Conference on

User Knowledge and Scientific Knowledge in Management Decision-Making

Reykjavík, Iceland 4 – 7 January 2003

Conference Proceedings

Edited by Grete K. Hovelsrud and Charlotte Winsnes

The North Atlantic Marine Mammal Commission 2006

The North Atlantic Marine Mammal Commission 2006
ISBN: 82-91578-17-6
Layout: Audun Igesund
Printed by: GrafiskNord
Cover photo: Grete K. Hovelsrud

PREFACE

NAMMCO - the North Atlantic Marine Mammal Commission - is an international body for cooperation on conservation, management and study of marine mammals in the North Atlantic. The NAMMCO Agreement focuses on contemporary approaches to the study of the marine ecosystem as a whole, and to understanding better the role of marine mammals in this system. Through regional cooperation, the member countries of NAMMCO aim to strengthen and further develop effective conservation and management measures for marine mammals. Such measures are based on the best available scientific evidence, and taking into account both the complexity and vulnerability of the marine ecosystem, and the rights and needs of coastal communities to make a sustainable living from what the sea can provide.

In January 2003, NAMMCO convened the conference on "User Knowledge and Scientific Knowledge in Management Decision-Making". More than 120 participants from eleven countries participated, among them hunters, fishermen, scientists, and resource managers. The aim of the conference was to find ways to incorporate user knowledge into the management decision-making process in parallel with science. The background for the conference was the apparent differences of opinion between the users (whalers, sealers and fishermen) on the one hand, and scientists on the other with respect to the information and data that are the basis for resource management such as the actual numbers of animals found in an area, their migratory routes, feeding habits and biology.

The Conference was sponsored financially by NAMMCO with basic funding from the member countries the Faroe Islands, Greenland, Iceland and Norway. Financial sponsorship was also provided by the Nordic Council of Ministers, Indigenous Survival International – Greenland, the Norwegian Ministry of Foreign Affairs and the Faroese Ministry of Fisheries. Generous in-kind support was received from the Ministry of Fisheries in Iceland and the Institute of Marine Research in Iceland.

It is a pleasure - after all this time be able to present this publication.

Grete K. Hovelsrud
Charlotte Winsnes

PREFACE

INTRODUCTION

WELCOME

KEYNOTE ADRESS

CHAPTER 1 Resource management: an overview

The use of science as decision premise in international resource– and environmental management: some lessons learned
Steinar Andresen 11
The structure of resource management in the Faroe Islands
Kaj P. Mortensen..... 16
An overview of resource management from a Norwegian perspective
Halvard P. Johansen..... 19
Resource management in Iceland and internationally
Stefán Ásmundsson 22
Resource management from a user organisation perspective
Jens Danielsen 23

CHAPTER 2 User knowledge

The role of user knowledge in co-management: the example of the Alaska Beluga Whale Committee
Henry P. Huntington..... 25
Lessons learned from a community and ecosystem-based user knowledge study
Lucassie Arragutainaq..... 27
Projects using user knowledge in management
Charlie Johnson..... 28
Experiences in co-management from the Alaska Native Harbour Seal Commission
Monica Riedel 29
Traditional knowledge of Chukotka indigenous peoples and modern science: providing mutual reinforcement
Vladimir Yetylin..... 32
Inuit Qaujimajatuqangit: Inuit knowledge in Nunavut
Meeka Mike 33
User knowledge and the Joint Secretariat, fisheries joint management - Inuvialuit Renewable Resources Committee, Northwest Territories
Max Kotokak Sr..... 34
User knowledge in Greenland
Kalle Mølgaard 35
Whaling and fishing: experiences from Norwegian waters
Nils Jørgen Nilsen 36
Hunting activities in the Faroe Islands: how user knowledge is gathered, kept and transmitted among pilot whale hunters in the Faroe Islands
Jústines Olsen 38

CHAPTER 3 Scientific knowledge

Scientific knowledge – its strength and limitations
Lars Walløe..... 44
Estimating abundance of seals in the North Atlantic: designing and conducting a scientific assessment
Garry Stenson 47

CHAPTER 4 User knowledge and scientific knowledge

Incorporation of user knowledge into the management of cetaceans: experience from the AWMP of the IWC
Greg Donovan 53
Utilisation of user knowledge in connection with development and implementation of hunting gear
Egil Ole Øen 59
Inuit Qaujimajatuqangit and scientific knowledge in decision-making
Olayuk Akesuk 62
Scientific use of user's knowledge in Faroese pilot whaling
Dorete Bloch 64
The dialogue between scientists and resource users: is it necessary for success?
Jóhann Sigurjónsson 66
The role of scientific knowledge among hunters in Greenland
Kalle Mølgaard 68

CHAPTER 5 Management decision-making process

Different ways of knowing in fisheries: problems and possibilities
Kjellrun Hiis Hauge, ... 69
Controversy and complexity: user knowledge and the management of beluga whales in Cook Inlet, Alaska
Henry P. Huntington 75
Wildlife management in Nunavut: integrating Inuit Qaujimajatuqangit and science
Michelle Wheatley 78

The management decision-making process in NAMMCO member countries

Norway
Lisbeth W. Plassa 80
Greenland
Amalie Jessen 82
Greenland
Kim Mathiasen 83
Faroe Islands
Kaj P. Mortensen 83
Iceland
Kolbeinn Árnasson 84
Iceland
Guðríður Margrét Kristjánsdóttir 84

COMMENTARY

Strengths and weakness of user knowledge in the management process
Milton M.R. Freeman 85

PARTICIPANT LIST

INTRODUCTION

Grete K. Hovelsrud, General Secretary of NAMMCO

Management decisions are predominantly based upon scientific advice, although successful co-management programs exist, and users are involved in management decisions in some countries. This conference provided a venue for how to understand the difference between the user[1]- and scientific knowledge, and between the different ways of knowing. The conference focussed on a set of key topics:

- national and international aspects of resource management, and the structure of the decision-making process;
- existing projects on user knowledge involvement in management;
- how user knowledge and scientific knowledge is gathered, kept and transmitted and their strengths and weaknesses;
- an examination of the co-operation between scientists and users with respect to the utilisation of their knowledge; and
- the role and application of user knowledge and scientific knowledge in management decisions.

This publication is based on presentations by users, scientists and managers, on plenary discussions and on the recommendations drafted at the Conference. The format of the presentations varied and this is reflected in the text presented here. An effort has been made to preserve the different voices of the presenters and the participants.

Science is a critical element of management, and is likely, within the current systems, to remain the main source of information for managers. For some science is considered to be neutral and objective, while others see science as subjective and partially based on opinions. The scientific models, to work, cannot deal with the complexities of the natural world and may therefore be perceived as limiting in some ways. User knowledge is seen as encompassing the complex relationships found in nature without needing proof. This in turn is often problematic for the scientists. It is also a challenge to synthesise complex relationships into informative and easily understood formats. A top-down resource management approach without local input and involvement in the process creates tension between the two levels. Users through their intimate knowledge of the land and their environment are an extremely valuable resource for managers and scientists. The community based co-management initiatives in Alaska and Canada show that user knowledge contributes to and expands the knowledge base and understanding of natural resource use.

It is difficult to document user knowledge, which is often oral and not recorded in the same way as science. It is, however, critical that the representation of such knowledge should not be filtered, interpreted or judged by the scientists. In many of the studies reported the users were frequently found to distrust the scientists and were reluctant to give out information. The users should be involved in setting the management objectives and goals, selecting the local participants, and in designing the scientific studies. The examples presented at the Conference showed that the more the users were involved in the process the more interested they became in both research and management, and ultimately they more readily accepted the management decisions.

User knowledge is gained through experiences in the natural environment, and is based on oral tradition reflecting the past, present and the future. It is passed down through generations, and pertains to the environment as a whole. The accumulated knowledge from the past will always have to be fine-tuned to fit the present. The concept of Inuit Qaujimajatuqangit (IQ) from Nunavut is one example of such knowledge. It is knowledge that has accumulated over many centuries, has evolved over time and is still used today in hunting and management practices and in the cultural aspects of Inuit life. A common thread amongst the users is that the natural environment is an important source of physical and inner strength, is a link to people's emotions, and is intertwined with the cultural practises and traditions. Extensive knowledge of the land and the natural environment is also in many cases essential for survival. Hunters also exchange considerable information between themselves; however, such knowledge is not easily recorded.

Scientists formulate hypotheses, collect data, analyse and interpret data and draw conclusions. Like user knowledge scientific knowledge begins with observations of regularities in nature (empirical laws), and continues with trying to understand the interconnections between the different laws through theoretical laws. These laws are tested through educated guesses or hypotheses. In contrast with user knowledge it is usually the simplest possible explanation that is expressed. In physical science and more recently biology the explanation is expressed in mathematical terms. This poses a problem when such models are applied to practical situations, such as resource management. The managers are usually not aware of the many simplifications and assumptions that are embedded in the models, and do not consider this in the decision-making process. The simplified explanations of natural phenomena is a weakness but also a necessity for modelling interconnections. In contrast to user knowledge science does not attempt to account for all the complexities in the natural environment, although abundance estimates of a population involve a complex set of data. The data are gathered at many levels and for many factors, such as stock identity, pup count, human-induced and natural mortality, age structure, catch data, reproductive rates and pup production. Some of this information comes from the users. An abundance estimate gives an estimate of the current size of a population and allows for determining trends. It also allows for an estimate of sustainable harvest levels, and to determine the role and understanding of resource use.

The conflicts that are often experienced between resource management and science on the one hand and users on the other are in many cases due to different perspectives on the natural resources, such as wildlife and the environment. There are in many cases lack of trust, of coordination and of understanding between the two groups, which creates barriers for cooperation. There are, for example, strong opposing viewpoints between the scientists and the Inuit with regard to the size of the polar bear population. In this case science could benefit from increasing the use of Inuit knowledge (IQ) if the goal is to establish effective polar bear management. User knowledge in general can provide guidance and experience in the process of interpretation and implementation of scientific data and methods. It is a challenge, however, to reconcile and maximise the use of both. The users need a forum where information can be shared. Likewise a mechanism is needed by which the government or the scientists could gather and utilise the experience that has been accumulated by the users. It is difficult for the local communities when the scientists come to study the natural environment and the resources that are important to the local people with a view of nature limited to preservation. It is therefore important for the scientists to recognise that their conclusions will have consequences for the users and the communities. In many cases there are no strict clear borderline between user- and scientific knowledge, but the knowledge may nevertheless be acquired from different sources and for different reasons.

User knowledge is a valuable source of information, but does not constitute an alternative to quantitative scientific studies. Rather such knowledge is complementary to science. The application of good science in combination with user knowledge is likely to result in a stronger and more effective management regime. Cooperation between users and scientists must start as early in the process as possible, and if no forum for cooperation exists, it ought to be created. However, such formalisations must not hinder the scientific integrity. This is because science calls for objectivity and independence from the results of the research. Successful cooperation also entails that the information is brought back to and evaluated in the communities. Creating a management procedure is an iterative process, where the users should also participate in setting the goals for management. It may not be appropriate that the scientists participate at this stage. Both scientists and users should be involved in determining whether the data are available and obtainable. For the process to be effective the scientists should develop the procedures and the users and managers develop the design. The advantages to users in having management procedures instead of ad hoc management are that the objectives are known, the data requirements are specified, and that it will ensure stability of catches. The two systems are not necessarily in conflict but are, as noted above, complementary. It is therefore imperative that users and scientists are cooperating on solving resource management questions. A common understanding of the management goals and objectives, a common interpretation of the results and a development of a common terminology are ideals to strive for.

Confidence building and trust between users, scientists and managers are critical for a successful resource management. This has been recognised by some governments, who have formed hunting councils or formalised relationships with local and national hunting associations. The hunting councils often include representatives from the hunting and fishing associations, from the industry, the scientific community and the ministries. In general terms these councils have input in most aspects of management, including regulations and quotas, giving the users a strong voice through the councils. When all stakeholders are brought together in a constructive discussion they have an opportunity to explain their perspectives and understanding to others with an interest in the same issue (in a process of social learning). In this way important issues are not handled by experts alone, and other aspects, such as social and cultural, are brought into the discussion. An important aspect of the management decision-making process is formulating the questions, goals and objectives. The questions chosen will usually determine the answers one gets. It is highly likely that the involvement of users in formulating questions, goals and objectives will lead to better management.

The five following chapters will address these topics from various angles. Chapter one gives an overview of resource management starting with a discussion from a political science perspective of the role of science in such management, continuing with resource management from the managers' perspectives in the Faroe Islands, Norway, Iceland and from a user organisations perspective in Greenland. Chapter two discusses what user knowledge is and how it has been used in management. In this chapter conference participants from Alaska, USA, Arctic Canada, Chukotka, Russia, Greenland, Faroe Islands and Norway share their knowledge and experiences from a number of initiatives and projects that have utilised user knowledge in management. These include examples of co-management, lessons learned from community based initiatives on combining scientific and user knowledge, descriptions of co-management structures and of how user knowledge is gathered, kept and transmitted. Chapter three briefly discusses scientific knowledge, from a more abstract perspective of what such knowledge is and how scientists go about doing their work, and from the perspective of how to conduct a scientific abundance estimate. Chapter four addresses how scientific and user knowledge have been combined in projects in Alaska and Norway and how managers seek to utilise both in their management decision-making process in Nunavut, Canada, Faroe Islands, Iceland and Greenland. The final chapter addresses principles of the management decision-making process, how user knowledge has been utilised and suggestions for improvements of such integration.

Resource management is complex and the decisions made have implications for a wide range of stakeholders, not least the people and communities depending on the resources. How to utilise the rich knowledge held by users along with that held by scientists in the decision-making process is also exceedingly complex. In this book we have attempted to illustrate such complexities through a variety of voices and topics. It is the hope that what is presented here will be of use to resource managers, resource users and scientists alike.

Footnotes

1 User knowledge is here used to cover local, traditional and indigenous knowledge

WELCOME

Amalie Jessen, Chair of NAMMCO

NAMMCO sinnerlugu tamassi tikilluangaaritsi, ukiortaamilu sulilluarnissassinnik angusaqarluarnissassinnillu kissaappassi. It is my pleasure to welcome you to the first NAMMCO conference on User Knowledge and Scientific Knowledge in Management Decision-Making.

In the last two or three decades, the value of user knowledge has been recognised in relation to management decision-making, especially when talking about management of wildlife resources. I think there is a clear need for better coordination and dialogue between the users and scientists, and their knowledge, in order to minimize the direct conflicts we have seen from time to time. As a manager, and being in between the two groups, we need these two groups to cooperate and supplement each other.

We have heard about conferences, publications, meetings and even scientific research on the issue in other arctic areas. In NAMMCO we have discussed the issue ever since our establishment in 1992, but this is the first time NAMMCO is addressing the issue with this conference after the Commission made its decision at the annual meeting in 2000. I am sure that this conference will not be the last one.

It is therefore with great interest and expectations that I open the first NAMMCO conference on User Knowledge and Scientific Knowledge in Management Decision-Making.

Before I give the word to the Minister of Fisheries here in Iceland, let me conclude my welcoming remarks by quoting two selected old sayings from Greenland as follows:

The first one, I dedicate to all biologists visiting Greenland every spring and summer to do their research on whales.

"Kumak immamut igikkaanni anorlilernavianngilaq."
"When you throw a flea to the sea, there will not be wind."

The last one is for all whalers in the Arctic and Nordic areas.

"Arfanniartoqartillugu nunalerisoqassanngilaq."
"During the whaling, nobody is allowed to work with turf."

Unfortunately, I was unable to find any sayings relevant to our wildlife management nowadays and the managers who are the users of users' knowledge and scientific knowledge in the decision-making process.

KEYNOTE ADRESS

Árni M. Mathiesen, Minister of Fisheries, Iceland

Conference guests, ladies and gentlemen:

May I say that I welcome especially this opportunity to address you at the opening of this conference entitled "User Knowledge and Scientific Knowledge in Management Decision-Making".

Achieving sustainable fisheries has for years been one of the principal concerns of nations whose economies are based on fisheries to a greater or lesser extent. This is a complex and challenging task, because despite extensive research on the marine ecosystem, we still lack a comprehensive and fully satisfactory understanding of it. Our scientists are also faced with the fact that there are so many external factors which have an impact on the ecosystem. Fisheries technology and capacity for catches develops so rapidly that it is difficult to even compare catch per unit of effort (CUPE) between different periods in time. This underlines the importance of linking together user knowledge and scientific knowledge in management decision-making. Here we have two groups of people possessing different types of knowledge. We know that there is no single approach which will ensure a solution to the issue; instead we must attempt to take all the factors into consideration. We have to put our trust in science, but at the same time take into consideration what users of the resource themselves have to offer. They possess a different type of information than do the marine scientists.

We all know that user knowledge is of enormous value and is often available in advance of that of scientists. We take advantage of this information on a daily basis, for instance, with information on undersize fish. This knowledge can thus be exploited in connection with general management issues and application of more specific technical measures.

Here at this conference you will emphasise especially utilisation of marine mammals. As you well know, the view that management practices need to consider the ecosystem as a whole is gaining international recognition. A significant step in this direction was taken at the Reykjavík conference, held by the UN Food and Agriculture Organisation (FAO) and the Icelandic government with support from Norway, just over a year ago. The conference adopted a special declaration: The Reykjavík Declaration on Responsible Fisheries in the Marine Ecosystem. The substance of the Declaration is of critical significance for overall policy concerning utilisation of marine resources. The Declaration quotes a FAO resolution on the need for increased research into the interactions of various aspects of the ecosystem and the importance of viewing it in its entirety. In this connection consideration must be had for the information and assessments of both scientists and those parties actually utilising the resource, because both of them possess extensive and valuable information, although this is of different sorts. Their varying perspectives often lead to friction, but our aim has to be to have regard for both perspectives, while at the same time endeavouring to understand developments in the ecosystem better than we do today.

Iceland has recently re-joined the International Whaling Commission (IWC). This naturally makes no difference as far as our membership and efforts within NAMMCO are concerned. We will continue to participate in the extensive work carried out under its auspices. One could thus say that our position today is the same as Norway's has been since NAMMCO was founded.

I know that many interesting lectures will be delivered here and that this Conference will without doubt increase both cooperation between and common knowledge shared by scientists and users. This is not least important for us, the politicians, because these are the parties who have the greatest influence on our decision-making. We cannot, and must not, regardless of where we stand politically, refuse to accept the responsibility placed on us to pass on the oceans' resources in a good condition to coming generations.

I hereby declare this Conference officially open.

CHAPTER 1 Resource management: an overview

The use of science as decision premise in international resource– and environmental management: some lessons learned

Steinar Andresen

1. Introduction: purpose and scope

It is increasingly acknowledged that science in the traditional narrow sense is insufficient as a decision premise in international resource and environmental management. Various forms of local and user knowledge represent additional and alternative information that should be considered by decision makers. One area where such knowledge is not only useful but also necessary relates to marine resources. Marine resources have been harvested for thousands of years, long before the scientists entered the scene. Obviously, various forms of user knowledge and experience have been attained that cannot necessarily be captured by the sophisticated models developed by the scientists. Nevertheless, it is the point of departure for this paper that science in the narrow traditional sense will remain the main source of information for decision-makers in the area of resource management for the foreseeable future. As important as alternative approaches may be, it seems most likely that they will have the same position as alternative natural medicine will have to traditional textbook medicine.

Traditional science is needed for decision-makers to make informed decisions in these areas. As a point of departure the scientists represent a 'neutral' input on behalf of the resource or environment in question. Although this is a simplified assumption, reflect for a moment on the state of the art in the absence of science. We all know about the so-called 'tragedy of the commons' in various areas – not the least related to the management of the large whales. We also know that short-sighted economic interest and drive for profit tends to go before long term interests and concerns for the common good. However imperfect, we need traditional scientific input to balance these forces. Unless we have fairly good knowledge about the resources in question, management tends to be based primarily on luck – usually not a good guiding device in the long run.

With this caveat, this paper is organised in the following way. First a short general overview is given of the extent to which science is a major input for decision-makers within international environmental and resource regimes. This is based on studies of the following international regimes: the whaling regime, North Sea marine pollution, acid rain, ozone and climate. (Andresen et. al., 2000) The regimes have been split up in distinct components and/or phases, altogether 19 units of analysis. The reason is that the different phases and components exhibit distinctly different characteristics both in the dependent and the independent variables. This provides a broader base for generalisation compared to only five regimes. Nevertheless, we do not maintain that our findings apply to a wider universe of cases.

Based on this research, in section 2 the extent to which science is a major input to decision-makers is briefly discussed. As there are strong variations regarding the extent to which science has an impact on decisions taken, in section 3 I briefly discuss some factors contributing to such differences. What happens to the scientific process when there are strong conflicts over values within a given regime? This is a different phenomenon from 'ordinary' conflicts of interests as value conflicts often imply that there are fundamentally opposed views as to what should be the goal of the regime. This is illustrated by briefly discussing the whaling regime in section 4. Finally, I discuss whether there are ways to alleviate such polarisation of science or if this is a problem we have to live with.

2. Science is a major source of input to decision makers

The general picture, based on the set of cases studied, may be summarised as follows:

Scientific research is generally recognised as a major supplier of relevant knowledge. In all five regimes decision makers have turned to science for problem identification and diagnosis, and in some cases also for explicit policy advice. Also, in all regimes research-based knowledge has been generally perceived as an important basis for making informed or rational policy decisions.[1] This applies even in cases where the state of scientific knowledge was recognised to be relatively poor. Scientific bodies have been established as more or less integral parts of the decision making system in all these regimes. Moreover, there is a tendency towards increasing formalisation of links between decision making bodies and the scientific community as regimes 'mature'. Even though the pattern is not very robust, there is also a tendency towards higher-level utilisation of research-based knowledge over time. Finally, a tendency towards broadening of the range of scientific inputs requested can be observed, notably to include not only natural sciences but also to some extent economics.

Governments rarely explicitly dispute what the scientific community considers to be 'consensual knowledge'. This is not to say that uncertainty and knowledge gaps are not exploited for tactical purposes in international negotiations. On the contrary, particularly in the early phases progress is often hampered by one or more parties demanding more conclusive evidence or by competing interpretations of available information. Yet, the evidence suggests that most governments are reluctant to dispute openly the factual conclusions that a clear majority of competent scientists consider 'state-of-the-art' knowledge. Moves to exploit uncertainty or favour biased interpretations are common, but open and explicit challenges seem to be rare.

Faced with broad consensus among competent experts on the description and diagnosis of a (severe) environmental problem, governments do in fact most often take some kind of collective action. That is, some substantive targets are usually set and/or regulatory measures introduced. Moreover, it seems that these steps were taken at least in part as a response to scientific evidence. This is by no means to suggest that scientific evidence is a sufficient condition for collective action. Nor do we suggest that policy responses are typically derived from research-based knowledge. It would be an exaggeration to say that regulations were in any strict sense derived from scientific inputs. The typical pattern is one where new evidence about environmental damage or resource depletion leads, first, to increased attention and requests for further study, and – perhaps at a later stage – to some substantive measures designed to alleviate the problem. In other words, scientific evidence often plays a major role in agenda-setting, and often serves to precipitate some kind of policy response. The substance of that response, however, is determined essentially by politics rather than science.

Even though broad consensus among competent experts about the nature and ramifications of a problem tend to facilitate international negotiations, conclusive evidence is not a necessary condition for collective action. Substantive measures may be agreed upon even in the absence of conclusive evidence about (the amount of) environmental damage.[2] It also happens that the regulatory body moves substantially beyond the recommendations made by its scientific advisory body.[3] The increasing support for decision rules such as the precautionary principle might suggest that we could expect to see more instances of pro-active environmental regulation in the future. This will not necessarily change the overall level of attention paid to research-based knowledge, but it may well change the way in which inputs from science are used and conceivably also the kinds of inputs requested by policy-makers. For a truly pro-active environmental policy, science seems to be useful particularly to the extent that it can serve as a kind of early warning system, identifying future risks.

Therefore, in thinking about the role of science in international environmental regimes we probably see science primarily as a supplier of warnings serving as spurs for protective measures. This image has considerable merit, but our case studies indicate that scientific evidence can sometimes have the opposite and sobering effect on decision-makers.[4] This reminds us that better knowledge about the environment will not necessarily serve to support the most radical demands for regulatory intervention.

Normally, we would also expect to find a positive relationship between the demand for and the supply of scientific inputs. We would expect the demands for inputs from science to increase as the state of knowledge improves, and supply to be cut back when demand declines. The two do not, however, always go in tandem. The policy makers may not always wish to hear the advice that the scientists put forward. This again may intensify the scientists' efforts.[5] The causal mechanisms behind this odd pattern are complex, and I am not suggesting that demand slackened as a consequence of improvement in supply! The interesting point is that supply and demand are driven in large part by different mechanisms, and that the dynamics of the interplay seems to be more complex than recognised by 'conventional wisdom'.

3. Conditions affecting the impact of scientific input

A number of factors may account for the impact of scientific input on decision-makers. Some possible factors are[6]:

- Consensual knowledge vs. controversial and uncertain conclusions
- Feasible cure available vs. no cure available
- Effects close in time and social space vs. remote effects
- Problems affecting centre of society vs. periphery of society
- Problems developing rapidly and surprisingly vs. slowly and as expected
- Effects visible to the public vs. 'invisible' problems
- Low political conflicts vs. high political conflict

Obviously, the first part of the points mentioned above increases the chance that scientific advice is followed, while the latter part decreases the chance that scientific advice is followed. In the following I will deal very briefly with the first (state of knowledge) and the last point (degree of political conflict) and discuss their significance and how they interact. This will be illustrated by linking the discussion to the more recent period of the whaling regime.

The state of knowledge as well as the degree of political conflict both have bearing upon the nature of the issue at hand, whether it is 'benign' or 'malign'. As a point of departure, the more 'malign' an issue, the lower the effectiveness of the regime in question – and vice versa (Miles et al., 2001). Malign issues are characterised by strong political conflicts as well as uncertain and often contested knowledge. Knowledge usually plays a very limited role when political conflicts are significant. It has been suggested that one small, but still important way to enhance the effectiveness of regimes is through deliberate institutional design of the science-policy interface by combining autonomy and involvement on part of the scientists in the decision – making process (Andresen et al., 2000). The good news from this project for policy makers and researchers was that institutional design does matter. In short, it pays to consider carefully how institutions are designed, including how the interface between science and policy is organised. The bad news is that there was one notable exception to this rule – when strong values are at stake, as in the whaling regime, there are poor conditions for the influence of knowledge. The reason was not poor design in relation to the science policy nexus. In fact, it has been maintained that the whaling regime is a 'modern' regime by conventional standards and has an elaborate institutional design – not the least regarding the science-policy interface (Andresen, 2001a). I will pursue this somewhat more in detail in the next section.

4. Values, conflicts and science

The basic facts about the history of whaling and the International Whaling Commission (IWC) will not be dealt with in this chapter, as it is well known and much researched.[7] Still, considering that this book is written by supporters of sustainable commercial whaling, and opponents of the present policy of the IWC, it is extremely important to point out that the 'green groups' that contributed to 'hijack' the whaling regime in the 1970s and early 1980s, as a point of departure had a good cause. The history of modern whaling, well into the 1960s, was a depressing story and has aptly been described as the 'fox guarding the hen-house' (Victor, 2001). As one small illustration, the Japanese did not stop the commercial hunt of blue whales until the level of catch was less than 30 animals for one season! Therefore, adopting the whale as a symbol for the environmental movement – at the time – was understandable.

However, when anti-whaling states and green NGOs launched this campaign, the IWC was already well underway towards sustainable management of the large whales. This development was abruptly stopped with the polarisation of the issue. Instead it became a simple battle, in favour of or against whaling. Those who are familiar with the whaling issue know that the reality is more complex. It has never been a question of whaling vs. non-whaling in the IWC as whaling has taken place all the time. The anti-whaling forces have been clever to convey the fact that scientific whaling has taken place by Japan and Norway – and more recently also by Iceland. This is perfectly legal according to the whaling convention, but the anti-whaling forces claim it is a disguise for commercial whaling. In contrast, the pro (commercial) whaling groups have not been equally successful in getting across the fact that aboriginal whaling is also taking place – making the US a major whaling nation, in comparative terms. This is also legal according to the whaling convention, but the difference between aboriginal whaling and commercial whaling today is almost non-existent (Young et al., 1994). Therefore, the 'true' story is not one of whaling vs. non-whaling but (politically) acceptable vs. (politically) not acceptable whaling.

Nevertheless, in broad political terms and in the media this issue has been perceived as a battle over whaling vs. non-whaling. The main architects behind this simplified picture have been a rather strange alliance, Greenpeace and the US.[8] Traditional power politics and coercion have been used to intimidate the pro-whaling forces. Still, emotions and conflicting values have also been running high on this issue. Conflicts are commonplace in international politics but the hostile value laden atmosphere in the IWC is quite rare, especially since the parties to this conflict are traditional allies (Japan, Iceland and Norway vs. the US, UK, Germany – and others). Moreover, from most perspectives, this is a marginal issue at the very fringes of international politics. Somewhat paradoxically, this may be one reason for the strong polarisation – as most actors have no economic interests involved they have 'allowed' emotions and rather extreme forces to have a rather dominant place.

What can be said about the role of science in this setting? Among the 19 cases in our 'science-policy project', the most recent phase of the of the IWC stands out as a conspicuous 'outlier' among our 19 cases in that it combines the lowest score with regard to use of research-based knowledge with one of the highest scores in terms of state of knowledge and conducive institutional arrangements. To simplify, this is a case where the knowledge base and institutional arrangements have a top score, but decision-makers do not want to make use of it. The explanation for this seeming paradox is straightforward: This is the only case in our study characterised by a stark conflict over basic values. Research can produce information on the state of a stock or an ecosystem and provide factual inputs for determining sustainable levels of harvest, but there is no way it can resolve the issue of whether it is morally right or wrong to utilise a particular species for consumptive purposes. Introducing a 'rational' element that science represents has limited effect when bargaining is over values and not numbers. Whenever conflict focuses on basic values, (natural) science is likely to be sidelined – however sophisticated its models and however accurate and reliable its conclusions may be.

5. Concluding comments

Does this mean that under such circumstances there is no room for science? In the 1980s this seemed to be the case. At the time there was not only politically strong disagreement, there was also strong disagreement between the scientists and science was highly polarised. That is, science was 'infected' by the political conflicts. Although there is still some scientific controversy in the Committee, it has been reduced considerably over time. Essentially there are only a few 'footnote' scientists left – with close ties to the 'green' movement. Through a process of massive scientific effort as well as innovative scientific procedures, one has come as close to a scientific consensus as one can expect. In short, there is no serious scientific disagreement today that some species, like the Northeast Atlantic minke whales, may be carefully harvested on a sustainable basis. This shows that patience, a long-term strategy and solid scientific research reduces scientific uncertainty as well as the possibility to misuse science for political purposes.

This is in itself is no small accomplishment, but does the more consensual scientific message have a stronger bearing upon management decisions? As a point of departure the answer is negative. The Commission in 1994 accepted the Revised Management Procedure produced by the Scientific Committee, but it has never been implemented. The anti-whaling forces in relatio n to the call for a New Management Scheme have tabled new demands regarding such issues as inspection and control. Although some of these provisions may be legitimate, there is hardly any doubt that in essence this is a strategy to postpone and stall the resumption of commercial whaling. The main reason is simple; although it is established beyond doubt that some species may be harvested commercially within safe scientific borders, the majority does not want to do so, for political reasons.

Still, there are some interesting recent developments, creating nuances in this picture. One is the considerable change in the diffuse but important 'force of argument' used by the contesting parties. The force, authority and superiority in the argumentation of the anti-whaling movement struck anyone who took part in the IWC meetings at the end of the 1980s. The pro-whaling forces were reduced to a small, whispering group completely overrun by the other side. There is no doubt that one reason for this was the scientific uncertainty and controversy – effectively exploited for political purposes by the anti whaling states. Attending an IWC meeting after the turn of the century is a very different story.[9] The pro-whaling nations have much more confidence, are much more active, and not the least, they have many more supporting nations than they used to in the 1980s.[10] There may be many reasons for this change of atmosphere and negotiation strength, but again there is no doubt that one important reason for the change is that the main scientific message is no longer disputed – and it is essentially in support of the pro-whaling forces.

Today, some of the more moderate, but major 'green' groups like the WWF also accept limited commercial whaling on specified conditions, unthinkable a decade ago and also unthinkable without the emerging scientific consensus. More recently, major and respected media sources like the New York Times and the Economist have printed articles accepting the scientific basis for commercial whaling – equally unthinkable a decade ago. These are all indications that the tide is about to turn in the long-standing battle over the large whales – and one crucial element in the gradual transformation of the issue is the role of traditional science. On the other hand, as was evident at the 2003 IWC meeting, the counter forces are mobilising and working relentlessly to make the IWC into an organisation that focuses on protection rather than management.

In short, we can expect the battle over the whales to continue. It is still my opinion, maybe too 'rational', that those forces that have science solidly on their side will prevail in the long run – one way or the other. Turning back to where I began, there is no doubt that we need alternatives as well as supplements to the traditional 'hard sciences'. Science with capital S is no magic word for good management. Still, I see science as a necessary and important counterweight to strong political and economic forces. If this perspective is valid I hope that traditional knowledge and user group knowledge find more common ground with scientific knowledge than with short-term economic and political interests.

References

Andresen, S, Skodvin T., Underdal A. and Wettestad J., 2000, Science and politics in international environmental regimes: Between integrity and involvement, Manchester University Press.

Andresen, S, 2001a, The whaling regime: 'Good' institutions but 'bad' politics, in Friedheim, R, Towards a Sustainable Whaling Regime, University of Washington Press, pp.235-269.

Andresen, S, 2001b) "The International Whaling Commission: More Failure Success?" in Miles, E, et al., 2001, Environmental Regime Effectiveness, MIT Press, pp. 379-405.

Andresen, S, 2004 (forthcoming), "Whaling: Peace at Home, War Abroad" in J.B. Skjærseth (ed.), International Environmental Regimes and Norway's Environmental Policy: Crossfire and Coherence, chapter 3.

Birnie, P, 1985, International Regulation of Whaling: From Conservation of Whaling to Conservation of Whales and Regulation of Whale Watching. 2 Vols., Oceana.

Miles, E, et.al., 2001, Environmental Regime Effectiveness, MIT Press.

Tønnessen, J.N and Johnsen A.O., 1982, The History of Modern Whaling, University of California Press.

Underdal, A, 1989, "The politics of science in international resource management": A summary, in Andresen, S, and W Østreng (eds.), International Resource Management, Belhaven Press, pp. 253-269.

Victor, D, 2001, "Whale Sausage: While the Whaling Regime does not need to be fixed", in Friedheim, R, Towards a Sustainable Whaling Regime, University of Washington Press, pp.292-311.

Young O, et al., 1994, "Subsistence, Sustainability and Sea Mammals: Reconstructing the International Whaling Regime", Ocean and Coastal Management, 23 (1994), pp.117-127.

Footnotes

1 The latest phase of the whaling regime is the only exception. I will have more to say about that case later on.

2 Measures taken to protect the North Sea environmental regime is a case in point.

3 This has been the case for the IWC more recently.

4 New knowledge had a sobering effect on some of the initial pushers regarding Nox emissions within the acid rain regime. Similarly, new knowledge has contributed to undermine the call for a blanket moratorium on all whaling.

5 This development is typical for the most recent phase of the IWC.

6 This is a somewhat shorted and simplified list made on the basis of Underdal, 1989.

7 For comprehensive evaluations and descriptions of the history until the early 1980s, see Tønnessen and Johnsen 1982 and Birnie, 1985. For more recent evaluations, see Andresen 2001 (a and b) and 2004 (forthcoming).

8 For an elaboration of this point, see for example Andresen, 2001 (a and b).

9 I attended the IWC meetings in 1989 and 1990 at the Working Group level as a member of the Norwegian delegation. I took part as a member of the Norwegian delegation at the Commission level in 1999 and 2001. However, I was not an 'ordinary' member as the expenses were paid by my research institution. I was there to observe, not to negotiate.

10 After a long stand still in terms of membership (around 40) more recently the 50th member state (Ireland) joined the IWC in 2003. There has been strong mobilization on both sides. On many important controversial issues there is now close to a 50% - 50% divide between the two parties – a far cry from the overwhelming majority mastered by the anti-whaling forces in the 1980s.

Resource management in the Faroe Islands
Regulation of all resources in the Faroese Fisheries Zone (FFZ) is based on the Commercial Fishery Act, 1994. The Act states that the living marine resources in the FFZ and Faroese allocations in waters outside the FFZ are the property of the Faroese people and that those fisheries should be sustainable in biological and economic terms. Socio-economic factors should also be taken into account.

The marine mammals which primarily include the pilot whales (Globicephala melas) are regulated by national legislation. I will concentrate my speech on fisheries under this session and come back to the marine mammals in a later presentation.

The demersal fisheries in the FFZ, regulated by fishing days, are the main supply for the land based fishing industry in the Faroe Islands and account for the largest part of total Faroese exports. Fish farming and fisheries outside the FFZ based on bilateral and multilateral agreements account for the rest. Straddling stocks are also regulated based upon arrangements between the relevant coastal states.

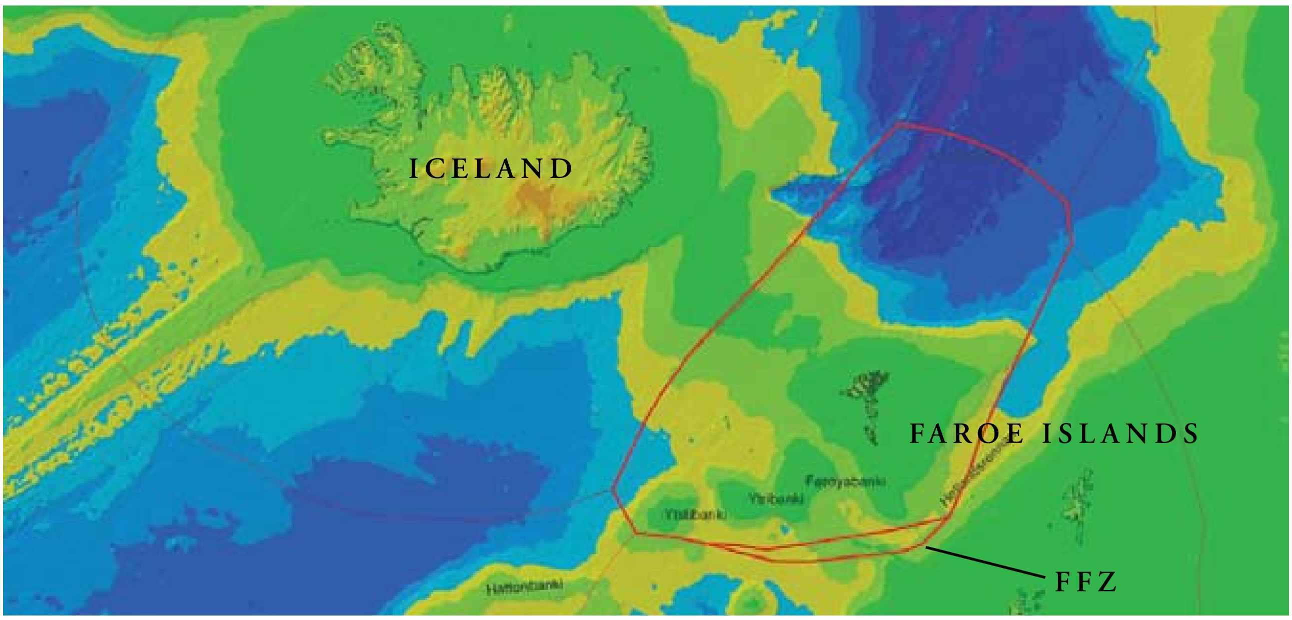
The main demersal fish species in the FFZ are cod, saithe, haddock and redfish. The regulatory system aims at controlling fishing capacity so that not more than approximately 33 % - in numbers - of each stock is taken every year on average. This should secure biological sustainability.

The fishing fleet exploiting these stocks consists of a large number of vessels below 110 GRT, and groups of larger vessels – mostly single trawlers, pair trawlers and long liners. Vessels below 15 GRT are regulated by an overall quota of fishing days, the rest by individual quotas of fishing days.

With the unanimous support of all fisheries organisations in the Faroe Island the demersal fisheries in the FFZ in 1996 were brought under a regulatory system of Individual Transferable Quotas (ITQs). The quotas are, however, not given in tonnes of individual species, but as fishing days for various groups of fishing vessels in the FFZ. The system is based on an assessment of the fishing power of each vessel group based on a data series from 1985-1994.

Each fishing year (September-August) each group of vessels is allocated a number of fishing days and these are again divided between a number of individual licensees in the Group. Law fixes the number of licences.

To monitor the system and continuously control that the system meets the statutory requirements of biological and economic sustainability, the Committee on Fishing Days advises the government at least once a year, specifically on the number of fishing days to be allotted for each fishing year. The Committee consists of representatives of the ship owners and the unions, and a chairman selected by the government. The Committee bases its analysis on advice from the scientists and an industrial advisory board on the state of the stocks.



The regulatory system has been reviewed by independent international experts and found sound and operational.

The advantages of the system are that it minimises the risks of discards and forged catch statistics. It is also seen as an advantage, rather than a disadvantage, that it makes it unnecessary to set annual quotas on single stocks as the basis for the fisheries regulation, but allows certain flexibility between the main stocks over a number of years, driven by catches and market prices.

The inherent problem in a regulatory system based on effort is monitoring increases in efficiency, which could change the fishing power of the different vessel groups. Since 1996/1997 the number of fishing days has been reduced 16-17 % for the largest vessel groups, but the efficiency has still to be analysed in more detail.

Recently the introduction of the precautionary approach has raised the question of biological sustainability. The precautionary approach in general leads to lower levels of exploitation. Is an exploitation of 33 % of the stock in numbers then the correct level? This matter is under analysis at the moment and will probably be taken up between the stakeholders and political authorities in the near future.

Conservation and exploitation
Few countries, if any, are so dependent on well-managed fisheries as the Faroe Islands. Almost all export revenues and a large part of the GNP are derived from fisheries. A good management of the fish stocks of the FFZ and of the stocks outside the FFZ, where Faroese fishing vessels have allocations, is very important for the Faroese national economy.

The main objective is to establish a long term framework in which a strong, competitive fisheries sector can develop, is able to work under market conditions, and strikes the right balance between conservation and exploitation.

Environmental concerns
Fisheries in Faroese waters do not experience user conflicts with other legitimate uses of the sea to the same extent as in many other areas of the sea closer to metropolitan areas. Faroese aquaculture only occupies sheltered littoral zones, industrial and other wastes are very limited in the Faroe Islands, and levels of persistent organic pollutants are very low. Shipping is also limited.

Involving the industry
It has been widely recognised in recent years in analysis of fisheries management systems that to create enforceable and equitable systems it is of the utmost importance to involve the stakeholders and especially the fishing industry in management. In the Faroe Islands the industry was very active in designing the present system and has a statutory role in filtering the scientific advice in preparation for political decision. The management systems are very much based upon the users' knowledge.

The Commercial Fishery Act 1994
The Commercial Fishery Act of March 10, 1994 introduced a consolidated legal framework for all Faroese fishing vessels and all fisheries in the Faroese Fisheries Zone, (FFZ). It covers all elements of fisheries management and includes recent developments in international law and conventions, for example regarding sustainability. It also covers both economic and biological (ecological) and ecosystem and biodiversity considerations. Both users' knowledge and scientific knowledge has been taken into account in management decisions.

Chapter 1, §s 1 – 3, describes the framework and objectives of the Act:

§ 1. The Act encompasses all commercial exploitation of living resources in the Faroese Fisheries Zone and exploitation by fishing vessels flying the flag of the Faroe Islands in waters outside the FFZ.

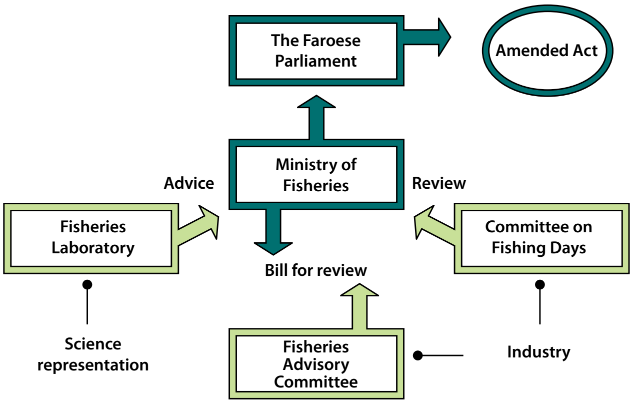
§ 2. The living resources in the FFZ and the allocations the government of the Faroe Islands has acquired outside the FFZ are the property of the Faroese People. In the administration of this act the aim should be to conserve the resources and exploit them in a sustainable and rational way, both in biological and economic terms, and with due concern for the relationship between stocks of plants and animals in the sea and their abundance, in order to secure the most optimal flow of benefits for the society, constant employment and income and possibilities for commercial activities all over the country.

§ 3. paragraph 2. Fishing rights allocated in accordance with this act do not transfer property rights to the licensees. The fishing rights can be withdrawn without compensation.

The Act, furthermore, establishes a committee system, to scrutinise the scientific advice and make recommendations to the Minister of Fisheries. The Committee on Fishing Days reviews advice on the demersal stocks in the FFZ and recommends the number of fishing days to be allocated. The Fisheries Laboratory of the Faroe Islands also assesses the state of the stocks each year and makes recommendations on the number of fishing days and other regulatory measures to the Minister.

The Minister then decides and prepares a bill to amend the Commercial Fisheries Act. This bill is reviewed by the Fisheries Advisory Body, and is then introduced to the Løgting, the Faroese Parliament, shortly before the new regulatory year which starts on 1 September.

Bill on fishing days



The fishing stocks are managed together and the fishing days do not control the fisheries. The Ministry of Fisheries of the Faroe Islands is responsible for the administration of this bill, which includes drafting regulations and coordinating Faroese participation in international scientific and conservation bodies which deal with the management of whale stocks. The closed area system is an additional division of the FFZ into an inner and outer compartment regulating, in essence restricting, the access to certain stocks for the most effective gears. Experience has shown that directivity has not changed very much even in the presence of large price differentials between stocks experienced in recent years.

Evaluation

The investments would have been larger if the fishing fleet had adapted more rapidly to the resource available - on average. However, the rate of adaptation is left to the industry and a process of substituting older vessels with new has now started. This process will in due course bring down the number of licences and improve returns.

The differentiation between those parts of the fleet running under full market conditions and those parts that are bound to certain villages and employment has eased political tensions about the effect of transferability.

There is still scope for improvements, the most important being the extension of the system to all Faroese fishing vessels and improved scientific advice on increases in harvesting capacities. Knowledge from users is also needed to reach our goals and it is my hope that this conference also may improve the managers' decisions.

An overview of resource management from a Norwegian perspective
Halvard P. Johansen

The main objective of the Norwegian policy for managing living marine resources is to make possible a profitable development of the fishing industry. Sustainable resource management is the main prerequisite to obtaining this goal. The fishing industry is expected to create opportunities for jobs in scattered settlements along the coast - close to where the resources are - through adaptation to the market opportunities. An important feature of the Norwegian management policy is that the industry and the users as well as the scientists are closely involved in the decision-making process. This gives credibility and legitimacy to the outcome of the process.

From the perspective of the management authorities, the most important aim is to manage the resources in a way that will give the users sustainable and stable harvesting conditions. If this policy is successful, the resources will last forever, and the users and the communities that depend upon them will prosper.

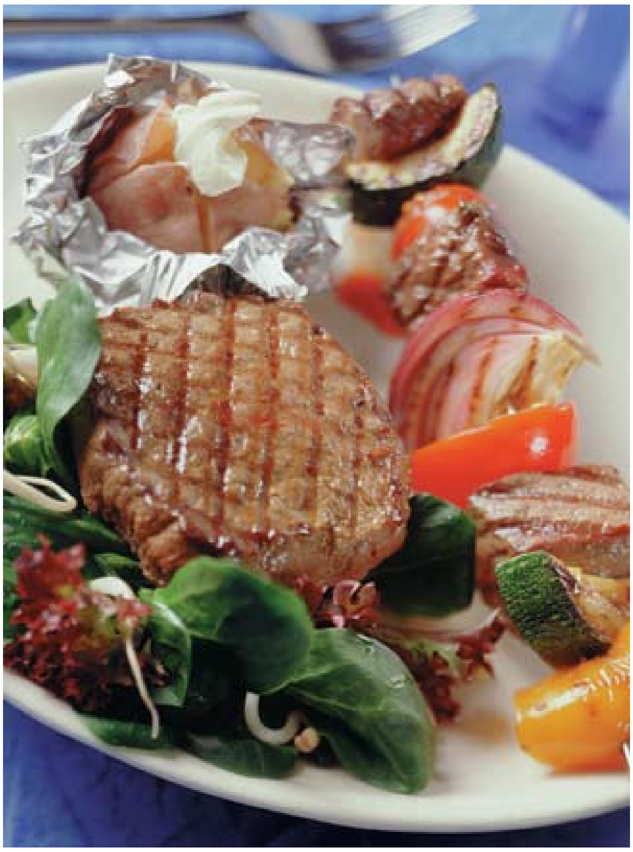
Our management procedures are based on the following process:

1) scientific surveys for estimation of stock abundance;
2) recommendations from the scientific community as to the sustainable levels of harvesting;
3) advice to the Minister of Fisheries from the experts in fisheries management; and
4) finally, a political decision as to the size of the quotas and the distribution of quotas to the different groups of fishermen.

For details on these procedures see the presentation from Lisbeth W. Plassa, page 80 in this book.

The involvement of the fishermen and the hunters in the decision-making process is very important. There is a formal structure established as the representatives of their organisations are members of the councils and boards that give advice to the political authorities on management policy concerning specific stocks, and general regulations for the fishing and hunting activities. In addition to this formal structure, the politicians, managers and scientists meet with the representatives of the industry regularly at annual meetings of the fishermen's associations, also at regional levels. There can be lively exchanges of views at such meetings, and the discussions between fishermen, managers and scientists are educational for all parties.

Norway has an active policy for managing living marine resources, including marine mammals. When quotas are set, attempts are made to consider the interrelations between the different species in the ecosystem. For example, when quotas are set for certain fish species, such as capelin, we take into account that predators like seals and whales - in addition to many fish species - consume considerable amounts of key species like capelin. This means that quotas for fishing, in order to be responsible, have to be set at levels that can sustain both the fishing activities and the predation by other fish species and marine mammals. We have not considered reducing the number of predators like whales and seals drastically in order to reduce the pressure on commercial fish stocks from marine mammals. But in accordance with the principles of the ecosystem approach we have a management scheme for marine mammals, which can be developed as new knowledge is made available.



Minke whale meat is a treasured source of food in Norway. *Photo: Norwegian Seaffood Export Council*

Internationally, there is general agreement amongst most nations on the principles for the management of marine living resources: Such management is to be based on the best scientific advice available, and available resources should be harvested with caution. However, when these principles are to be applied, there appears to be fundamental disagreements over how to do it. Norway promotes the idea of managing whole ecosystems to the extent possible while other nations - who agree on the interrelationship between the different species in large ecosystems - will say that the charismatic mega-fauna will have to be excluded from the management of these ecosystems. This type of deviation from the accepted management principles is based on cultural preferences and emotions, and Norway does not as a general rule accept that these aspects should be applied to wildlife management everywhere.

Norway is a strong proponent of sustainable use of wildlife. Obviously, this also means that species and stocks that need protection have to be managed cautiously. Management plans for rebuilding stocks have to be established when necessary.

The international community and the Non Governmental Organisations (NGOs) are increasingly taking great interest in the management of wildlife resources. This is a fact that the policy-makers must take into consideration when decisions are made. It does not mean that decision-makers have to change their policy, but that they will have to stand up and explain the reasons for their decisions. A reasonable decision will only be accepted if people understand the rationale behind it. Sometimes, when the disagreement or opposition to sensible harvesting programs are based on cultural differences, it also requires a lot of courage to make the right decisions and defend them.

Any policy for managing living marine resources has to take into account international co-operation, and resource managers have to abide by the relevant international agreements. But they also have an obligation to apply the agreements in the way that they were intended. It can harm wildlife management in general and also important cultural traditions if we try to avoid conflicts with those who do not respect the spirit and the letter of agreements.

Norway has chosen a policy that again will make whaling and sealing a natural part of our harvesting of marine living resources and also a legitimate part of our trade in marine products. It is, however, important to accept that it will take time to normalise this policy. Eleven years ago whaling was not permitted except for a limited catch for scientific purposes. The situation for the whaling industry has since then improved considerably. The sealing industry is currently not profitable, but a small fleet has remained.

We have 10 whaling seasons behind us since the resumption of whaling in 1993. Whale meat is regarded as an important and healthy part of traditional Norwegian food and also as a delicacy. It is sold all over the country, and some of the products are exported. We still have some market problems to solve before we can say that the whaling industry is fully re-established, but we know that progress will come in small steps; there will be no great leaps forward, and that progress will always take time.

There are more important problems in the sealing industry. Some progress has been made as many of the restrictions that were imposed on the industry in the 1980s have been lifted. But the main obstacle is the lack of a well functioning market. There are reasons for optimism with increasing seal pelt prices. But the important thing is to preserve the knowledge of seal hunting until the market conditions improve substantially. If we are not able to do that, it will harm the overall fishing industry. Consequently, continued use of subsidies in order to maintain the sealing industry may be worthwhile. Another argument for maintaining the sealing industry is that seals are important predators on commercial fish stocks.

When we see what is going on in some international organisations for resource management, it is easy to predict that our management of marine living resources also in the future will be scrutinised according to values that we do not share. Consequently, we will have to make sure that we do the right things and are prepared to defend our management decisions.

While Norwegian fisheries management has been widely accepted, we have gained some experience in defending a policy concerning marine mammals that is still not fully accepted internationally. When we resumed whaling in 1993, the general perception was that this was not a battle that Norway could win. We were told that it was impossible to oppose the prevailing opinion against whaling prevalent in the west. We were advised to spend large sums of money to explain and defend our policy and still be prepared to accept defeat.

We have spent some money on informing the national and international public on our policy for the management of marine living resources including the marine mammals. This is reasonable considering the importance of the fishing to the economy. But the amounts we have spent on this information program are only fractions of what we were recommended to allocate. It came as a surprise to many communication specialists and NGOs that a small country dared to oppose the general view that "some animals are more equal than others".

Some of our major critics still express the view that whales and seals in general are endangered and therefore should not be harvested. This view is not based on scientific evidence. Criticising our policy for the management of living marine resources involves no costs, and consequently it is easy. But it lacks credibility, now more than ever before. People whom in the future want to have say in management of wildlife will have to recognise that conservation of species is necessary, but also that wildlife management in general will have to encompass whole ecosystems.

In the long run we assume that a rational approach to the management of living marine resources will prevail. With an increasing world population to feed only rational decisions can be defended.

Resource management in Iceland and internationally
Stefán Ásmundsson

All marine living resources are limited. Utilisation therefore must be managed to ensure sustainability. Free and open access would lead to disaster for the resources. The questions are about how the resources should be managed, and about who has the duty to manage them, who has the rights, and who has no business in the management. The question of who depends on the type of stock and on the jurisdictions involved. There are 4 categories of stocks:

1) stocks that occur only within the jurisdiction of one coastal state;
2) stocks that occur within the jurisdiction of two or more coastal states, but not on the high seas;
3) stocks that occur both within the jurisdiction of one or more coastal state and on the high seas; and
4) stocks that occur only on the high seas.

In the first category states have simple jurisdiction. Management of stocks in the second category imposes a duty to cooperate on the states involved. The third category includes states that fish on the high seas. Coastal states have a right to participate in such management even if they are not utilising the resources. In the fourth category only the states that take part in the fisheries have a right to manage. Coastal states, states that have catches on the high seas, and states that have been given the right in a special agreement have the right to take part in the management of living marine resources.

There are special provisions for the management of marine mammals. Their utilisation can be managed more strictly than is otherwise the norm. States shall work together on the management of cetaceans through international organisations. The United Nations Convention on the Law of the Sea, Article 65, stipulates that states "shall cooperate with a view to the conservation of marine mammals and in the case of cetaceans shall in particular work though appropriate international organisations for their conservation, management and study."

The obligation to work through organisations can result in states that normally would not have the right to take part in management getting that right through membership of an organisation (e.g. IWC has members who are not even coastal states). The right of those states is not based on international law but on their rights under the IWC Convention. International law sets the framework for the management of the utilisation of living marine resources and makes clear whose right and duty it is, but does not specify how the management should be done.

Resource management from a user organisation perspective
Jens Danielsen

From Disko Bay. *Photo: F. Ugarte*

Resource management in Greenland as seen from a user perspective is often not satisfactory and is a source of conflict between the central administration and the users.

For example when regulations have been made regarding what time of the year the animals may be hunted, and these regulations are not in correspondence with the traditional knowledge of hunters, these regulations are criticized as being too one-sided. This in a sense is true, since the knowledge of the hunters is knowledge which have been passed down from generation to generation, and should not be disregarded.

An analogy to this may be the relationships in marriage. In a marriage, a partner knows his mate much better than would a third party. But should the third party comment erroneously about his partner, it is the duty of the partner to comment on the matter to correct the mistake. This is also apparent between hunters and biologists. Hunters and fishermen live in nature all throughout their lives and partake of its resources. Nature is their partner of which they have an intimate and unique knowledge. It is a relationship of respect and care, since they satisfy all their needs from the resources of nature.

With regards to resource management in Greenland, the management conducted is dominated by a Western view of nature as well as by an excessive desire for control. This is evident in regulations regarding hunting from the central administration.

For example, in the management of larger whales, animal rights activists and environmentalists are convinced that the International Whaling Commission (IWC) is the sole organization entitled to determine regulations of the hunting of whales. Nations who do not have a tradition of whaling can be members of the IWC, and due to the increased number of member states in that category, as well as a growing number of member states only interested in protecting animals, Greenland and other whaling nations are faced with higher and higher demands. Such is the influence of the animal rights activists and environmentalists, that the desire of the Greenlandic hunters to hunt from the increasing stock of humpback whales can not be realized. It should also be pointed out that the Greenlandic people who subsist on hunting whales can not vote in the IWC. It is therefore the opinion of the KNAPK, the Greenland Hunters and Fishermen's Association, that in regard to the management of whales, Greenland is still to be regarded as a nation subject to Colonial rule.

In the case of the humpback whales, hunters have observed an increase in the number of animals. The biologists nevertheless have determined that this is not so, their reasoning being that there has been no counting of large whales over the last ten years. According to the methods used by biologists, the only counts that are valid are the latest conducted counts. It is the words of the biologists that are listened to in management and thus people all over the world are being made to believe that the stock is not increasing. This is evidence that scientific methods have weaknesses and can be limited. Hunters can attest to this fact, not only in regards to large whales. Biologists' limited knowledge of migratory patterns of birds and their limited knowledge regarding caribou, beluga and narwhals, walrus and other species have often been heavily criticized by hunters.

The Greenland Institute of Natural Resources, *Pinngortitaleriffik*, is limited in its scope and does not have the expertise to deal with the vast and unpredictable Greenlandic environment. It is therefore hard for the KNAPK to see how the institute can produce satisfactory scientific results that may be useful both to the government and the hunters themselves. The biologists primarily function as consultants to the government when it comes to questions of regulations regarding the hunting of animals.

The KNAPK acknowledge that scientific knowledge about the animals we hunt and scientific knowledge about the environment is necessary, but this should not be the only knowledge utilised by the managers in Greenland. It is not only the scientists who should be consulted on management regulations but also the KNAPK and the Hunters' Council. Furthermore hunters have also often expressed a desire to participate in the research studies i.e. counting of different mammals.

In 2002 the government implemented an Executive Order on Birds that was later revoked after protests from KNAPK. KNAPK turned to the Greenland Parliament's Ombudsman reasoning that the Hunters' Council had not, in accordance with the laws, been consulted or heard before the order was implemented. The Hunters' Council was established in 1998 in response to a demand from the general public and population in Greenland. This was indeed a welcomed development on our part.

KNAPK had several times claimed that there was no legal basis for the Executive Order on Birds. This was ignored because the government was more inclined to listen to their officials coming from abroad, who claimed that KNAPK's protests were not valid. It was not until the Ombudsman recognised that the Executive Order on Birds was not at all based on traditional knowledge of the hunters but on scientific knowledge and knowledge from outside experts, that the order was revoked. Thus KNAPK is of the opinion that users are subject to a colonialist attitude "from above and from the outside". This has to change on the government level. We have to keep in mind that the main source of income for most people in Greenland is derived from using the living resources of this land.

It is therefore of utmost importance that the traditional knowledge of the hunters and the fishermen should be utilised on a much broader level than today. This could be achieved through a legislation that would give much more power to the municipal authorities than today. This would also help local fishermen and hunters and their associations to take more responsibility for this very important issues.

For the sake of our descendants we have to ensure a development based on wildlife in this country. Co-responsibility, restraint and freedom for self-determination are inseparable components which ensure the development of our resources for the times to come and for our descendants.

On behalf of KNAPK
Svend Heilmann, Chairman of the Hunters Council, KNAPK
Jens Danielsen, Member of the Hunters Council, KNAPK
Kalle Mølgaard, Member of the Committee, KNAPK
Leif Fontaine, Chairman of KNAPK.

CHAPTER 2 User knowledge

The role of user knowledge in co-management: the example of the Alaska Beluga Whale Committee

Henry P. Huntington

Created in 1998, the Alaska Beluga Whale Committee (ABWC) is a co-management group that includes hunters, elders, scientists, and state and federal managers (Huntington 1992, Adams et al. 1993). The ABWC sought to establish sound co-management of beluga whales (*Delphinapterus leucas*) in part to forestall intervention by the International Whaling Commission, as had occurred for bowhead whales (*Balaena mysticetus*) in Alaska in the late 1970s. In seeking to prevent rather than react to a crisis situation, the ABWC promoted cooperation between hunters and researchers from outside the hunting communities as the only way in which sound management could be achieved[1]. The sense of shared purpose is an essential characteristic of the ABWC, providing the means to unite different groups. Various approaches have been used to help foster and sustain that sense of shared purpose and unity, including the role of user knowledge. Two recent studies have examined user knowledge of beluga whales and its role in the workings of the ABWC, offering lessons for other applications of user knowledge in wildlife management.

The first study documented user knowledge of beluga whales in three sites, expanding the scope of knowledge of beluga behaviour, biology, ecology, and changes over time (Huntington et al. 1999). This information is useful in its own right as a contribution to our collective understanding of beluga whales. In addition to extending available information about the natural history of beluga whales, including providing greater time depth, the study demonstrated some of the key characteristics of that knowledge. For example, in discussing beluga movements and behaviour in Norton Bay, western Alaska, elders and hunters described the potential impact of increasing numbers of beaver (*Castor canadensis*). As the beaver population increases, more streams are dammed, which affects fish spawning habitat and thus the populations of fish on which belugas feed. While the connection seems obvious in retrospect, it is unlikely that many researchers would have considered such a link before embarking on a study of belugas in the area. This level of ecological detail and interconnectedness is a particularly valuable feature of user knowledge.

The study also found, indirectly, that the process of documenting user knowledge raised the standing of that knowledge in the eyes of the hunters as well as others by indicating interest in presenting what the hunters had to say, without simultaneously filtering it through a scientific perspective. Indeed, many of the hunters who were interviewed were surprised at first that their knowledge was being sought and surprised at the conclusion of the interviews that they had so much to say. This was probably the result of their never having stopped to consider how much information they had acquired over a lifetime of listening to others and observing the world themselves. Furthermore, the process of documenting knowledge helped some hunters feel more engaged in the co-management process, thus enhancing the ability of the ABWC to address research and management issues. Certainly, the ABWC had incorporated user knowledge to a great extent prior to this particular study, but the explicit documentation of the knowledge for its own sake was a new step and one that helped clarify one of the strengths of the Committee.

The second study, following from these indirect findings of the first study, examined more closely the ways that the ABWC encourages and allows the incorporation of user knowledge (Huntington et al. 2002). The key findings of that study are that the ABWC meetings have three characteristics that promote strong interactions between scientists and hunters. First, the meetings are preceded by extensive preparations by all members, so that everyone knows what to expect and has done the preliminary work necessary to provide succinct reports and to take an active part in discussions. Second, the meetings themselves allow for open discussion and the application of different forms of knowledge to common questions. Third, those who agree to take on projects or actions are accountable the following year to the Committee for their work, and thus the annual reports of different members are complete and on time. In addition, the core membership of the Committee is relatively stable, with modest turnover from year to year, creating additional continuity.

Clearly, an examination of one case, no matter how detailed offers only a limited foundation for drawing general conclusions. Nonetheless, the experiences of the ABWC should be instructive in two respects. First, the ability to apply user knowledge and scientific knowledge to common purpose is a worthy and important goal, but not one that can be achieved simply and quickly. Rather, it takes time and effort by all concerned to forge a common understanding and develop the ability to communicate effectively, which in essence is a matter of understanding and respecting each other's perspectives. Second, even among users the value placed on their knowledge may not be fully appreciated until it has been examined in its own right to see just how extensive, detailed, and helpful it is. There is an assumption that users know a great deal, but to demonstrate this as a fact requires examining how much information the users hold. This process also helps bring that information into the management or co-management setting in a formal way, conferring an additional degree of recognition to a large body of knowledge that all too often is left just outside the door.

Village in western Alaska where they hunt beluga whales. *Photo: Henry P. Huntington.*

References

Adams, M., Frost, K., and Harwood, L. 1993. Alaska and Inuvialuit Beluga Whale Committee (ABWC) -- an initiative in "at home management". Arctic 46(2):134-137.

Huntington, H.P. 1992. Wildlife management and subsistence hunting in Alaska. London: Belhaven Press. xvii + 177p.

Huntington, H.P., and the Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik. 1999. Traditional knowledge of the ecology of beluga whales (Delpinapterus leucas) in the eastern Chukchi and northern Bering seas, Alaska. Arctic 52(1): 49-61.

Huntington, H.P., Brown-Schwalenberg, P.K., Fernandez-Gimenez, M.E., Frost, K.J., Norton, D.W., and Rosenberg, D.H. 2002. Observations on the workshop as a means of improving communication between holders of traditional and scientific knowledge. Environmental Management 30(6): 778-792.

Footnote

1. Under the U.S. Marine Mammal Protection Act, restrictions on Alaska Native harvests of marine mammals can only be imposed if a species or stock is found to be "depleted." Thus, in the absence of a management crisis, only voluntary management is typically possible.

Lessons learned from a community and ecosystem-based user knowledge study
Lucassie Arragutainaq

The Sanikiluaq Hunters and Trappers Association has since the 1980s, been involved in community-based initiatives to combine user knowledge and scientific knowledge in management decision-making. The projects include a reindeer project, eiderdown harvesting in co-operation with the Canadian Wildlife Service, and the Hudson Bay Program focusing on the bio-region related to the Hudson Bay hydro-electric project. The traditional knowledge programs were aimed at understanding the changes in the environment. Respected elders and hunters were selected on the basis of trust in their knowledge. The problems encountered by these projects can be summarised as follows:

1) the scientists thought of Traditional Ecological Knowledge (TEK) as "old wives-tales";
2) the participants felt distrust for the scientists and were cautious in giving the information;
3) a lot of information was gathered, but there was not enough time to consider it all; and
4) the work on the TEK was looked down upon by the scientists because no proof was presented.

There is a clear difference between the scientists who require proof in order to believe something and the users who respect what the hunters and elders say. Through the project they learned that user knowledge is complex and involves the whole environment, people's lives and economy and their feelings about the environment and wildlife.

It is clear from this work that the people involved must learn to ask the right questions and to stay on the topic. It was a challenge to synthesise complex traditional ecological knowledge into informative and easily understood formats. The presentation of the information and material was difficult. An unsolved issue remains of how best to present it. Another lesson learned is that this is only the tip of the iceberg because all knowledge of life belongs in the category of traditional or user knowledge. The following recommendations were offered:

- Be clear about what kind of information is wanted.
- Select people who have knowledge.
- Don't use survey techniques (people give opinions).
- Give something back to the contributors.
- Bring users and scientists together in a positive environment to talk

Projects using user knowledge in management
Charlie Johnson

In Alaska, user or traditional knowledge really came to the forefront in the 1970's when the bowhead whale was listed as depleted with only 700 animals under the Endangered Species Act. The listing meant that the Secretary of Commerce had to drastically curtail the harvest of these whales by the Inupiat and Yupik whalers of Alaska. The whalers contended that there were at least 10 times that many whales and that the scientists had missed most of the whales during their population surveys. The National Oceanic and Atmospheric Administration (NOAA) under the U.S. Department of Commerce, the management agency, agreed to consider the accumulated knowledge of the whalers, learning that the whales were capable of blowing a hole in ice up to half a meter to breathe and that by counting only in open water, they had missed most of the whales. Now the population is estimated at more than 10,000 and a co-management agreement is in place between the whalers and NOAA to manage the subsistence harvest.

In Alaska the U.S. Fish and Wildlife Service has management authority over polar bears. Estimating the population has always been a considerable challenge. The bears are mobile travelling long distances with the ice making accurate population estimates difficult. Biologists working for the Service had limited field time with the bears making their observations of limited value in making population estimates and identifying habitat use areas. In the late 1990s the Service realised that the local hunters held considerable knowledge about feeding areas, migration and travel routes and den sites by season. It began a program where the hunters were interviewed and what they knew about the polar bears was noted and mapped. Scientists assisted with the design of the project. The result has been that critical habitat areas have been identified for protection and that hunters groups manage the hunts according to the results.

Alaska has two populations of polar bears, one in the Southern Beaufort Sea shared with the Inuvialuit of the Northwest Territories of Canada and another in the Bering and Chukchi Seas shared with Chukotka in Russia. Information on habitat use by polar bears had been gathered in Alaska, but was missing in Chukotka.

Photo: Georg Bangjord

In 1998 the Alaska Nanuuq Commission and the Union of Marine Mammal Hunters, now the Association of Traditional Marine Mammal Hunters of Chukotka (ATMMHC) signed a partnership agreement to conduct a similar study in Chukotka. The study is being conducted by the ATMMHC with training and funding through the Alaska Nanuuq Commission. More than 65 hunters have been interviewed. The sufficient number of interviews has been found to be 3-4 hunters per village, after that experience from these studies shows that the information is duplicated. Local people of Chukotka have been trained in interview techniques, and in documenting the activities of the polar bears by season. One problem in Chukotka is the lack of map resources. The hunters' information about the polar bears has revealed that the polar bear dens are multi-chambered, with a "toilet", "playroom" and a "bedroom". The results are being used in developing the Polar Bear Management Plan for Chukotka which will identify critical habitat and protected areas, define seasons and provide other regulations for the hunt.

The Alaska Nanuuq Commission is now beginning a Synthesis of the Role of the Polar Bear in the Cultures of Alaska Inupiat and Yupik People. There will be two phases to the study, one a literature review to develop an annotated bibliography, and two interviews of elders and hunters in the villages. The reports will be used for educational purposes.

These are the projects we are directly involved in, but there are many others.

Experiences in co-management from the Alaska Native Harbour Seal Commission
Monica Riedel

The Alaska Native Harbour Seal Commission (ANHSC) was established in 1995, and is funded through congressional appropriation. It is a tribal consortium comprised of native communities within the habitat range of the harbour seal (Phoca vitulina) on the coast of Alaska.

The overall goal of the commission is to strengthen and increase the role of Alaska Natives in the decision making process concerning research and management of the harbour seals. In modern life, harbour seals continue to play an important cultural and nutritional role for the Alaska Natives. The ANHSC follows traditional conservation measures in their management such as seasonal harvest, taking mostly males, taking only what is needed, respect for all animals and the principle of non-wasteful hunting.

The primary focus of the ANHSC is to maintain the integrity of cultural values. This is done through:
1) Articulating the Alaska Native's spiritual relationship to and respect for all animals
2) Transferring that understanding to our youth
3) Sharing the catch and perpetuating the value of giving, especially to elders
4) Practicing non-wasteful take
5) Celebrating the gifts of our natural world.

The ANHSC's activity portfolio includes: administration of base funding, Co-management Agreement (1999), Co-management Action Plan (2001), harvest data assessment (1992 – present), Biological Sampling (1996 – present) and MMPA Reauthorization, Indigenous Peoples' Council for Marine Mammals (IPCoMM) (1993 – present).

The ANHSC/NMFS Co-Management Agreement

In Alaska, the Marine Mammal Protection Act (Sec. 119) describes the relationship Alaska Natives have with United States agencies responsible for marine mammal management. Building upon this relationship a cooperative agreement was signed in 1999 between the ANHSC and the U.S. National Marine Fisheries Service (NMFS) to use co-management to set forth the conservation and management of harbour seals through expanded harbour seal research and education for all people.

The Agreement established a Harbour Seal Co-management Committee made up of ANHSC and NMFS representatives that are charged with preparing and updating an Annual Action Plan. Both the NMFS and the ANHSC enlist scientific advisors. The shared decision-making is done through consensus, based on mutual respect and understanding of each party's cultural perspective. The meetings between the parties are held twice a year or as needed.

The Annual Action Plan is the guiding document for joint and separate management actions by the ANHSC and NMFS related to the conservation and management of subsistence uses of harbour seals. The Action Plan describes relevant information, specifies mutually agreed upon actions to be implemented by NMFS and the ANHSC, and sets forth recommendations for additional activities that promote harbour seal conservation. The Action Plan is evaluated and updated on an annual basis. The Action Plan is comprised of the following four sections: 1) population monitoring, 2) harvest management, 3) education and 4) research.

The Co-management Committee is currently working on issues such as stock assessment and the need to draw new stock boundaries. The existing data (pre-

Hunter John Boone training hunters and youth in bio-sampling methods. *Photo: ANHSC*


Tlingit Village of Angoon: A board meeting discussing the reintroduction of the Sea Lion into the traditional diet. *Photo: ANHSC*

dominately genetic) suggest that there may be 12 or more genetically distinct stocks of harbour seals. The ANHSC, however, is not convinced of the correctness of this and is conducting a review of the data. The "management effect" of a situation with more stock divisions is lower quotas and more science. The NMFS is being pressured by environmental groups to list the harbour seals under the US Marine Mammal Protection Act. Both NMFS and ANHSC agree that more data on the harbour seals is needed with respect to traditional knowledge on movement, prey and population surveys.

Harvest Data Assessment Programme
The Alaska Department of Fish and Game (ADF&G) began collecting data in 1992 and ANHSC entered into a cooperative agreement with ADF&G to co-manage the project in 1998. Currently (2004) ANHSC has a full-time staff member to oversee and report findings from the project. The programme involves 62 villages that have been and will be surveyed and the establishment of an important network between ANHSC/ADF&G and each participating community. There has been a shift in paradigm in the sense that tribes now have an active role in the collection and ownership of the harvest data which is used in decision making within public policy. Traditional knowledge is being passed on and documented although there is a need for acknowledgment and recognition of hunters and their knowledge to be explicitly referenced in academic literature. The hunters also provide biological samples of the animal to the scientists.

A number of problems have been encountered in this process. These include lack of trust between agencies and users, the geographical expanse of the species (impossible to meet with everyone in each community), complex agency regulations which can be difficult to learn in a short time span, no evaluation process for the Action Plan (after the plan was adopted no process for following up was thought of/put in place), low confidence range of the harvest data, and logistical barriers with the bio-sampling such as shipping, regular contacts and data forms.

The lessons learned so far show that the participants must be open-minded and not too critical. It is also important to be consistent between areas and maintain regular contact. It is necessary to understand how the agencies work, and what constraints they have. A process is needed for evaluating research plans. Recall surveys need to evolve to real time reporting. It is necessary to create a harvest data calendar, and maintain contact with the surveyors throughout the year, through training workshops and other meetings. The key points are: focus, do not take on too much at a time, instil strict scientific protocols, report and stay in contact.

Some recommendations have been put forward: the Co-Management Committee must keep the meeting schedules, the findings by the scientists should be validated with harvest surveyors/hunters regularly, the cultural respect for the animals must be combined with the biological data collection protocols, and that more tools, such as calendars are made use of to track harvest levels.

Users can participate in management by focusing on local management plans and by developing better methods of harvest monitoring that cause minimal interference with the hunting activities. With respect to harvest monitoring, ideas such as using global positioning system (GPS) and hiring high school students as local monitors during the hunt have been put forward.

Summary of recommendations

- work with regional natural resource organisations, tribal leaders/hunters/subsistence users to develop or revive local management plans;
- hold training workshops, hire local monitors;
- publicise draft plans in newspapers;
- formally adopt the management plan and
- implement the plans.

Collaboration recommendations:

- share the findings with regional and tribal organisations;
- collaborate with environmental groups to gain their support;
- use the media to reach and educate all affected communities, use newspapers; posters, flyers, radio talk shows and
- share data during Cultural events, try especially to include students

Other collaborative efforts:
ANHSC works within a state-wide organisation called the Indigenous Peoples Council for Marine Mammals (IPCoMM) to preserve the Native Exemption in the US Marine Mammal Protection Act. IPCoMM includes 15 Alaska Marine Mammal Commissions serving Native hunters of Beluga, Walrus, Bowhead, Seals, Sea Lions and Sea Otter. The Alaska Steller Sea Lion/Sea Otter Commission serves the same hunters in the same regions of Alaska.

Where to look for more information:
ANHSC: harborsealcommission.org
Alaska SeaLife Center: alaskasealife.org
National Marine Fisheries Service:
fakr.noaa.gov/protectedresources/seals/default.htm

Traditional knowledge of Chukotka indigenous peoples and modern science: providing mutual reinforcement

Vladimir Yetylin

In recent years, the technocratic resource management has entered into a kind of a global crisis, which has resulted in a growing demand for traditional knowledge collected by the indigenous peoples of the polar areas. The traditional resource management of the Arctic indigenous peoples has proved to be more robust and stable as compared to the technocratic one.

Traditional and scientific knowledge differ in the way they are gathered, transferred, communicated, stored, etc. For example, scientific knowledge may appear, as one says, 'at the edge of an ink pen', while the traditional one usually results from centuries of efforts, often involving combined experience of several Arctic nations.

An important explanation lies in the fact that indigenous peoples of the Arctic do not as a rule try to confront or 'conquer' the natural environment, but to the contrary view themselves as its inherent generic part. Moreover, they tend to cherish a sacred respect for the nature in their traditional culture and beliefs.

For most Arctic peoples, the human being is merely a small and by far not the strongest element of nature. The human behavior towards the environment is respectively limited by numerous prohibitions and models, which result in harmonic relations between man and nature.

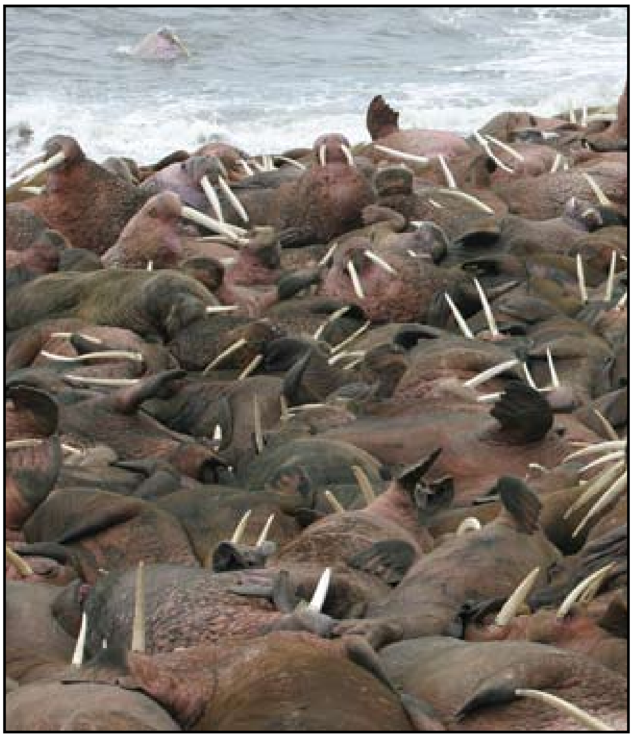


Photo: Joel Garlich-Miller, US Fish and Wildlife Service

The technocratic resource management is to the contrary based upon the presumption that the human being stands above nature and represents its conqueror, owner, and master. Such attitude gives rise to an inherently different mode of conduct, the so-called technocratic or European pattern of behavior.

Throughout the recent years, the indigenous population of Chukotka Peninsula has witnessed, and participated in, the above-mentioned development whereby their traditional knowledge has been strongly required by scientists. The Association of Traditional Marine Mammal Hunters of Chukotka (ATMMHC) was formed in Chukotka in 1997. This organisation represents traditional indigenous users as opposed to commercial users. There are 6 administrative areas and regional branches in Chukotka. The organisation has a Board, a Scientific and a Coordinating Council. It has commissions on whales, walrus, reindeer and polar bear.

The Scientific Committee has both scientists and experts on user knowledge. The projects include user knowledge on bowhead migration and grey whale migration, medical knowledge, boat building, and mapping indigenous cultural and nutrition needs for whale products (presented at Shimonoseki IWC54). The polar bear commission is a joint project with the Alaska Nanuuq Commission. This commission documents user knowledge on polar bear ecology and cultural needs, using the Alaskan methodology. There is also a monitoring programme for walrus hunting to get real harvest statistics. The walrus population appears to have a problem in that there is a large proportion of sick walrus. It could be that the significant numbers of travellers and tourists are disturbing resting walrus and causing stress related problems.

The aboriginal peoples of Russia are represented in the Russian delegation to the International Whaling Commission (IWC). This has been beneficial for the aboriginal catch quotas. It is a problem for Chukotka that the IWC has turned into an anti-whaling commission. In managing aboriginal whaling there is consensus on no voting on aboriginal quotas, aboriginal hunters should have the right to sell products they do not consume and use of products for handicrafts.

Inuit Qaujimajatuqangit: Inuit knowledge in Nunavut
Meeka Mike

Inuit Qaujimajatuqangit (IQ- Inuit knowledge) is the foundation for wildlife management in Nunavut. Unlike scientific knowledge, it has a history of many thousands of years. Combined with the tremendous observational skills of Inuit, the valuable experience that our people have gained over these many centuries is still used today in our hunting and wildlife management practices.

I want to present to you a report of what the Nunavut Wildlife Management Board (NWMB) has been doing during the last several years, and intends to do in the next few years. The NWMB is a co-management body established in 1993 by the Nunavut Land Claims Agreement. It is composed of equal numbers of appointees from Inuit Organisations and the governments of Canada and Nunavut. The NWMB is the main instrument of wildlife management throughout the Nunavut Settlement Area – an area covering on e fifth of Canada (2 million square kilometres) with a coastline of more than 104,000 kilometres.

Inuit Bowhead Knowledge Study

Under the terms of the Nunavut Land Claims Agreement, Inuit secured a commitment form the government of Government of Canada for the NWMB to undertake a five-year study of bowhead whales in Nunavut, relying upon the knowledge and participation of the Inuit people. The study was carried out between 1995 and 2000, and published in 2000. The publication is entitled "The Inuit Bowhead Knowledge Study".

Elders and hunters were key contributors to the Study. A committee of four NWMB members, including myself, was responsible for overseeing this important study. It consisted of 257 separate Inuktitut audio and video-taped interviews conducted in 18 communities, transcribed into both Inuktitut and English. In addition, 8 workshops were held in communities with extensive knowledge of bowhead whales. The study focussed on the history of whaling, their seasonal distribution, trends in abundance, ecology and behaviour of bowhead whales, as well as the cultural and traditional importance of bowhead whales to Inuit.

The NWMB has gathered user knowledge dating from the very earliest existence of Inuit, including the measures our people took in respect to nirjutiit and our co-existence with wildlife. We survived off the animals and – at the same time – Inuit always kept in mind the principles guiding their hunting practices and overall awareness of the species.

What are the weaknesses of IQ?

The outline asks that I address the weaknesses of IQ in this presentation. In my view, that is the wrong question to ask. IQ has been a very successful knowledge system for many thousands of years. Unfortunately, the majority of research and management attention is placed on scientific knowledge. The result is that the bulk of published reports on wildlife are based on scientific knowledge and not IQ. The primary problem is that not enough funds are dedicated to IQ-based studies about wildlife. The NWMB is looking to increase the amount of traditional knowledge in its work.

Looking for seals
Photo: Henry P. Huntington

User knowledge and the Joint Secretariat, fisheries joint management - Inuvialuit Renewable Resources Committee, Northwest Territories
Max Kotokak Sr.

In 1984, the first land claim settlement in the Northwest Territories and Yukon was completed. The Inuvialuit Final Agreement affects the Western Arctic Region of the Northwest Territories and the Yukon North Slope known as the Inuvialuit Settlement Region. Three goals were recognised in the Agreement:

- to preserve Inuvialuit cultural identity and values within a changing northern society;
- to enable Inuvialuit to be equal and meaningful participants in the northern and national economy and society and
- to protect and preserve Arctic wildlife, the environment and biological productivity.

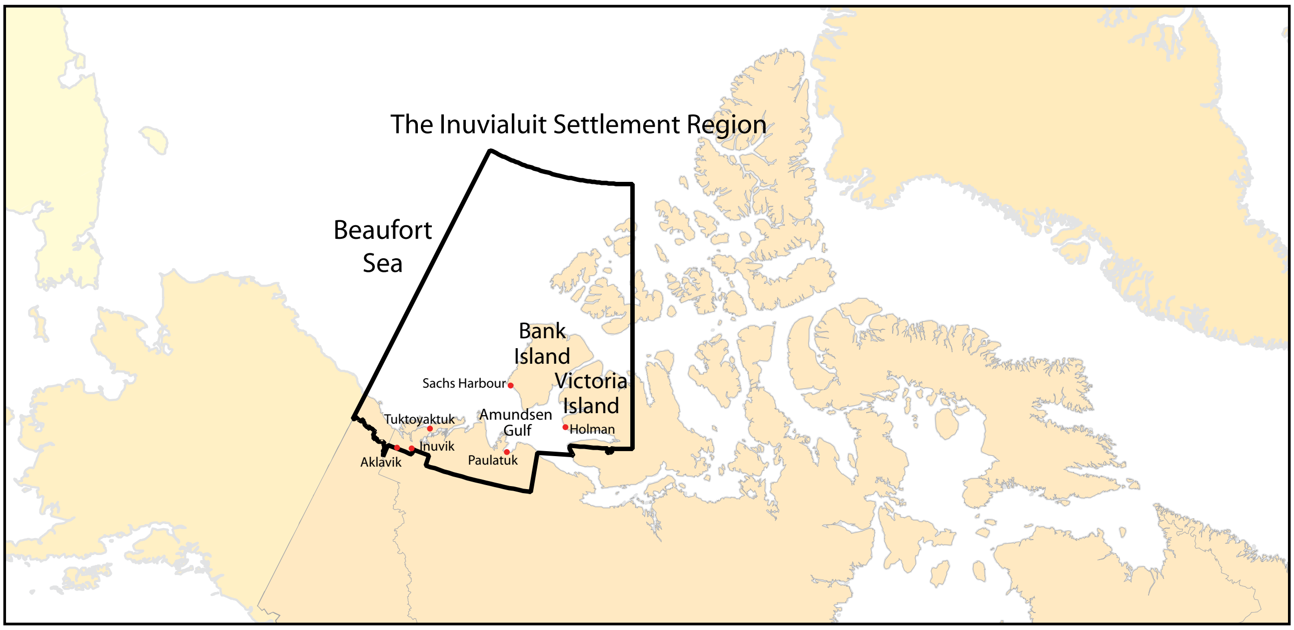
The Co-management System:
To meet these goals, a system of co-management (co-operative management) was developed. At the foundation of this system are five co-management groups:

- the Environmental Impact Screening Committee
- the Environmental Impact Review Board
- the Wildlife Management Advisory Council (Northwest Territories)
- the Wildlife Management Advisory Council (North Slope), and
- the Fisheries Joint Management Committee (FJMC).

The FJMC has four members: two representing the Inuvialuit and two appointed by the government of Canada, plus a member appointed Chair. The chair is an impartial, non-government person acceptable to both groups. The FJMC assists Canada and the Inuvialuit in managing the regions fish and marine mammals. Advice is provided to the Minister of Fisheries and Oceans on these issues. Researchers and resource developers should consider the co-management groups as one of their initial contacts when preparing project proposals of consequence to the Inuvialuit Settlement Region.

To ensure that users have influence and input in the decision-making, FJMC hold public meetings in all the communities in the settlement region. These meetings are useful in identifying concerns and determining research needs for the fisheries.

The FJMC has sponsored three studies on bowhead, beluga and broad whitefish. The work undertaken is a joint effort between scientists, users (elders and hunters) and government representatives. Today aerial surveys confirm a beluga stock in the region of 120,000 animals. The Inuvialuit annual catch about 200 beluga, which is sufficient to meet their needs.



User knowledge in Greenland
Kalle Mølgaard

Our Arctic homeland: sea, ice, land are places where we hunt, this is our homeland. The sea, ice and land where we hunt are the source of strength for the hunter, not only a source of physical strength, but it is also a vital link to our inner selves and to our emotions; this is the home and land of our ancestors. Important events that took place long ago, and throughout our lives, are remembered and passed on through the hunt.

The understanding the hunter has about the environment, he receives from the culture that he has inherited. This is most evident in place names: *Natsilik*: the place were the seal roam, *Qammavik* – the place where one lie in wait for the game to appear, *Aataarniarfik* – the place one hunt's the Greenland seal', *Ttuttulissuaq* – the place of abundant caribou etc.

The way of life of the hunter and his family is very different from that of people living in so-called 'developed' countries. The hunter and the nature in the Arctic are tied together with strong ties and the hunter is part of Nature. Nature is neither an object to be conquered nor one that should be made into a national park or a museum.

No, Nature is the core and basis for the value of life for the family and for the society, and one must use its resources wisely and with restraint. Nature is the continuum of life long ago until the present. This would not be possible without the knowledge that has been passed on from long ago.

Knowledge is obtained through years of pursuing life as a fisherman or a hunter throughout most of the days of the year, living among the animals of Nature. The families accumulate knowledge and experiences through generations and pass it on to future generations. This is knowledge about animal behaviour, abundance, migratory patterns, where they concentrate, their peak and low seasons and fluctuations of animals, how animals should be hunted, how to make a clean kill, during what times they should be left alone in order to ensure that their numbers are not declining etc. Without this knowledge it is not possible to survive on the land.

Drying whale meat. *Photo: F. Ugarte*

Hunter cheeking his flensing knife. *Photo: F. Ugarte*

The weakness of this type of knowledge is the lack of means of distribution such as centres where this knowledge can accumulate, be written down and be a benefit to others. The user knowledge should be documented better because it is critical for the management process. The hunters and the managers currently communicate through hearing processes. There is no other forum for exchange and there is a lack of trust between hunters, the government and the biologists. Trust and respect are fundamental elements in the process.

On behalf of KNAPK
Svend Heilmann, Chairman of the Hunters Council, KNAPK
Jens Danielsen, Member of the Hunters Council, KNAPK
Kalle Mølgaard, Member of the Committee, KNAPK
Leif Fontaine, Chairman of KNAPK.

Whaling and fishing: experiences from Norwegian waters
Nils Jørgen Nilsen

Nils Jørgen Nilsen's whaling boat. *Photo: Jon Eirik Olsen*

In his personal account the minke whaler/fisherman from Røst in the Lofoten Islands explained that he is the second generation of whalers and that he has been whaling for a couple of decades. There are 5 whaling vessels in his town.

The Norwegian whalers have observed that the minke whales (*Balaenoptera acutorostrata*) in the area have started to migrate past where they used to stop to feed, and that when there is more herring there are more whales. The whalers and fishermen often see resources where the scientists see little and this is because the whalers live more closely to the natural environment. The scientists seem to accept a large margin for error with respect to abundance estimates. The whalers feel, however, that the current quota of minke whales is sufficient for the number of active boats.

The whalers continuously exchange information and learn from each other about where whales have been observed, how they are migrating and what they eat. Their knowledge is also accumulated over the years, and the whalers are increasingly improving their skills. They acquire knowledge through hands-on experience and the "school of life", and it is therefore not easy to put such knowledge on paper.

To recruit more young people to become whalers more people must be trained from when they are very young. Such young recruits must think of nothing else but whaling. For the whaling industry to thrive new export opportunities are needed and people in southern Norway must learn how to eat whale meat. It is also necessary to learn how to better process the meat and the blubber.

In the past the quotas were higher, but when the scientists began to estimate abundance, the quotas were reduced. At one point the whalers believed in the numbers collected by the scientists, but when "you mix math and politics you get madness". (*Når man blander matematikk og politikk så blir det galskap*.) A more recent development has been to divide the minke whale quota into five geographical zones. It is very difficult for the whalers to catch whales within arbitrary lines drawn on a map, and whaling is also weather dependent.


The gunner in position.
Photo: Tore Haug

The whalers have a reasonable contact with the scientists and are eagerly following their work. Currently Norwegian whalers are looking forward to the new abundance estimates. The management of whales in Norway includes inspectors who monitor the catch. The whalers have no problems with these inspectors who often wonder why they have to watch over the whalers.

The Norwegian minke whale hunt provides opportunities for scientists to collect samples for reserach.


Photo: Bjørn Tore Forberg


Photo: Bjørn Tore Forberg

Hunting activities in the Faroe Islands: how user knowledge is gathered, kept and transmitted among pilot whale hunters in the Faroe Islands

Jústines Olsen

Introduction

The pilot whale (*Globicephala melas*) has had a central place in the everyday life of Faroe Islanders since the first settlers came here from Norway some 200 years ago. The meat and blubber of the pilot whale has provided the islanders with an important part of their staple diet. The blubber, in particular, has been highly valued both as food and for processing into oil which was used as fuel for lighting and other purposes. Parts of the skin of pilot whales were also used for ropes and lines, while stomachs were used as floats, the oesophagus was used for shoes and the penis was dried and cut into strips, which were used as sewing thread for skin shoes.

Law has regulated the rights to whales since medieval times. References are found in early Norwegian legal documents, while the oldest existing legal document with specific reference to the Faroes, the so-called Sheep Letter from 1298, includes rules for rights to and shares of both stranded whales and whales driven ashore.

The pilot whale hunt today is still carried out in largely the same way as in former times. When a school of pilot whales is sighted, boats gather behind the whales and herd them towards a certain location, usually a bay or the bottom of a fjord. This location must be well suited for the purpose, which means that the seabed must gradually slope from the shore out to the deep water. Given such conditions, chances are good that the whales can be driven fully ashore or close enough to the shore that they can be secured and slaughtered from land.

The actual slaughtering method has changed very little throughout the history of the hunt in the Faroes. The main idea has been to secure the whales either directly by hand or with a hook fixed in the whale's outer layer of blubber and muscle, after which the whale is cut across the back of the neck and down to the spinal cord, severing both the main blood supply to the brain as well as to the central nervous system. After this cut has been completed made, the whale lies completely still.

If the conditions for driving and beaching a school were not favourable, a whale spear was used to pierce the whale in the heart. Another function of the whale spear was to prod one of the whales at the back of the school as the whales were being driven in, just before they had reached the shallows. This would cause the whale to panic and swim quickly past the others, thereby leading the rest of the school in a rush to the shore, where the whales would, as a result, strand higher up on the shore and therefore be easier to secure and kill.

Finally, it should be added that if a school of whales could neither be driven ashore nor speared from boats, then the communal hunt would be abandoned and any individual would then be free to try his luck at harpooning single whales, and would then be entitled to keep for himself whatever he could catch.

Although neither the nature of the pilot whale hunt nor the methods used have changed greatly over the years, there have been significant improvements in the driving procedures as well as in methods and equipment in recent years. This is due to the banning of the spear and harpoon as whaling equipment, the development and introduction of a new method for securing the whales prior to slaughtering, and the re-evaluation of slaughtering techniques. In addition, all authorised whaling locations have been subject to a thorough reassessment and whaling regulations have been updated in accordance with these changes in practice. The result of these amendments is that official whaling equipment today comprises the traditional whaling hook and the new blowhole hook for securing whales, and the whaling knife for the slaughtering.

Hunting activities

Hunting of pilot whales and other small cetaceans is opportunistic. Hunters are not searching for the whales in open water, but once whales are spotted near or between the islands, the hunt starts. Since ancient times the knowledge about the abundance of whales has been very limited. It was known that it was most likely to spot the whales in late summer and early autumn even though they could be spotted throughout the year.

Hunting activities are described below

- Pilot whale drive hunt
- Other small cetaceans and bottlenose whale
- Large whales
- Seals

The main hunting activity is for pilot whales. The average annual catch is approximately 900 whales, (catch statistics reach back to 1584). Other small whales are also caught, such as white sided dolphin, white beaked dolphin, bottlenose dolphin and harbour porpoise. A few stranded bottlenose whales are also harvested. The pilot whale drive hunt is conducted as described above. The rules for driving, killing and sharing of the catch are the same for other small cetaceans, except for harbour porpoise, which are taken in open water. The annual catch of these is very low: some years a few, but in many years none are taken.

Bottlenose whales have been hunted the same way as pilot whales, but were more often found stranded on the beach during the night. The bottlenose whale is very shy and therefore was very difficult to drive. If noise could be heard from land they turned around and escaped. Anecdotes report that the tradition was that if bottlenose whales were sighted, all women, children and dogs should be kept indoors, to avoid any noise. Only rowing boats were used and woollen mittens were put on the tholepins, also to avoid noise. In modern time with motor boats, cars and electrical lights, it is very difficult to drive these whales. Normally they are found in the morning after having beached themselves during the night. The annual catch is two or three whales, and there are two particular locations they come in.

Commercial whaling for large whales was conducted from the Faroe Islands for approximately one hundred years. It was initiated by Norwegian whalers and was later conducted by the islanders themselves. There were 7 whaling stations, though not all were running at the same time. The last large whale was caught in 1984.

Seal hunting was an important hunting activity earlier, with special rules designating the rights of the hunters. This activity ended early in the 20th century. Today seal hunting is related to fish farming. It is actually not hunting, but more a sort of preventive act, since seals can be a plague for the farmers, destroying the nets so the fish may be lost.

Who is a user or a hunter?
According to Faroese legislation on the pilot whale drive hunt, every person fourteen years or older theoretically can be counted as a pilot whale hunter. They have the right to participate in the hunt and can be allocated a share of the hunt for this activity apart from their share as a citizen in the local community.

The hunt is a collective activity where each single person contributes on a different level, i.e. on a boat for the driving activity or on the beach securing and hauling the whales to be killed and later hauling the whales to a place to be butchered. Every single person needs to acquire basic knowledge for the execution of the hunt.

What sort of knowledge?
Specific knowledge is needed to be able to participate in the hunt. This is stipulated in the law and regulations on the hunt and deals with:

- Species that can be taken
- Authorized whaling bays
- Orders to be obeyed
- Driving techniques
- Killing method
- Butchering techniques

Species that can be taken were dealt with above. Authorized whaling bays are noted in a special list where the geographical limits are stipulated according to the shape of the sea bed in every separate bay to be sure that the beaching can be done properly. The participants in the hunt have to obey orders from the sheriff and the foremen. They also have to be aware that if orders are not obeyed, penalties can be allocated. Participants on board the boats have to be aware of special orders that can be given by the foremen dealing with arrangement of the size of boats and the speed of the drive. The hunters dealing with the killing obviously have to acquire the necessary knowledge about the method and technique. The butchering is not an actual part of the hunting activity itself, but the participants have to know how and where to show up when the butchering is done. The butchering is also teamwork.

Special knowledge
The foremen leading the hunt are elected by the citizens in each whaling district and are appointed by the sheriff. Four foremen and two vice foremen are elected for each whaling bay. The foremen are elected and appointed according to their special knowledge and experience on different subjects in the districts. Very often they are fishermen with acquired knowledge on weather and current condition in open water, sounds and fjords. The understanding has been that once whales were sighted it was very important that the right decision was taken as to where to drive the whales. The most important factors that can influence the success are the weather and current conditions. Currents change direction on a daily basis depending on the moon's position relative to the earth and in strength according to the moon's phase (Figs. 1 and 2). This fact combined with the very unstable weather conditions around the islands may in a very short time change the whole situation; thus people with special skills are needed to lead the activity.

Gathering of knowledge
In the introduction it was mentioned that the pilot whale drive hunt has been carried out since the islands

were settled some twelve hundred years ago and is therefore a very old tradition passed on from generation to generation. In the early days and up to 1832 the landowners around each whaling bay could claim up to 3/4 of the catch. In 1832 this was lowered to ½ of the catch. This right influenced which bays were selected and preserved. Many of the bays were by nature well suited for the purpose, but others were not. In 1937 the owners' right came to an end. Today the whaling bays are selected according to the shape of the seabed and are monitored regularly to repair possible changes made by weather conditions.

The whale drive was formerly carried out using rowing boats. This very often meant that the drive was extremely tough: a sort of competition to keep the whales in front of the boats. In the 20th century the boats were equipped with engines, which meant that the driving was not so physically demanding. In spite of this the hunters had a tendency to forget that it was not necessary to sail at full speed. Nowadays we have

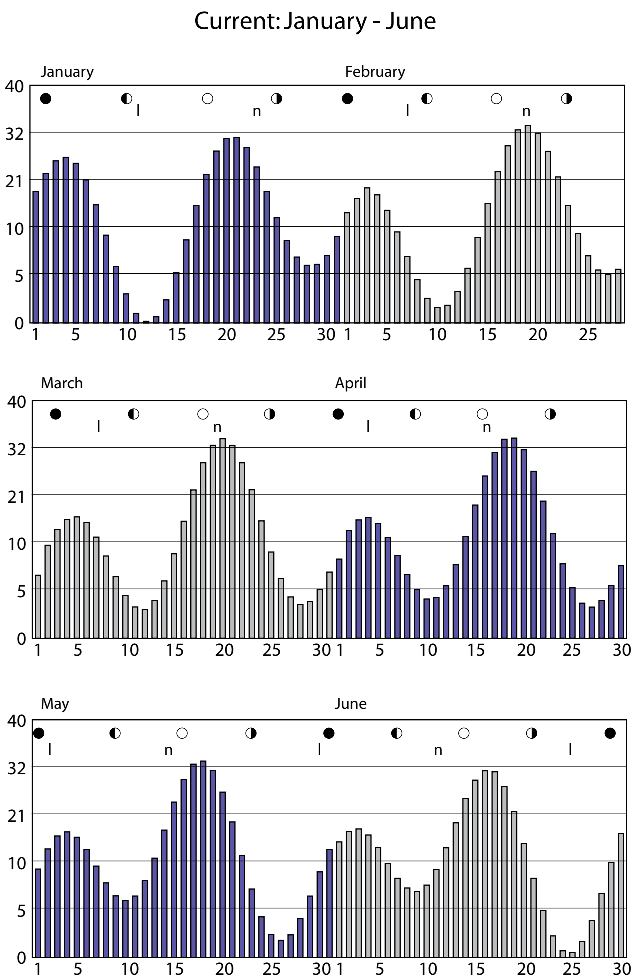


Figure 1. Currents relative strength in relation to moon phase, January – June 2003
Drawing: Álmanakkin 2003, H. N. Jacobsens Bókahandil, FO-100 Tórshavn

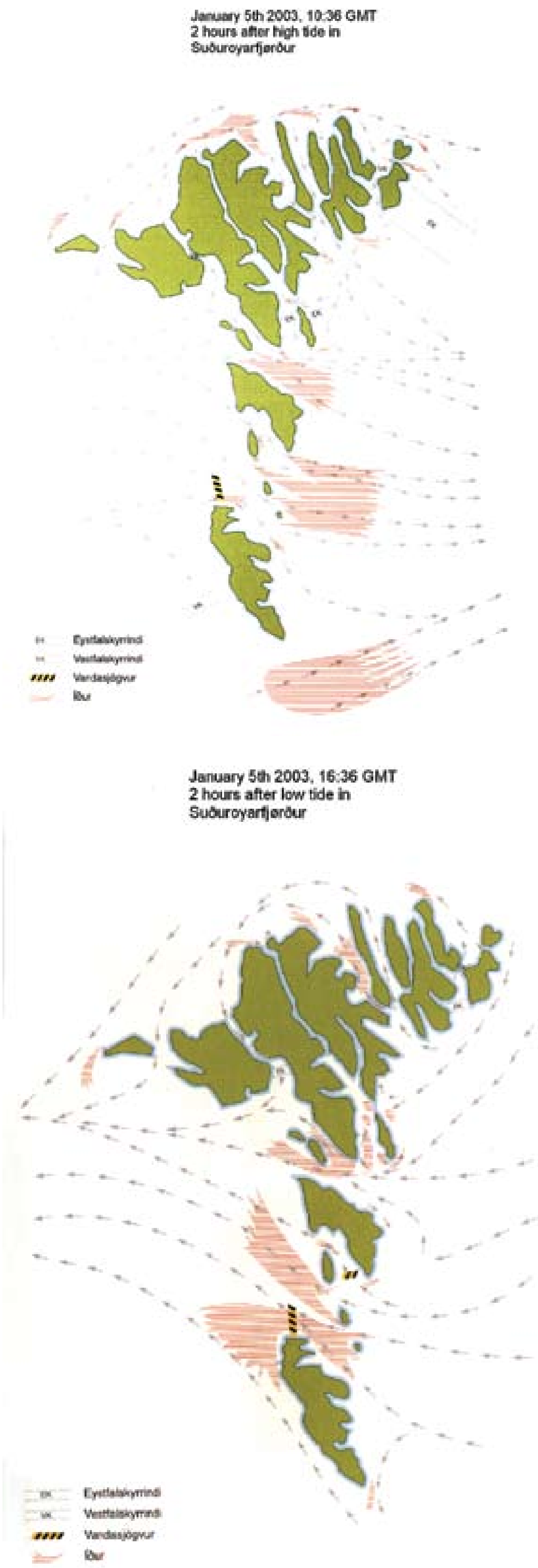


Figure 2. Current direction related to moon position, January 5th 2003
Drawing: Álmanakkin 2003, H. N. Jacobsens Bókahandil, FO-100 Tórshavn

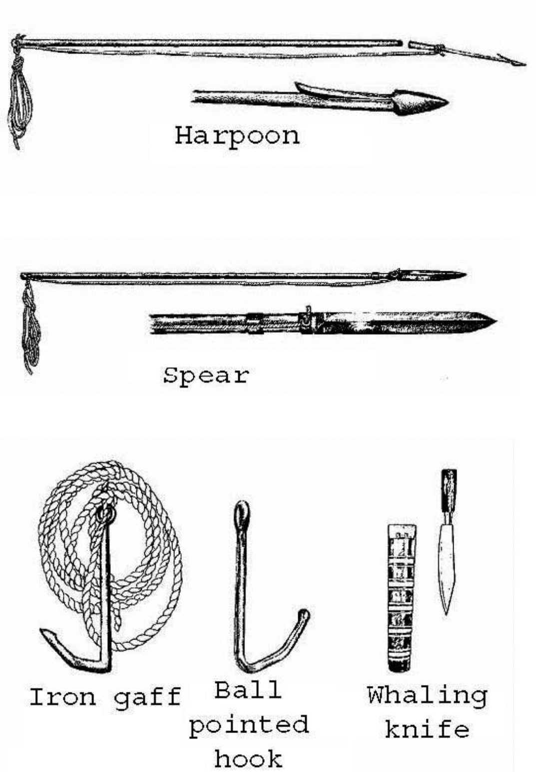


Figure 3. Equipment for the pilot whale drive hunt, past and present
Drawings: Astrid Andreasen, Føroya Náttúrugripasavn, FO- 100 Tórshavn

experienced that the old traditional gentle driving gives the best results but adaptation to new boat types is still necessary, the newest invention in this respect being the so called water scooters.

Different sorts of equipment have been used for securing the whales in connection with the killing (Fig. 3). In the early times whales were secured simply by holding the fingers in the blow hole. Later on small iron hooks were introduced. Still later again the iron gaff was introduced. Anecdotes say that the iron hook came from Shetland. Today a new blunt hook intended for insertion into the vestibular air sac of the blow hole has been invented (Fig. 4.). The killing technique is to make an incision in the back of the neck to severe the spinal cord and the surrounding blood vessels (Fig. 5 and Fig. 6). This is a safe and effective method. Exsanguination by severing the carotid arteries, which was used over a short period, is now abolished as new information on the blood supply to the brain of the whale has revealed that this was not an efficient killing method.

Figure 4. Ball-pointed hook in vestibular air sac, left: dorso-frontal view, right: lateral view
Photo: K. Lindenskov

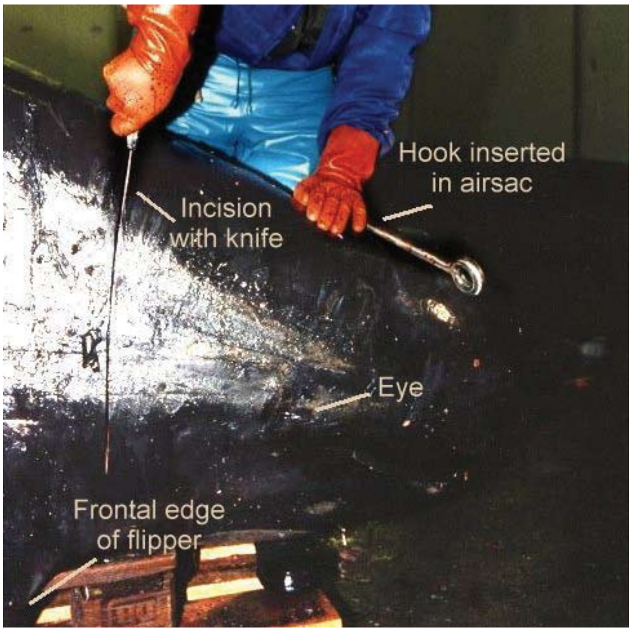


Figure 5. Killing technique: Incision 1 hand breth behind the blowhole. *Photo: K. Lindenskov*

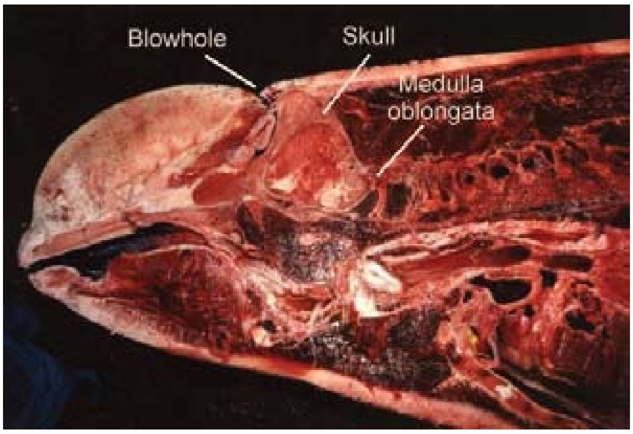


Figure 6. Longitudinal section of head of pilot whale showing anatomical feature of the brain and medulla oblongata
Photo: K. Lindenskov

The development of equipment for killing pilot whales has been going on since ancient times. The first tool to bring up is the knife, which of course was used by the first settlers and is the only tool used for killing today. The spear has been used for two purposes. The first was for prodding one of the whales at the moment the sea front was approached to speed up the whales to make them swim up on the beach. The other purpose was for killing whales that could not be beached. The aim was to make an incision into the heart. The spear is now banned since it is not considered as appropriate hunting gear or killing equipment. The harpoon, which is also now banned, was used in open water for hunting whales that could not be beached. The securing of the whales is done using an iron gaff which is driven in the blubber and muscle in the back of the neck or in the thick blubber of the melon. The whale is then hauled in to the shore where the killing can take place. Under special circumstances and with permission from the foremen, the gaff can be used from boats if some whales can not be secured from the beach. Anecdotes tell that the gaff was imported from Shetland some two hundred years ago.

During the last ten years a new invention in form of a ball pointed hook was developed for securing the whales. This ball pointed hook was invented by a Faroese pilot whale hunter. It is designed to be inserted in either of the lateral vestibular air sacs of the blow hole. The idea is that this is a non-vulnerable securing gear and is less dangerous to handle than the iron gaff. It is available at all whaling bays today.

The butchering of the whales is done as a private activity where each participant takes care of his own share, working together with the other hunters which have a share in the same whale. Today the butchering only deals with taking the blubber and the meat of the whale. In older days many other parts were dealt with in the butchering. The stomachs were preserved and used for floats. Inedible blubber was processed to oil. Part of the skin was used for ropes and the oesophagus was processed to leather for shoes. The butchering has always been a major concern where older people are telling the others how it should be done. We have a proverb which says “From the head shall the whale be butchered” (Fig. 7).

Keeping and transmission of information on the pilot whale drive hunt

In ancient times information on pilot whaling was passed on to the next generation as a tradition. This has continued until recent times. There were some benefits in the old principle. People were living in a closed community. Young and old spent the whole day together in work outdoors as well as at home. There were no public schools up until 150 years ago. The learning method was watching and copying or using the phrase “take one - be one - make one” meaning see what one person is doing and then do it yourself and in the end get another person take after you. In the old isolated villages this could also be a disadvantage. The reason for this is that the pilot whale drive hunt is very opportunistic. There are districts that could have no whales come in for many years. In some places 50-60 years could pass without whales, which meant that more than one generation would not experience a pilot whale drive hunt. This could lead to difficulties because it was difficult to travel from one place to another. There were no roads and no cars, so it could end up that there would be very few experienced persons in some places to deal with the hunt.

In modern society, where children and parents do not live close together in everyday life, it has been necessary to acquire, maintain and bring forward the knowledge in other ways. The pilot whalers' association, established in 1993, has become an important forum to keep the whalers properly informed, and works hand in hand with officials to bring forward the knowledge of this collective activity. Much debate has been raised amongst the whalers and officials in the different districts, dealing with both local problems, such as the maintenance of the condition in the bays, the sharing and distributing system of the catch as well as on the killing methods and development of new techniques. Young people are receiving information in general both on history and killing techniques at school. Modern educational materials and techniques such as pictures, video and internet are also applied to the educational program.

Figure 7. "From the head shall the whale be butchered"
Drawing: Óli Petersen

Conclusion

The pilot whale drive hunt has been an annual activity in the Faroes for more than a thousand years. Knowledge about the stock abundance has been very limited until about 15 years ago, when scientific calculations or modelling have shown that the North Atlantic stock of long finned pilot whales is approximately 800 000 animals. This has been of minor importance since the annual catch is approximately 800 animals or 0.1% of the stock. The main interest in the pilot whale hunt has been to be prepared when the whales show up, which is most commonly during summer and autumn. The knowledge about this hunting activity has been passed from generation to generation over time, with amendments and adoptions made at the appropriate moment. The main aspect with this hunting activity is that it has always been based on a communal structure. Should this hunting activity continue in the future it will be necessary to keep the entire population updated with knowledge about the hunting activity, as this hunting needs many participants for every single hunt. There have been no difficulties in exchanging this sort of knowledge between the users and the authorities. Other things than just knowledge about the hunting seem to be more necessary today than in the past, and will be in the future. Concerns about pollution of the circumpolar territory including the pilot whales and the human population harvesting these whales have arisen. Knowledge about mercury and other pollutants in whale meat and blubber seems to be of major importance for the future, especially for women of reproductive age. They might need to know how much whale meat and blubber is advisable to eat without bringing the new unborn individual in danger of being poisoned by this formerly so healthy food supply.

CHAPTER 3 Scientific knowledge

Scientific knowledge – its strength and limitations

Lars Walløe

Everyone, even the most sceptical of us, believes a lot. All our actions presuppose in varying degree beliefs – about how the world is and about our place in it. To believe is to hold something to be true. However, just that something we believe is true does not mean that we have knowledge. In order to have knowledge, our belief, in addition to being true, must also be justified. These three requirements were first formulated by the Greek philosopher Plato more than 2300 years ago ("…true opinion, combined with reason, is knowledge") and have fairly universally been accepted by later philosophers. It is not sufficient to have a belief, not even if that belief is true. You have to have a good reason to believe it. This third condition is a central theme in the theory of knowledge: What is a good reason for believing something?

One good reason to believe something is to have observed it. Thus, both user (or traditional) knowledge and scientific knowledge begin with direct observation of single facts. Nothing else is observable. "Christmas Day AD 1405 at noon Gisli observed that the sea level was high in Reykjavik harbour." When many such observations are compared certain regularities may be discovered, e.g. that high and low tide both occur twice during twenty-four hours, and further, that the exact timing is related to when the moon is south. Statements expressing such regularities can be found both in traditional and scientific knowledge. In science such regularities are expressed by statements called "empirical laws", which is a subgroup of "scientific laws". What purpose do such "laws" serve in science and in everyday life? The answer is twofold: They are used to explain facts already known, and they are used to predict facts not yet known.

Scientists are usually not satisfied only by discovering empirical laws. They want to understand how these laws fit in with other such laws and with the rest of our scientific knowledge. Such interconnections seem to be central to understanding. For this purpose scientists have introduced another subgroup of scientific laws which may be called "theoretical laws". A theoretical law is distinguished from an empirical law by the fact that it contains terms that are not observable, like "gravitational field", "molecule", "gene", "population size", "carrying capacity" etc. A successful theoretical law can explain many apparently independent empirical laws and perhaps predict new empirical laws. Both empirical and theoretical laws are usually first introduced as educated guesses, usually called hypotheses. A hypothesis in combination with established laws is used to predict new observations. Hypotheses are thus justified by showing that the consequences derivable from them conform to our experience. If they do not confirm, the hypothesis is rejected, and another hypothesis has to be proposed. This process is usually called the hypothetic-deductive scientific method. In many situations it is possible to set forth several alternative hypotheses, all of which can explain the same observations. Among these, we chose one or a small number that we continue to test. One important criterion for this selection is "simplicity". Both for theoretical and pragmatic reasons we chose the simplest of the alternative hypotheses. In the physical sciences, and in later years also in the biological sciences, hypotheses are commonly expressed by mathematical terms and in mathematical formulas. A researcher working with a mathematical model in a specific field will initially chose a model sufficiently complex for the relevant tests, but still as simple as possible. She will only retreat to a more complex model if the test results or other evidence indicates that the simple hypothesis is false. But even if the simple model cannot be rejected, the scientists who have introduced the model are usually well aware of the many simplifications and assumptions embedded in it.

The situation is very often quite different when an accepted hypothesis is applied on a practical problem, e.g. when mathematical population models are used to provide input to management decisions on harvesting from wild populations. It is easy both for the scientists involved and especially for the managers to forget all the assumptions, simplifications and uncertainties involved in the models. And since another good reason to believe a scientific claim (in addition to direct observation) is that it is derivable from a well-established hypothesis, the results of such model calculations are often believed to be true without reservations.

Two biological models commonly used in management decision-making will briefly be discussed in light of the commentaries above: 1) the mark – recapture model for estimating population size, and 2) the logistic population growth model often used to predict "maximum sustainable yield" etc. The main points are that the simplicity of both models represents both their strength and their weakness.

My first example is the mark-recapture method for assessing population size. The scientific model is very simple. We mark a number of animals; assume that the marked animals in every way behave like unmarked animals and that they mix completely with the whole population. Some time later we take out a number of animals and observe the proportion of marked animals in the sample. Examples of use of this method are abundant in ecology. A relevant example in our context is the first assessments of population sizes of the baleen whales in Antarctic waters and in the North Atlantic in the 1960-ies and 1970-ies by "Discovery" marks – steel rods that were shot into the back muscles of a number of whales at the end of the hunting season. Recoveries were obtained from the whaling operations the next year and in the following years. Estimation of stock sizes of humpback whales in the North Atlantic by photo-ID is a more recent example, and in the future genetic ID obtained either from biopsy sampling or from foetuses of hunted whales, may provide basis for the estimation of abundance of other marine mammal stocks. The strength of the mark-recapture method is its simplicity and generality. The method is well understood. We know how to calculate not only our best guess for the population size, i.e. the point estimate, but also the uncertainty of our guess, i.e. its Confidence Interval. But let us not forget the weaknesses and limitations of the method: Not only dilution by untagged animals, but also mortality will reduce the number of tagged animals obtained during the re-sampling. This mortality is likely to be unknown and may even be influenced by the method (e.g. having a steel rod shot into your back is perhaps not very healthy, not even for a large whale). The assumption about complete mixing may also easily be violated. There are possibilities of population structure, site fidelity, sex or age separation, and the marked animals may even learn to avoid vessels, all of which may strongly influence the calculated abundance estimate.

My second example, which also plays an important role in management of marine mammals, is the logistic population growth model. This model assumes that populations will grow exponentially if they have been hunted far down, but that the growing population will flatten out at a certain population level called the carrying capacity. This model also defines concepts like MSY (maximum sustainable yield), MSYL (MSY level) and r (growth rate at low population levels). It rests on a number of assumptions such as an approximately constant carrying capacity, but more important, when this model is used to calculate sustainable quotas, it is assumed that the harvest is taken randomly from the population.

When I was given responsibility for the Norwegian minke whale research in 1987, the first and most important question I had to attack was the population size. Sidney Holt claimed that the abundance of the North-East Atlantic minke whale stock was less than 19 000 animals. Since catches were close to zero at the time, the mark recapture method could not be used, so we had to rely on another method, the so-called line-transect method, which has its own set of critical assumptions. My colleague Tore Schweder developed an improved line-transect method which gave an abundance estimate close to 100 000 animals based on field work in 1989. That was certainly an important result, and after some further scientific discussions, corrections and additional experiments, the method and the results were generally approved. To me, however, the greatest satisfaction and assurance were that the abundance number we obtained by the line-transect method, was of the same order of magnitude as a number obtained back in the late 1970-ies by the mark-recapture method. Why was that so? The reason was that the two methods rest on quite different assumptions, and thus strongly supported each other.

What is the bottom line of all this? Based on my experience over a number of years from different scientific fields I still have a strong belief in the scientific method. Conclusions of science are reliable, though tentative and often based on critical assumptions. Science is always a work in progress, and its conclusions and predictions should therefore always be open to scrutiny. Some scientific theories are extremely well tested under all relevant conditions, but the majority are not. Most theories and models in biological fields, including population and harvesting models, belong to the latter category. They do not represent "scientific knowledge", but are "scientific beliefs" based on educated guesses. We should regard the predictions from such models, including harvesting quotas for fish and marine mammals, with scepticism and always examine the underlying assumptions.

Not only scientific theories, but even scientific empirical laws mentioned above, sometimes have a weak empirical basis. This is true for most scientific fields. Medicine is one example. Much of what until quite recently was regarded as established treatment methods has today been thrown out due to new evaluation of the empirical evidence. Regarding empirical knowledge I see more similarities than differences between "scientific knowledge" and "user knowledge". May be that part of what today is called "user knowledge", some of which is obtained from systematic interviews of users, rather should be called "user beliefs". Before this "user knowledge" is incorporated into our total "body of knowledge", it should perhaps be subject to confirmatory investigations. With this caveat in mind I see no reason why "well established user knowledge" should not be regarded as very relevant to managers when they decide harvesting patterns and quotas, in addition to results from scientific empirical investigations and model calculations.

Estimating abundance of seals in the North Atlantic: designing and conducting a scientific assessment

Garry Stenson

Introduction

Knowledge of current population and trends in abundance are critical for understanding the status of a population and the impact of human activities or natural changes. As such, estimating abundance of a species is one of the most important activities we can do to assist in making appropriate management decisions; among other things it allows us to estimate sustainable harvest levels, determine the species' role in the ecosystem, and better understand the impact of environmental change.

Sealers and hunters often have a very good understanding of the abundance of marine mammals in the areas they utilize. However, most marine mammal populations range over large areas and it is difficult to get information on total population size. Abundance in local areas can change as a result of changes in the total population, or through changes in distribution. As a result, in order to set quotas or understand population changes it is necessary to estimate the total population in a manner that is not affected by local changes in distribution.

Harp seals

Harp seals (*Pagophilus groenlandicus*) are found throughout the north Atlantic and give birth on the pack ice in the White Sea, near Jan Mayen in the Greenland Seal, off the coast of southern Labrador and/or northeast Newfoundland (referred to as the 'Front') and in the Gulf of St. Lawrence (Sergeant 1991). The seals that pup at the Front and in the Gulf of St. Lawrence are part of one population referred to as the northwest Atlantic population (Anon 2006). In the fall, most of these seals migrate southward to Atlantic Canadian waters where they give birth during late February or March. Following moulting in April and May, seals disperse and eventually migrate northward. Small numbers of harp seals may remain in southern waters throughout the summer while others remain in the Arctic throughout the year. Their total range is in the order of 2,000,000 km2.

Because harp seals range over such a vast area, spend much of their time in water, and are often segregated by sex and/or age, counting all of the harp seals in the northwest Atlantic is impractical. Seals congregate during the whelping and moulting periods, but not all of the population is present at the surface at any one time. For example, nursing females do not stay on the ice all of the time and the proportion present varies with time of day and environmental conditions (Perry and Stenson unpubl. data) so counts of females are not a good estimate of total numbers. Fortunately, the number of harp seal pups born in a year can be estimated from aerial surveys conducted during the spring pupping period. The total population can then be estimated from a population model that incorporates independent estimates of pup production with information on reproductive rates, natural mortality, and human-induced mortality from hunting and bycatch in fishing gear.

Stock identity

The first issue in estimating abundance of a population is to determine the boundaries of the group of concern. This is critical so that the data collected can be assigned to the correct assessment. Based on information obtained from a variety of sources including flipper tags that are returned by hunters, tracking of individual seals using satellite transmitters (Stenson and Sjare 1997, Stenson and Hammill unpublished data), and DNA analysis (Perry et al. 2000) we know that the seals that inhabit the eastern Canadian Arctic and western Greenland down to the Gulf of St. Lawrence are part of the same population. The range of northwest Atlantic harp seals overlaps with that of harp seals from the Greenland Sea population off the southeast coast of Greenland and as a result, catches from this area are divided between the two populations (Anon 2005).

Removals

One of the major inputs into the harp seal population model is an estimate of human-induced mortality or removals (Stenson 2005). These include number of seals taken by commercial or subsistence hunters, animals that are struck but not recovered and reported in the catch statistics, and seals killed as bycatch in commercial fisheries. For each source, we try to estimate the total number of seals killed each year and their ages.

Harp seals are taken in the Canadian commercial hunt off the coast of Newfoundland and in the Gulf of St. Lawrence, and by hunters in Greenland and the Canadian Arctic. The number of seals taken in the Canadian commercial hunt is obtained from the catch statistics maintained by the Department of Fisheries and Oceans. They take catches reported by sealers and local fisheries officers and check them against the number of seals sold. The number of seals taken is split by age class: young of the years vs. seals one year of age and older. The Greenland Government provides estimates of the number of seals taken by Greenland hunters. It usually takes a couple of years to obtain the hunting statistics in Greenland and so data for the most recent years are usually estimated with the help of Greenlandic scientists. Once the data become available the statistics are updated. We attempt to use the most accurate data possible and if other studies indicate that corrections are required, they are applied when appropriate. For example, a study carried out by Greenland scientists indicated that approximately 10% of the catches were not reported so we now adjust the estimates to account for this under-reporting.

Catches of harp seals in the Canadian Arctic have not been well documented, but generally, they are low. Recently the Nunavut government carried out a harvest study that provided data on recent catches (Anon 2005). A small number of harp seals are taken in other areas of the Canadian Arctic (e.g. Nunavik and Labrador) but their numbers are thought to be extremely small.

In addition to reported catches, some seals are killed but not recovered or reported (referred to as 'struck and lost'). The number of animals lost will vary greatly with the kind of hunt, weather conditions, and the time of year. The latter is important because the buoyancy of the seals varies seasonally as the thickness of their blubber layer changes. Loss rates of young seals during the Canadian large vessel, whitecoat hunt (prior to 1983) are considered to be low (~1%). Studies of the loss rates during the current hunt for beaters also indicate that loss rates are low (Sjare and Stenson 2002). However the proportion of seals lost during the open-water hunt, especially during the spring and summer when the seals are thin, will be much higher. Historical reports of loss rates in the Arctic range from 50-65% (Lavigne 1999). Sjare and Stenson (2002) were able to obtain some estimates of loss rates during the Canadian hunt for older seals that indicate that losses were generally lower than this, but in the absence of other information we have assumed a struck and loss rate of 50% for the Canadian Arctic and Greenland. When additional information becomes available we will modify this estimate to reflect the new data. In the meantime, we have tested the impact of making this assumption and found that it does not affect the population estimates significantly (Stenson et al. 1999).

Harp seals are also taken incidentally as bycatch in fishing gear. In some areas these animals are considered part of the harvest and included in the catch statistics, while in others they are not. Using phone surveys and fishermen's log books it was determined that the majority of bycatch in Canada occurs in the Newfoundland lumpfish fishery. Using a monitoring programme based upon logbooks maintained by lumpfish fishermen, Sjare et al. (2005) estimated the number of seals caught based upon the number of days nets were in the water, number of nets used, and the amount of fish caught. Catches varied greatly among years depending upon the fishing effort, timing of the fishery, and ice conditions that affect the migration pattern of seals and so must be monitored annually. Seals are also taken in other fisheries although the numbers caught have not been estimated. In addition a small number of harp seals are taken in fishing gear in the northeastern United States (Waring et al. 2004). Based on reports from fisheries observers, the number of seals killed is estimated and also included in the total bycatch figures.

Knowledge of the age of animals killed is needed to determine the impact of these removals. To estimate the age of harp seals killed, a sample of seals is taken by hunters and this age structure is applied to the appropriate catch. Although we have good age structure data from the Canadian commercial hunt and bycatch, there are few data for recent catches in Greenland and the Canadian Arctic. We are working with other scientists in order to obtain samples as this is a major gap in our data.

The seals are aged by counting the growth rings in their teeth, the same way trees are aged. Different people read teeth and therefore it is important to ensure that the ages they obtain are accurate. Readers undergo a training session each year during which they examine teeth from seals of known age. We are currently participating in a study to compare different readers to ensure that their readings are comparable.

Mortality from the different sources are combined to estimate the total number of seals killed. In addition to this human-induced mortality, there is mortality due to 'natural' causes. The number of seals that die annually due to natural mortality can be determined independently in some populations or assumed based on information from similar populations. For the northwest Atlantic population, the level of natural mortality is estimated within the population model. As a result, errors in the reported catches or assumptions about the level of struck and loss do not have as large an impact on this population estimate as for other populations.

Reproductive rates

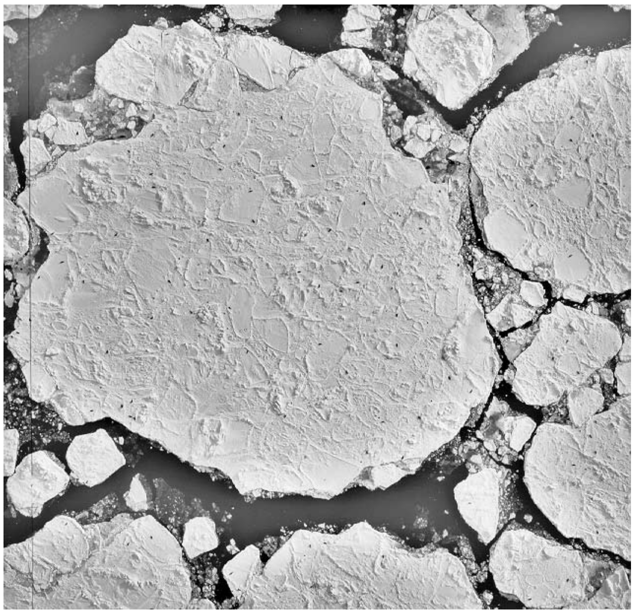
The second critical input to the population model is the proportion of females that give birth each year. This can be estimated by examining the reproductive tracks of seals collected prior to the pupping season. The majority of samples have been collected by sealers who have been trained to remove and preserve the ovaries and uteri. These are examined in the laboratory and, using easily-identified structures, it can be determined if the female was pregnant or had given birth in the past. Ideally, seals should be sampled throughout their range but to date, the majority of samples have come from the Newfoundland area. We are working with scientists in other parts of the world to collect comparative samples to determine if sampling in one area introduces a bias in estimates.

Data on maturity and pregnancy rates have been collected in Canada since 1954, with annual information available from the mid 1980s to the present. Analysis of this long time series has indicated that female reproductive status varied as population size and environmental conditions changed over the years. A study by Sjare et al. (2004) indicates that pregnancy rates have declined since the mid 1980s. Also, the age at which females tended to become sexually mature also varied over time. Changes in reproductive rates have also been reported in harp seals from the Barents Sea/White Sea population (Frie et al. 2003). Therefore, it is important to collect data and monitor reproductive rates regularly as they can change fairly rapidly. Also, these new data must be made available to other scientists so that reproductive changes can be incorporated into models.

Pup production

The third piece of information required to estimate total abundance is an independent estimate of the number of pups born (Stenson et al. 1993, 2002, 2003, 2005). These are not required every year, but should be obtained at four to five year intervals. Prior to the mid 1980s pup production was estimated using a method known as mark-recapture. Seals were tagged with small flipper tags and the total number of pups born was estimated based upon the number of tags returned by sealers. Since the mid 1980s, however, aerial surveys have been used to estimate pup numbers for

Aerial survey. *Photo: Garry Stenson*



Harp seals whelping area. *Photo: Garry Stenson*

harp, hooded (*Cystophora cristata*), and grey (*Halichoerus grypus*) seals.

Aerial surveys are intensive projects that require considerable effort and funding. Carry out a harp seal survey and analysing the data typically takes a year of effort and cost close to $900,000 Canadian. The first step is to determine the location of all major whelping concentrations. This is done through extensive reconnaissance surveys of the areas where seals have historically given birth. These areas have been identified by reviewing historical records from sealers and through discussions with hunters and sealers. Because harp seals give birth on moving pack ice, the ice is surveyed repeatedly over the pupping period. Once a whelping concentration is found, a radio transmitter or satellite beacon is placed on the ice within the group to monitor ice drift and to make sure the concentration does not drift out of the survey boundaries, or get counted more than once. Missing a pup concentration or counting one twice is the largest single error that can be made in estimating total pup production and so it important that the entire area be covered and all pupping groups identified.

Once all of the concentrations have been located, the number of pups in each group is estimated. Because the concentrations can be quite large, we cannot count all of the pups. Instead, lines (transects) are flown over each group and the pups are photographed from fixed-wing aircraft and/or counted by observers in helicopters. The height of each transect is recorded so the total area surveyed can be estimated. The photographs are examined in the laboratory and the number of pups on each one determined. This can be very time consuming

Counting seals from photos taken in the aerial survey. *Photo: Garry Stenson*

as it is common to take almost a year to read the over 8,000 photographs obtained during one season. Since harp seal pups are white they are often difficult to find on the photographs unless the readers are experienced. Therefore, we carry out additional tests to ensure that the different readers are comparable and to adjust for any pups that may be missed. By knowing the number of pups present in a given area and the total size of the concentration, the total number of pups in the concentration can be derived.

The pup count estimates must also be corrected for pups that may not have been born at the time of the survey or that may have already left the ice. In order to do this we fly repeated surveys through the pupping area to obtain information on the proportion of pups of different ages within the patch. As the pups gets older their size and fur colour change which allows us to assign them to different age categories. By knowing the duration of each of these age categories and changes in the proportion of seals over the survey period, it is possible to model the distribution of births over time and determine the proportion of pups born after the survey aircraft has passed.

Since the results obtained are based upon only a sample of the pupping area, there is uncertainty associated with the estimates that must be calculated using various mathematical techniques. In 2004, for example, our best estimate of the total number of pups born was 991,000. However, if we were to redo the survey, the estimate would fall between 878,000 and 1.1 million pups, 19 times out of 20.

Total population

By incorporating a time series of annual reproductive rates, removals, and pup production estimates into a mathematical model, the total population and trends in abundance can be determined (e.g., Healey and Stenson 2000, Hammill and Stenson 2005). Unfortunately none of the inputs to the model are known exactly and this uncertainty must be incorporated into the estimates of total population. The mean abundance estimate for northwest Atlantic harp seals in 2004 was 5.8 million. However, the population had a 95% chance of being between 4.8 and 7.1 million seals (Hammill and Stenson 2005). Reviewed over time, the harp seal population declined during the 1960's and reached a minimum of less than 2 million in the early 1970's. Since then it has increased steadily until the mid 1990's and is currently at its highest level since the current time series began. Due to the large harvests in recent years, the population has been relatively stable since the mid 1990s.

Scientific advice

In Canada, scientists do not set quotas. Instead they provide managers with information on the state of the population and estimate population size relative to biological reference levels. In 2003, Canada adopted a management model (referred to as Objective Based Fisheries Management or OBFM) that incorporates the Precautionary Principle. Under this approach, certain population levels are identified as reference points at which specific management actions will be taken. The primary reference level is a conservation reference point which is a level at or below which there is an unacceptable risk of serious or irreversible harm to the population. This is a level which is to be avoided as much as possible. In order to avoid this level and because scientific data are uncertain, a precautionary reference is used as an indicator of the level at which harvesting must change in order to reduce the risk that the resource will decline. Because the majority of harp seals are killed as young of the year and we survey pups to estimate abundance, OBFM has incorporated two precautionary reference levels to ensure that appropriate management actions can be taken before the population approaches the conservation limit (Hammill and Stenson 2003). Currently the northwest Atlantic harp seal population is considered to be above the first precautionary reference point which has been set at 70% of the highest population observed or inferred (5.82 million). The objective of the most recent management plan is to maintain an 80% probability that the population remains above this precautionary reference point. In this way, this approach directly incorporates the uncertainty associated with scientific assessments into the management of northwest Atlantic harp seals.

In addition to providing information on the current status of the population, scientists also provide estimates of the impact of future harvest strategies (e.g. Hammill and Stenson 2005). In order to do so, a number of assumptions must be made about future harvest levels and reproductive rates. Uncertainty in these assumptions are incorporated into the projections and provided to managers an indication of the consequences of their decisions.

Peer review

An important characteristic of scientific assessments is that once the data are available, the results are presented for peer review. The objective is to present all of the data and assumptions used in drawing the conclusions and to provide other scientists and the general public an opportunity to discuss and debate the results. Once an initial level of peer review has been completed, a description of methods used, data inputs, assumptions required, results and inferences taken from the results is published in a scientific journal where it is available to everyone. This provides a record for others to use in further studies, or to review and draw their own conclusions.

Strengths and weaknesses

The major potential weakness of any assessments is the quality of the data. All scientific assessments are dependent upon obtaining data to estimate the parameters. Collecting these data is usually costly and time consuming. It is often difficult to obtain some of the required data in a timely manner. As a result, the estimates can change once new data become available. Also, since we never know everything, all studies require a number of assumptions. A good scientist will identify each of these assumptions clearly and explore the sensitivity of their results to changes in these assumptions. Finally, the harp seal assessment described here is designed to determine the total number of harp seals in the northwest Atlantic population and its trend over time. However, this overall trend may not reflect trends in local abundance in some areas. As a result, the experience of local hunters may not be reflected in the estimates of total numbers and trends in abundance.

Scientific assessments of abundance have a number of strengths. They attempt to account for the entire population which allows us to determine if local changes in abundance are due to changes in distribution or overall population size. They are objective, with no preconceived goals, and are quantifiable in the sense that they provide abundance with an indication of the associated uncertainty. The methods used are documented clearly and peer reviewed. Others can examine the data and either agree or disagree based on the same information. The analyses can be repeated and updated as new data become available. Finally, those data which are obtained from observations or are based on assumptions are clearly identified and the conclusions of the study are separated from inferences about cause or consequences drawn from these conclusions.

The methods we use can be standardized so that if others carry out a similar study, the results can be compared. By repeating the aerial surveys using the same techniques we can directly infer changes in pup production. The methods described here are also used to estimate pup production in the Greenland Sea and White Sea. As a result, we can compare the estimates and know we are discussing the same measure. Finally, because the estimates are quantitative and clearly laid out, they can be used to predict future changes or impacts of a given level of hunting. If these prove wrong, the assessment can be reviewed to determine how it can be improved.

Incorporating user knowledge in scientific assessments

User knowledge is distinguished by a number of characteristics that can compliment scientific knowledge in many situations (Usher 2000). Users can provide factual knowledge about the environment and identify important issues that result in testable hypotheses. Also, users tend to have a long history in an area that can provide important context and indications of trends. Our research team has worked extensively with local sealers and fishermen in Newfoundland and Labrador for a number of years. In doing so, we have learned a lot from them about the life history, behaviour, distribution, and diet of harp seals in our area. Our programme incorporates the knowledge of local users; their knowledge and observations often provide a basis for our scientific studies by forming the basis of the questions we attempt to answer. In addition, we rely upon these people to collect some types of data we use to improve our population models. Alone, user knowledge is local in nature, qualitative and restricted to personal observations (Usher 2000). The emphasis is often on observing conditions, trend and variations which are not sufficient by themselves to address the quantitative, large scale questions required for assessing population status.

Literature cited

Anonymous. 2005. The Nunavut Wildlife Harvest Study. Nunavut Wildlife Management Board. Iqaluit, Nunavut.

Anonymous. 2006. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. ICES CM 2006/ACFM:6.

Frie, A.D., Potelov, V.A., Kingsley, M.C.S. and Haug, T. 2003. Trends in age-at-maturity and growth parameters of female Northeast Atlantic harp seals, Pagophilus groenlandicus (Erxleben, 1977). ICES Journal of Marine Science 60:1-15.

Hammill, M.O. and Stenson, G.B. 2005. Abundance of Northwest Atlantic harp seals. Canadian Science Advisory Secretariat Research Document. 2005/in press.

Hammill, M.O. and Stenson, G.B. 2003. Application of the precautionary approach and conservation reference points to the management of Atlantic seals: A discussion paper Canadian Science Advisory Secretariat Research Document. 2003/067.

Healey, B. P. and Stenson, G. B. 2000. Estimating pup production and population size of the northwest Atlantic harp seal (Phoca groenlandica). Canadian Stock Assessment Secretariat Research Document 2000/081. 27p.

Lavigne, D.M. 1999. Estimating total kill of northwest Atlantic harp seals, 1994 1998. Marine Mammal Science 15(3):871-878.

Perry, E.A., Stenson, G.B., Bartlett, S.E., Davidson, W.S. and Carr, S.M. 2000. DNA sequence analysis identifies genetically distinguishable populations of harp seals (Pagophilus groenlandicus) in the northwest and northeast Atlantic. Marine Biology 137: 53-58.

Sergeant, D.E. 1991. Harp seals, man and ice. Canadian Special Publications of Fisheries and Aquatic Science 114: 153 pp.

Sjare, B. and Stenson, G.B. 2002. Estimating struck and loss rates for harp seals (Pagophilus groenlandicus) in the northwest Atlantic. Marine Mammal Science 18:710-720.

Sjare, B., Walsh, D., Benjamins, S. and Stenson, G.B. 2005. An update on harp seal by-catch estimates in the Newfoundland lumpfish fishery: 1999-2003. Canadian Science Advisory Secretariat Research Document. 2005/049. Available at http://www.dfo-mpo.gc.ca/csas

Sjare, B., Stenson, G.B. and Healy, B. 2004 Changes in the Reproductive Parameters of Female Harp Seals (Pagophilus groenlandicus) in the Northwest Atlantic. Canadian Science Advisory Secretariat Research Document. 2004/107. Available at http://www.dfo-mpo.gc.ca/csas

Stenson, G.B. 2005. Estimates of human induced mortality in Northwest Atlantic harp seals, 1952-2004. Canadian Science Advisory Secretariat Research Document. 2005/050. Available at http://www.dfo-mpo.gc.ca/csas

Stenson, G.B. and Sjare, B. 1997. Seasonal distribution of harp seals, (Phoca groenlandica) in the northwest Atlantic. ICES C.M. 1997/CC:10. 23 p.

Stenson, G.B., Healey, B., Shelton, P.A. and Sjare, B. 1999. Recent trends in the population of northwest Atlantic harp seals, Phoca groenlandica. NAFO SCR Document 99/26. Serial No. N4082. 18 p.

Stenson, G.B., Hammill, M.O., Kingsley, M.C.S., Sjare, B., Warren, W.G. and Myers, R.A. 2002. Is there evidence of increased pup production in northwest Atlantic harp seals, Pagophilus groenlandicus? ICES Journal of Marine Science 59:81-92.

Stenson, G.B., Hammill, M.O., Lawson, J.W., Gosselin, J.F. and Haug, T. 2005. 2004 pup production of harp seals, Pagophilus groenlandicus, in the northwest Atlantic. Canadian Science Advisory Secretariat Research Document. 2005/037. Available at http://www.dfo-mpo.gc.ca/csas

Stenson, G.B., Myers, R.A., Hammill, M.O., Ni, I H., Warren,W.G. and Kingsley, M.C.S. 1993. Pup production of harp seals, Phoca groenlandica, in the Northwest Atlantic. Canadian Journal of Fisheries and Aquatic Science 50:2429-2439.

Stenson, G.B., Rivest, L.-P., Hammill, M.O., Gosselin, J.F. and Sjare, B. 2003. Estimating pup production of harp seals, Pagophilus groenlandicus, in the Northwest Atlantic. Marine Mammal Science 19:141-160.

Usher, P.J. 2000. Traditional ecological knowledge in environmental assessments and management. Arctic. 53:183-193

Waring, G.T., Pace, R.M., Quintal, J.M, Fairfield, C.P. and Maze-Foley, K.. 2004. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2003. NOAA Technical Memorandum NMFS-NE-182.

CHAPTER 4 User knowledge and scientific knowledge

Incorporation of user knowledge into the management of cetaceans: experience from the AWMP of the IWC

Greg Donovan

Introduction

The International Whaling Commission, without adopting formal definitions, has since its inception accepted a category of whaling traditionally termed 'aboriginal subsistence whaling' that it sees as separate from 'commercial whaling'. Implicit in this is a view that the two types of whaling are to some extent managed differently e.g. with respect to both levels of catches allowed and levels of acceptable 'risk' that catches may adversely affect populations (see below). The aboriginal subsistence whaling fisheries presently accepted by the IWC are given in Table 1. Catch limits are set by voting (or ideally consensus) by the member nations, based on the submission of a 'need' statement (incorporating both nutritional and cultural needs) and upon advice from the Scientific Committee. Member governments do not have to include representatives of the hunting communities in their delegations and the decision-making process but in practice, at least in recent years, they have endeavored to do so. In 1982, (partly as a result of the bowhead whale issue discussed later) guidelines for the provision of advice by the Scientific Committee on stocks subject to aboriginal subsistence whaling were developed but for most stocks, these were difficult or impossible to meet fully due to a lack of the required scientific information. Prior to this, advice was provided on a more ad hoc basis.

The IWC (by three-quarters majority) adopted a ban on commercial whaling in 1982 (that took effect from 1986). Subsequently, the IWC Scientific Committee spent several years developing the 'Revised Management Procedure (RMP)' for calculating safe catch limits for commercial whaling, that explicitly takes scientific uncertainty into account. After completing this ground-breaking work in the early 1990s, it moved on to working on a similar approach for aboriginal subsistence whaling (the Aboriginal Subsistence Whaling Management Procedure – AWMP). The purpose of this paper is to examine the features and benefits of a management procedure approach and illustrate the essential role user knowledge can play in developing a wise and fair conservation and management strategy. It is written for a non-technical audience and for ease

Table 1
Aboriginal subsistence whaling operations managed by the IWC. Note that IWC parlance, the strike limit applies to the number of animals struck at least once, not the actual number of strikes – thus if one animal is struck twice, that only counts as one strike.

Area	Species	Summary of catch limits
Greenland – west	Fin whale, *Balaenoptera physalus*	An annual catch of up to 19 whales for the years 2003 - 2007.
Greenland – west	Common minke whale, *B. acutorostrata*	An annual strike limit of up to 175 for the years 2003-2007 (up to 15 unused strikes may be carried over each year).
Greenland – east	Common minke whale	An annual catch of up to 12 whales for the years 2003 - 2007 (up to 3 unused strikes may be carried over each year).
USA -Alaska Russian Federation – Chukotka;	Bowhead whale, *Balaena mysticetus*	A total of up to 280 bowhead whales can be landed in the period 2003 - 2007, with no more than 67 whales struck in any year (up to 15 unused strikes may be carried over each year).
Russian Federation – Chukotka; USA -Washington State	Gray whales, *Eschrichtius robustus*	A total catch of up to 620 whales is allowed for the years 2003 - 2007 with a maximum of 140 in any one year.
St Vincent and The Grenadines – Bequia	Humpback whales, *Megaptera novaeanglia*	A total of up to 20 whales for the years 2003-2007.

of reading, there are no references in the text; rather a short bibliography for readers wishing to explore such issues as the details of the IWC's AWMP development process and associated issues is included at the end.

What is a management procedure?

In summary, the management procedure approach is as follows:

1) agree on management and conservation objectives, state them explicitly and assign them priorities;
2) agree on and specify realistic data and analysis requirements;
3) accept scientific and practical limitations and take the inevitable uncertainty explicitly into account by determining a precautionary method of calculating catch limits involving rigorous testing via computer simulations for both quantitatively and qualitatively known sources of uncertainty;
4) after steps (1) – (3), adopt a management procedure that incorporates the process right through from data requirements and analysis to determination of catch limits (or other management advice);
5) include feedback monitoring to ensure that the agreed objectives are being met.

The advantages of such an approach are clear; everybody understands and agrees: (1) what the conservation and use objectives are; (2) what the data requirements are; and (3) what the data analysis methods are. This removes the problems associated in the past with ad hoc assessment methods that could sometimes lead to greatly fluctuating scientific advice on appropriate catch levels from year to year. Such procedures are designed for long-term (decades) management. This allows inter alia appropriate long-term research planning. The users, managers, scientists and indeed the exploited populations, all therefore benefit from the management procedure approach.

Towards a procedure

Although it is easy to list the steps towards the development of an agreed management procedure, completion of those steps is a complex task requiring considerable cooperation between scientists, managers and users. A summary of the steps and who should be involved at the various stages is given in Fig. 1.

Objectives

Objectives are the key to any management procedure – they not only define what you want it to achieve but allow you to monitor to see if you are achieving the goals you have set. With natural resources, there are at least two types of objectives – those relating to the long-term users' needs and those relating to the long-term conservation of the resource. Inevitably, there will be some degree of trade-off: however small, even taking one animal theoretically increases the risk that a population will decline.

For the AWMP, the IWC agreed the following objectives:

1) ensure risks of extinction not seriously increased (highest priority);
2) enable harvests in perpetuity appropriate to cultural and nutritional requirements ('need');
3) maintain stocks at highest net recruitment level and if below that ensure they move towards it.

By contrast, the objectives set by the IWC for commercial whaling are that:

1) catches should not be allowed on stocks below 54% of the estimated carrying capacity (highest priority);
2) catch limits should be as stable as possible;
3) the highest possible continuing yield should be obtained from the stock.

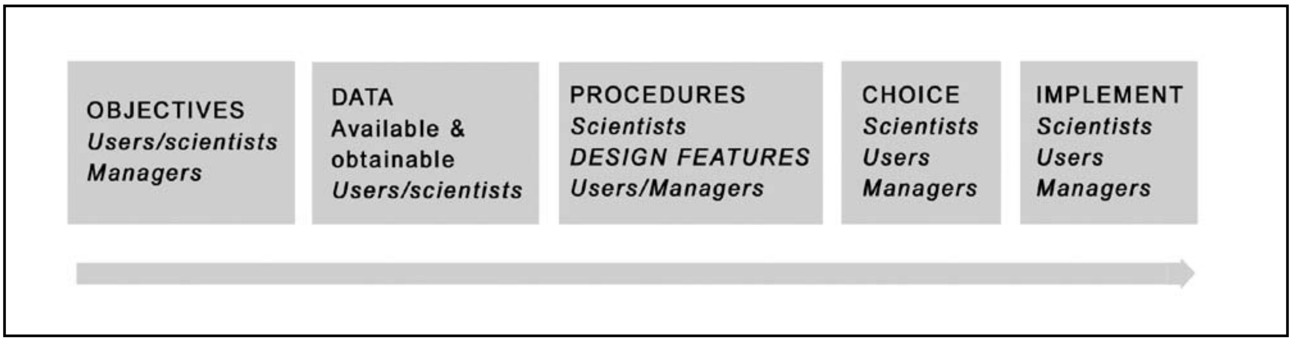


Figure 1. Towards a procedure

It can immediately be seen that there are quite marked differences, both in terms of yield ('need' versus 'highest possible') and levels at which catches can be taken (no specific level for aboriginal subsistence catches although they must allow the population to increase towards the level giving highest continuing yield).

These objectives were agreed by the Commission after consultation among scientists and users as well as managers. Agreement of the users to any management objectives is essential if an effective and fair management procedure is to be developed and successfully implemented.

Data

Any management procedure requires at least some data – both in terms of its initial design and in terms of future implementation. The IWC Scientific Committee recognised that for both logistical and financial reasons, an appropriate system for managing aboriginal subsistence whaling must have as simple data needs as possible whilst still allowing the objectives to be met. It is important to base advice on the best available information and also to take into account the inevitable uncertainty around that data. The basic data required for managing cetaceans are those relating to the identity of the 'stock' to be managed (e.g. are one or more populations being exploited) and those relating to its status (abundance and trends, past and present catches).

Cooperation between scientists and users is essential in obtaining the best scientific information possible. Unfortunately, there are many examples of where such cooperation has been lacking. This may be because some scientists have either been too arrogant to believe that non-scientists can hold relevant information on the animals they hunt and/or unwilling to try to translate traditional knowledge into scientific 'language'; and/or because some users do not trust scientists and believe they already know enough to manage their hunting satisfactorily without outside involvement.

In fact, user knowledge can be invaluable - for example, in determining the best timing and extent of abundance surveys. Users can also play an important role as participants in scientific research, for example by participating as observers in surveys and by collecting biological samples. In addition, cooperation between scientist and users increases understanding and trust in the outcome of the scientific research and ultimately in the implementation of the management procedure.

An example of cooperation – the bowhead whale case

Stocks of the bowhead whale have long been exploited by aboriginal peoples. However, the advent of commercial whaling from the 19th century greatly reduced their numbers, in some cases to near extinction; between 1848 and 1909 up to 600 animals were caught per year in the North Pacific. After commercial whaling ceased (it became economically unviable), a low level of subsistence catches continued (about 19 animals per year on average) between 1910 and 1969.

After 1970, largely associated with the advent of oil money in northern Alaska and greatly increased numbers of inexperienced crews, numbers of caught animals and animals struck-but-lost increased dramatically (up until then IWC regulations had given an exemption for bowhead whale hunting by native peoples but had not set a limit on numbers). For example in 1977, 29 bowhead whales were landed and 82 were reported struck-but-lost; many of the latter would have died. At the same time, the best abundance estimate available was between 600-2,000 animals – this was based on a visual census of whales as they pass through ice leads near Point Barrow on their spring migration. As a result of this, the IWC Scientific Committee recommended that catches should revert to zero. Whilst this may seem harsh for a subsistence fishery, if the lower abundance estimate was correct and all of the struck-and-lost animals died, the removals in 1977 amounted to some 18.5% of the population; a population that was thought to originally have numbered as many as 18,000 animals (i.e. may have been reduced to less that 5% of its original size). Given the best available scientific advice at the time, there were doubts expressed about the ability of the population to survive, even with no catches at all.

In the face of this recommendation from its Scientific Committee, at its June 1977 Annual Meeting the IWC eventually agreed that the catch limit should be zero. At a Special Meeting held in December 1977, this decision was amended to allow a limited hunt of up to 12 animals landed or 18 struck, coupled with a commitment to increased research. The bowhead whale issue was to remain contentious within the IWC for many years to come.

The decision to establish a zero catch limit understandably caused great concern amongst the Alaskan community, many of whom were unaware that an external international body had control over their hunting of the bowhead whale. As a result they formed the Alaska Eskimo Whaling Commission to determine an appropriate response both to the IWC and the USA government that represented them at the IWC. The AEWC wisely recognised that they would need to act to not only improve the scientific evidence (they believed the census results were very low) but also to improve hunting methods to reduce the evident waste as a result of the large number of struck-and-lost animals.

From a scientific point of view, it is a great advantage that bowhead whales reliably migrate close to land – this makes counting them considerably easier. However, a visual census is very dependent on weather and ice conditions; poor census conditions are not unusual in the high Arctic. In addition, even when visibility is good, the ice leads are sometimes closed and there is also the possibility that whales pass in leads outside the range of the visual observers. The scientists believed that the only reasonable assumption to make was that the whales could not pass when the leads were closed. The hunters however, did not share this view. Eventually, evidence that whales could indeed pass through 'closed' leads was found – hummocks in the ice (see Fig. 2) showed that the bowheads could use their heads to break holes in the ice through which they could breathe.

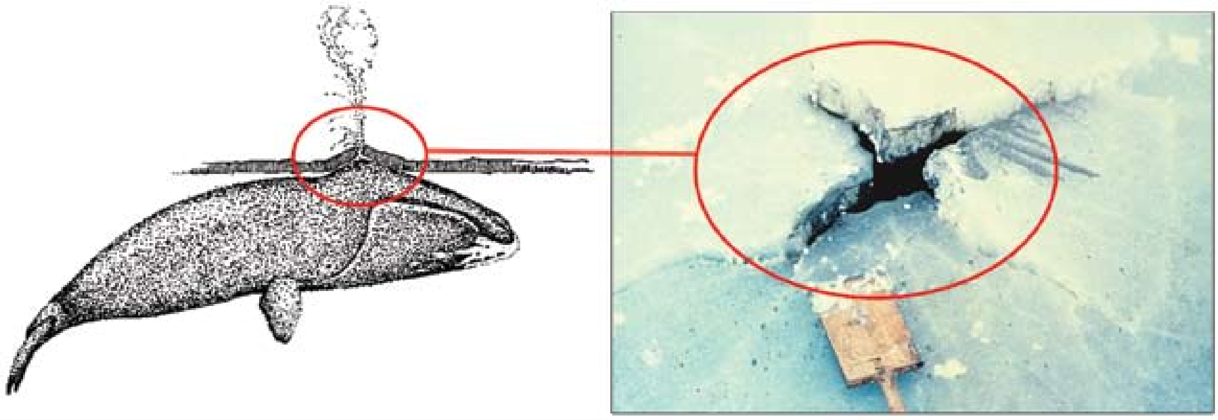


Fig.2. Bowhead whales breaking through 'closed' leads. *Photo: J.C. George*

However, this information (user knowledge) alone was not enough to improve the abundance estimates and thus management advice for the bowhead whale – what was needed was a method to estimate how many bowhead whales passed under the ice out of the sight of the visual census. It is not appropriate to go into details here as to how this was achieved but suffice it say that the development of a combined visual and acoustic census method for bowhead whales represents one of the most innovative and exciting improvements in cetacean science in recent years. This approach has been used successfully since the mid-1980s and has shown that the bowhead whale now (in 2001) numbers around 10,000 animals and has increased at an annual rate of between 2-5% since 1978 even in the presence of catches. Information such as this has proved vital in the development of a successful Strike Limit Algorithm, SLA (see below) for the bowhead whale, adopted in 2002 by the IWC.

This example illustrates the value of co-operation between scientists and users: traditional knowledge was used to develop a hypothesis that was successfully tested and quantified using appropriate scientific methods. The scientific field work was carried out by scientists and hunters together. The AEWC is to be congratulated on the positive role it has taken in the management of the bowhead whale hunt. However, it is important that a note of caution is introduced here – this exciting research programme was extremely expensive and could not have taken place without the local 'oil money' and the support of a wealthy government. It should also be noted that at the start of the programme, there was no guarantee that the research would confirm the hunters' views, at least in terms of the actual abundance of the stock.

Procedures

Strike Limit Algorithms (SLAs)

The SLA is the method used to take the data required (past and present catches, abundance) and calculate a safe strike limit (assuming that all strikes result in death, whether landed or not). Given the different circumstances and available knowledge for the various aboriginal subsistence fisheries and stocks, the IWC Scientific Committee has chosen to develop a separate SLA for each stock. By contrast the RMP for commercial whaling uses a single algorithm for all baleen whales. Whether the candidate SLAs are safe or not has to be extensively tested by computer simulations of populations under many different assumptions to incorporate the inevitable uncertainty in our knowledge. Table 2 provides some idea of the wide range of tests to which potential SLAs are subject before one is chosen.

Table 2.
Some of the tests faced by the candidate SLAs

- Several different population models and associated assumptions
- Different starting population levels
- Different population levels giving maximum productivity levels, ranging from 40% to 80% of initial
- Different productivity rates, ranging from 1% to 7% (including changes over time)
- Various levels of uncertainty and biases in population size
- Changes in carrying capacity (including reduction by half) – reflects environmental changes
- Changes in factors related to survival and reproduction over time
- Errors in historic catch records (including underestimation by 1.5)
- Catastrophes (irregular episodic events when the population is reduced by 20%)
- Past and future survey bias
- Various frequencies of surveys

Design features
In addition to the SLA, there are a number of 'design' features that form part of the overall management procedure that may well be generic to all whale hunts. These are a result of considerable consultation between scientists and hunters. They often relate to hunters' concerns and attempt to make data requirements as straightforward as possible and to account for the environmental conditions in the Arctic. The latter can make hunting and/or obtaining abundance estimates difficult or impossible in some years. Examples of these generic design features within the AWMP context include: the setting of strike limits in blocks of 5 years (with provision for carryover of unused strikes); long survey intervals (at least one abundance estimate every 10 years); and what to do if no abundance estimate is available within the specified time period.

The latter is a particularly difficult issue to deal with: it is not possible to manage safely in the absence of information but it is also a serious step to reduce catches below agreed 'need' levels. It is necessary to be fair to the hunters but recognise that heavily depleted resources will not allow need to be met in the longer term. Given the long survey interval period, it is not expected that a situation will arise in which there has been no abundance estimate for 10 years. However, it is important to be prepared and should ever occur, it is proposed that for the following 5 years (the 'grace period'), the total quota will be halved. The decision as to how many animals to catch in any one year will be left to the hunters – should an abundance estimate become available a new 5 year quota will be calculated – if one does not (i.e. no abundance estimate for 15 years), the limit will be zero until a new estimate is obtained.

Implementation
Throughout the AWMP process, great weight was placed by the Scientific Committee on consultation with both the Commission and hunters. As a result, the author (the Chair of the Standing Working Group on the Development of an AWMP) was available for both formal and informal consultation at each Annual IWC Commission meeting. It was important to keep them informed of progress and seek opinions on those matters which were of as much a practical as a scientific nature. This is extremely important – scientists must recognise that the work they do has a vital impact on peoples' lives as well as the natural resources they are harvesting. It is not acceptable to carry out several years of scientific work and then arrogantly present this as a fait accomplit to managers and users. It is neither respectful nor is it likely to result in a management procedure that will be accepted as fair and equitable.

Choice of an appropriate SLA and associated design features is thus a co-operative matter. The computer simulations of SLAs represent a huge amount of information. This must be initially interpreted by scientists – but that interpretation is based on agreed performance statistics reflecting both conservation (the status of the affected populations) and user needs (e.g. quotas reflecting need, stability of catches, practicality of data requirements). The results and implications of the interpretation must also be carefully explained to users and managers. In an ideal world, all should accept that the final management procedure is fair and agree to implement it fully. This was the case for the first of the SLAs adopted – the Bowhead SLA.

However rigorous one believes the simulation testing has been, 'feedback' monitoring to ensure that the true situation is within the scenarios that have been tested is essential. The AWMP system involves the concept of Implementation Reviews every five years (or unscheduled reviews should important new information arise e.g. evidence of mass mortality). These will at a minimum include incorporation into the SLA of new catch data each 5 years or new abundance data every 10 years, but may also include other biological or hunter information.

Conclusion
The advantages of managing natural resources through a fully tested and specified management system are clear, both from a user and a conservation standpoint (not that these are mutually exclusive). Development of a fair and equitable procedure involves partnership

among users, managers and scientists throughout the process. Such a partnership can only be successful if it is based on mutual trust and respect – and it is a fact that time and effort must be put into this, and the importance of individual personalities cannot be overemphasised here. Although often neglected in the past, users should play an important role in all stages of the process, from determining management objectives, to co-operating in scientific programmes, assisting with design criteria and final choice of the procedure. However, participation in a process carries with it the responsibility to fully implement the procedure, irrespective of the outcome.

Acknowledgements
Firstly, I would like to thank the NAMMCO Secretariat for funding my attendance, and for the professional and friendly way they organised a stimulating and valuable workshop. I would also like to thank all the participants in Reykjavík – as both a scientist and representative of the IWC I felt a little like I was entering the lions' den – your generosity in listening and making positive comments were greatly appreciated. Thanks are also due to all of the hunters and users that I have had the pleasure to work with during the AWMP development process. Their good humour, tolerance and patience at my attempts to explain the work that we were doing, and the many valuable comments and wise advice they gave me, proved invaluable in our attempts to develop a fair and equitable system. Similarly I would like to thank all of my colleagues in the IWC Scientific Committee's AWMP Working Group, too many to mention by name – it has been a pleasure to Chair the meetings and work with such a friendly and dedicated group of scientists. Finally, I would like to pay tribute to one of the members of the AWMP, Kjartan Magnússon, who sadly died in January 2006. Kjartan played a vital role in developing Catch Limit Algorithms for both bowhead and gray whales. His wisdom, warmth, fairness and friendship is greatly missed.

Bibliography

The Journal of Cetacean Research and Management (to subscribe see http://www.iwcoffice.org), 1999-present. See the Reports of the IWC Scientific Committee, particularly the Reports of the Standing Working Group on the Development of an AWMP, published each year as a supplement to the Journal as well as a large number of relevant authored papers in the regular issues of the Journal.

Burns, J.J., Montague, J.J., Cleveland, C.J. (eds). 1993. The Bowhead Whale. Special Publication No.2 of the Society for Marine Mammalogy, Allen Press, Kansas. 787pp.

Donovan, G.P. (ed). 1982. Aboriginal/Subsistence Whaling (with special reference to the Alaska and Greenland Fisheries). Reports of the International Whaling Commission (special issue 4). IWC, Cambridge UK, 86pp

Utilisation of user knowledge in connection with development and implementation of hunting gear

Egil Ole Øen

Scientists are often used as advisers by administrators in their decision-making on management matters. From time to time it is therefore useful for the scientist to ask himself if his (or her) conclusions will have consequences for the users and a spreading effect to the local and sometimes the larger societies. This should not restrict the scientist from giving the best advice or recommendations based on scientific knowledge, but simply to keep in mind the necessity for some professional modesty against making too powerful and absolute conclusions. Absolutism has been a distinctive feature of some scientists, as well as of some users, in connection with management topics that are controversial and disputed, like the management of marine mammals.

In matters that are disputed the scientist will often be given the credit of being the most credible and objective spokesperson and the conclusions given by scientists will usually have the greatest impact on management decisions. This is based on the belief that the scientist at the outset should be free, independent and objective with no economic interests in the outcome. The scientist has often the advantage of looking at the problem in perspective and from the outside. The users on the other side may act from motives of self-interest and in particular in connection with management of marine mammals, they have often been assigned the villain's part. Whether these two characters are valid in real life will not be further discussed this time, but from the many years I have been working with issues pertaining to hunting and utilisation of marine mammals, I have experienced "villains" from quite different and sometimes quite unexpected quarters. However, as the scientist is given this unique position in many societies, rightly or wrongly, it is incumbent upon the scientist to give objective and balanced conclusions.

But how can you be balanced without having factual knowledge from the field about which you are trusted to give advice and recommendations?

The scientist will usually, although not always, acquire knowledge through theoretical studies and experience from different types of research. The knowledge is obtained step by step. This knowledge will often be quite specific, a kind of expert knowledge, but in many professions this kind of knowledge can often be used in other fields in which the scientist is not necessarily an expert but where such comparative knowledge can be fruitfully utilised.

The users' knowledge does usually not originate from written sources. This knowledge will often be anecdotal and passed orally from person to person ("father to son"), acquired from practice and from lifelong learning. The user is "the eye that watches" and "the hand doing". The users' knowledge is characterized by a wealth of details, details that the scientist often lacks. This does not necessarily mean that the user interprets all his observations correctly and always behaves correctly in every situation. However, the detailed knowledge might often be very valuable when conclusions are to be drawn and the research-results are to be implemented.

In the following section I will attempt to give some examples and advice on how to establish good and valuable relationships and collaboration between user and scientist. I will discuss how to synthesise their specific knowledge in a fruitful way without compromising the integrity of either party, and where also the user may influence, not the results itself, but the conclusions that can be drawn from the results of the research. As we are in the forum of NAMMCO, it is natural to start with examples from my experiences with work in and outside of NAMMCO member countries, where I have developed new and improved hunting gear and technology for marine mammal hunting to improve animal welfare in hunting and reduce the risks for persons involved.

A bowhead whale being hauled onto the ice for butchering. *Photo: Henry P. Huntington*

User vs. scientist – collaborative work

The initiative to establish a collaborative forum in research projects usually comes from the scientist. However, the initiative should come early in the study and well in advance of any concluding phases or possible implementation of the results. As a rule it should be established in cooperation or understanding with the users organisations in the form of a contact forum of appointed persons or a reference group. However, such a formal group should not prevent the free flow of information, or bilateral or more informal contacts between individuals or groups of users. Good results depend on the parties' willingness to share their knowledge in a free, honest and respectful manner. If this is not the case, the scientist should immediately dissolve further cooperation with the group or person. However, it is important to keep in mind that the scientist and the users sometimes might have quite different understandings of the objectives for the study and expectations of the results. And the users, like others, may be influenced by their own expectations, selfishness or "user conservatism".

In some projects the fund raising or assignment body wants to have a steering function, a strong hand on the wheel, where they control every step and establish a steering group or steering committee. However, such groups or committees will often be counter-productive during the innovative phase of a project and should be avoided. An advisory group will often function better. However, at some stages in a project the advisory group might be transformed into a committee that is given more power and responsibility. In particular this can be useful in the concluding or implementing phase of a project and in some cases for logistical reasons. One example can illustrate this point: The Alaska Eskimo Whaling Commission (AEWC) assigned me to develop new weapons and technology for the Alaskan Eskimo's subsistence hunt of bowhead whales. I live in Norway, a fair distance from the Alaskan hunting grounds, which caused some logistical difficulties. After I had finished most of the development work, except for some further field tests, minor modifications, implementation and training of hunters and other personnel, a steering committee (Weapons Improvement Committee, WIP) was established. The WIP included users, scientists and administrative personnel from Alaska to locally administer and also conduct field operations and collect sample data. This Committee has been very successful and of considerable assistance in implementing the new gear and technology.

A common situation that the scientist often places himself in, or is offered, is the teacher role, which can be very tempting for the scientist to take on. Sometimes this role might be useful, but usually it will be better to create a forum for dialogue to avoid users taking the passive role where they do not need to identify themselves with, or take any responsibility for, the outcome of the discussion. However, such a dialogue forum can easily become a double-edged sword if the scientist cannot cope professionally with the different views and ideas that will be raised during the discussion.

All scientists will sooner or later come into situations where the interpretations of the results and the strategy for the further work may be unclear. When a good dialogue between scientist and users is established, it is sometimes useful to "send the ball" over to the users and ask for their explanation or interpretation of certain phenomena, based on their practical knowledge.

To keep a good dialogue going bilateral respect and confidence is needed. This can sometimes be very hard to achieve. In some societies respect and confidence to a foreigner, and/or a scientist, is not given automatically, but has to be earned. Academic merits or degrees mean nothing if you do not speak "the language". The way to get people interested, to get access to users' knowledge and to gain trust is to be honest, open minded and well prepared both theoretically and practically. When the outcome of a study may influence people's everyday life and livelihood, the scientist must at least have a minimum of knowledge and understanding of people's way of life and practice. If not, people certainly will lose respect for the scientist and science and the scientist might come under pressure. Many good ideas have been wasted and valuable information has been lost for science because academic bulls have run around with academic overconfidence in rural china shops.

Summary and conclusions

To establish fruitful and result-based collaboration between scientists and users, some basic principles must be followed.

Common to both parties

- There must be bilateral respect for each other's professions, professional platforms and knowledge
- They must free themselves from professional and cultural tunnel-vision
- They must have confidence in the motives of the collaboration

The scientist should

- Obtain sound and solid knowledge in the field through
  - Studies and dialogues (talks, workshops etc.) with users and other scientists
  - Taking part in field work

- Listen to comments and users' reactions and be open for information from users
- Be honest about his/her possible lack of experience and detailed knowledge
- Not immediately mistrust or reject information which sounds amazing and which is in opposition to their own opinions, but keep them in mind for later assessment as more knowledge is gained from the research
- Accept that users may come to other conclusions than they do
- Establish several sources for collection of information from users

Inuit Qaujimajatuqangit and scientific knowledge in decision-making

Olayuk Akesuk

Our knowledge and understanding of our land and resources can only benefit by studying it using both "user knowledge" and western science.

Inuit Qaujimajatuqangit (Inuit traditional knowledge), our name for user knowledge, and western science are both accumulated knowledge that have evolved with new information becoming available to the user over the years, decades and centuries. The most obvious difference between the two knowledge bodies is in the methods used in interpreting factors. While one is based on oral tradition and practical experience, the other is scientifically documented using empirical data.

Inuit Qaujimajatuqangit or IQ deals with Inuit knowledge reflecting the past, present and future. Inuit have always used knowledge gained from the past as a baseline to measure present circumstances and how they will affect future generations. Each generation fine-tunes the accumulated knowledge gained from the previous generation to make it relevant for the present. Therefore, IQ is evolving all the time.

Inuit knowledge has made it possible for Inuit to survive in the Arctic climate and co-exist with its wildlife for thousands of years. To this day we still eat and use most of the animals we harvest. We consider ourselves responsible when it comes to managing our wildlife in Nunavut as we rely on these animals for our survival.

Conflicts are often experienced between wildlife management and wildlife research on the one hand and Nunavut harvesters on the other. These conflicts are due to differences between the Inuit and scientists with a western perspective. As western science became more prevalent in Nunavut, traditional knowledge tended to become discounted and invalidated by those making wildlife management decisions. There is lack of trust and lack of understanding between the two groups, which makes it extremely difficult for both sides to work together in harmony for the good of wildlife. Both sides tend to question the validity of information provided by the other; a hunter will say "it is not possible for anyone (based on scientific knowledge) to know how many animals are out there, mere estimation is not enough" and a scientist will say " you may think you are finding more animals now than before but you cannot prove it". Animosity exists between IQ and western science due to a lack of understanding of each other. IQ needs to learn more about western science and western science needs to learn more about IQ in order for both sides to work in harmony towards a common goal.

An Inuit organisation, named Inuit Tapirisat of Canada, was established in the early 1970s to re-establish Inuit input into decisions made affecting the lives of Inuit. 1983 saw the establishment of another Inuit organisation called Tunngavik Federation of Nunavut to start the official negotiations between Inuit interests and the Canadian Federal Government. The Nunavut Land Claims Agreement was signed between the Federal Government and Inuit of Nunavut in the summer of 1993. The Agreement recognises the inherent role the Inuit, who comprise 85% of the population of Nunavut, have in controlling their own affairs.

Under the Nunavut Land Claims Agreement, the Nunavut Wildlife Management Board (NWMB) was created to be the main instrument in making wildlife management decisions from a Nunavummiut (people of Nunavut) perspective. Wildlife Co-management exists in Nunavut and includes, besides the NWMB, the Regulatory Agencies, Regional Wildlife Organisations and Hunter' and Trappers' Organisations. The Inuit of Nunavut thus have a voice through these organisations.

On April 1, 1999 the new territory of Nunavut became a reality. The newly formed government mandated itself to use Inuktitut, the Inuit language, as the working language by the year 2020 and to respectfully use IQ in the way the government functions. The Department of Sustainable Development, my department, has created a working group to find ways to implement IQ effectively into everything that the department does.

Inuit hunter. *Photo: Glenn Williams*

When the assimilation of western culture into Inuit culture was strong, IQ was absent from the decision-making process that affected the Inuit. In the 1950s, the harvest of polar bear cubs was prohibited, without consulting with the Inuit themselves. In the 1970s the government of the Northwest Territories introduced a polar bear quota system and closed seasons without Inuit having a say in the matter. Because of the restrictions imposed on Inuit, the majority of those who are 50 years or younger are no longer able to distinguish between male and female polar bears without first killing them.

Today, the management of our polar bear populations is a good example of how Nunavut is working to marry IQ with scientific research. We are facing strongly held opposing viewpoints where scientists believe that in certain areas polar bear numbers are declining dangerously, while Inuit have concluded that polar bear populations have increased significantly in the last few years.

If good science is to play a vital role in establishing good polar bear management, the use of IQ will have to be increased. While the Inuit of Nunavut are requesting an increase in polar bear quotas, this request is often denied based on empirical and quantifiable data. The challenge will be to reconcile this empirical knowledge with the experience and knowledge of Inuit elders.

With that in mind, our scientists are working with our communities to develop sustainable quotas for our hunters. Sustainable quotas are a necessity; the problem that remains is how to set sustainable quotas that accurately reflect IQ.

If western science is going to be helped by Inuit observation, it must provide numbers upon which to base its argument. Good science provides data that can be used for the benefit of all. IQ provides guidance and experience in how to interpret and implement scientific data, and the methods by which the data can be collected. For the first time the government of Nunavut has undertaken scientific research as well as an IQ study in one of the areas in Nunavut where polar bears are declining. Both of these studies basically say the same thing, therefore supporting each other. The main difference is that the IQ study has looked at possible reasons for why there are fewer bears, while the scientific study is based primarily on how many bears are left in the area. I truly believe that by engaging both types of studies/research we become richer in our understanding and knowledge of our land and our natural resources. One type of study does not preclude the other, but adds to it.

With the development of a new Wildlife Act, the government of Nunavut has been working to ensure that IQ is fully recognised and incorporated into the new Act and in all other new legislation.. The IQ personnel in my department and from Nunavut Tunngavik Inc. have worked closely with the legislative drafter to develop legislative provisions that give legal substance to the concept of IQ. A great deal of time and effort went into this section of the draft.

Although the western scientific community is a culture unto itself with its own language, Inuit are also a culture unto themselves with their own language. IQ presents the opportunity for the two languages to speak to each other in a meaningful manner. I believe that the application of good science coupled with IQ will result in a stronger, more effective management regime that will benefit both wildlife and people of Nunavut.

The walrus is hauled up onto the ice.
Photo: Glenn Williams

Scientific use of user's knowledge in Faroese pilot whaling

Pilot whaling has existed in the Faroe Islands for as long as they have been inhabited; as shown from excavations of houses from the Viking Age. Pilot whale skulls and ribs have been recovered, both items being of value. "Tran" oil is produced from the skull, and the ribs are used for human consumption, and are today still wind-dried and boiled for eating. This means that when the Vikings sailed north from the Scottish Isles and west from Norway to end their days as Faroe Islanders, they brought a knowledge with them that was much like the ancient Norwegian tradition of catching minke whales by stranding them in bays.

The knowledge the Vikings carried with them however had to be adjusted and developed by trial and error experience with the new and different circumstances in the Faroe Islands. From the outset, the laws, rules and executive orders concerning pilot whaling were from the old Norwegian laws, the "Elder Gulatings Law"which was adapted to the new Faroese conditions by the "Sheep Letter", the first special Faroese Executive Order, dated from 1298. Parts of this order are still working in today's rules.

The first written Faroese Pilot Whaling Executive Order appeared in 1832 and it described all the aspects of pilot whaling, from the moment when a pod was observed up until the individual share of the catches had been brought to the houses. It included who had the leadership in the different phases of the hunt, where to land the pod, and how to distribute the share, in an attempt to have all parts of the archipelago get as fair a share as possible. All details in the regulation were based on the knowledge the participants had experienced throughout the centuries. This Pilot Whaling Executive Order has since been updated and revised several times, according to ongoing changes in the country. Today it still builds on the knowledge from the participants - the users - in the pilot whaling.

An international scientific study on pilot whales was running between 1986-1988. This study also included an analysis of how the users' knowledge fitted both the biology of the whales as well as the topographical

A pilot whale drive and measuring the whales.
Photo: Dorete Bloch

circumstances involved. The research team consisted of Faroese and international biologists, and was coordinated by Faroese scientists. The international pilot whale study coincided with a period of large resistance from NGO's abroad against the Faroese pilot whaling.

The Faroese scientists have always been welcomed by the Faroese people who participate in the pilot whaling. During the study and afterwards, it was always possible for both them and the international researchers to receive local help: for instance, by lifting parts of the carcase while samples were taken inside the large and heavy animals; and by helping to carry the heavy samples back to the car; and not least, by a constant hospitality.

In the following some items from the Faroese Executive Order for pilot whaling which are founded on users' knowledge are mentioned.

One of these is the special executive order concerning the authorization of whaling bays. All usable whaling bays were mentioned in the first executive order from 1832. It is only the users' knowledge and experience that has shown which bays were usable and which were not. Some of the bays looked very usable when looking at them from land, but experience has shown that they are not usable due to the topographical conditions under the surface. This is knowledge that modern equipment has revealed to us, but for centuries the users knew why one bay was better than another for beaching the whales.

There are 23 whaling bays authorized today and the list of whaling bays is continually updated when harbours or quays are changed. The large harbours of Tórshavn, Klaksvík and Vestmanna have been closed for whaling for months while the whaling bays have been repaired and renovated, thus illustrating the significance of pilot whaling today in the community.

Cheap and effective equipment has been used through centuries when driving the whales: loose stones, or better yet, stones fastened in rope lines. The stones are continually thrown in the sea from boats placed in a half circle behind the whale pod. It was in the second half of the last century that it was first realised that the stones make a wall of air bubbles behind the swimming whales. This wall reflects their sonar and tells them that they can not pass the air wall and in this way they are driven to the beach.

The killing of the whales has always proceeded by effecting the cutting of the neck and spinal cord, resulting in a quick death. About ten years ago, it was found that the supplying arteries and returning veins to and from the brain in marine mammals are placed around and close to the spinal cord, the opposite situation from terrestrial mammals. This means that the old traditional Faroese way to kill a whale is the quickest and therefore the only acceptable method when you are killing a marine animal "by hand". In the last few years, the method has been timed by stop watches to examine how quick it is.

Another element in the Faroese pilot whaling where users' knowledge has played a key role is the special measuring rod. During the evaluation of the killed pilot whales, the edible part of the whale is measured by a wooden rod measuring 3-4 m in length. This rod is logarithmically divided in such a way that the length of the consumable parts is converted to the equivalent whale's weight. This special rod was incorporated in the executive order concerning pilot whaling from 1832. It was developed by a farmer with help from a priest, in response to dissatisfaction from the people who got their share of the pilot whaling. Today 40 rods exist, and are placed at the different whaling bays in the Faroe Islands. All were made in accordance and comply with the original, still existing one. All 40 rods have been measured and compared with the lengths and weights of pilot whales of both sexes and all reproductive stages. It is clear that the farmer and the priest were sharp mathematicians, but they also had a large amount of data at their disposal since nearly two-thirds of all landed pilot whales before 1832 belonged to the church as tithe and to the farmers as the landowner's share. Both men were also living in the village with the most often used whaling bay.

During the pilot whale study, the men participating in the pilot whaling provided several pieces of local information. Some of these have been tested scientifically. One of them was special "pilot whaling weather" around the time of a catch. The wind direction, wind speed and the barometer reading were examined for 110 pilot whale drives, running from 24 hours before to 24 hours after the message of the first observation of a pod. A correlation was found, although not that strong; perhaps because the weather conditions in the Faroe Islands are mostly very unstable.

The pilot whaling men also mentioned that the individual whales composing a pod in the northern part of the Faroes are often bigger than in the southernmost part. This has also been examined and it is a fact, although the reason is still not clear.

The dialogue between scientists and resource users: is it necessary for success?
Jóhann Sigurjónsson

Introduction

It is widely accepted today that although one may argue that we have up to now been far from successful in our attempts to manage our stocks based on science, science-based management of fisheries and other resources is the only choice available. While the reasons for failures are beyond the scope of this paper, one needs to keep in mind that too often the scientific advice has been ignored or modified by the managers to the extent that one may even question whether such management was based on science. Further, while a science-based management system requires a well founded scientific basis, it also requires a proper management framework, including enforcement and control, and not the least an active dialogue between the scientists, the users, and of course the management authority. Such communication is required to ensure that all available information is taken into account, which in turn requires different "cultures" to meet and build confidence in each other.

Thus, an active dialogue between scientists and users is definitely necessary in modern management of the resource. This paper gives a few examples of the importance of dialogue between resource scientists and the users of the resource with specific reference to whaling and fishing in Iceland.

The fisheries science and the fisherman's science

The world of the scientist and the world of the fisherman are different. However, we are not dealing with two conflicting elements, but rather complementary ones. The question as seen from a management perspective is how useful the fishermen's knowledge is in terms of objectively judging the status of the situation. Scientists formulate hypotheses, collect data, analyse and interpret the data and draw conclusions. The users draw conclusions of the present based on past experiences, traditional knowledge, the society of which they are members, and personal experiences.

Each type of knowledge has its problems or limitations. Scientists often lack real time observations, may use inappropriate parameters or methods, their scope of the study may be too limited and more research effort is often needed to draw firm conclusions. The users' observations often lack the broader overview, may be biased by personal interests and experiences, and tend to be characterised by short-term memory and in quantitative terms, an inaccurate documentation of the past. Thus while the hunter's experience and knowledge is a valuable source of information regarding the nature of the resource and certain aspects of it, it is important to stress that it does not constitute an alternative to quantitative, scientific studies. Such knowledge, however, may be extremely important in understanding the crucial questions to be addressed, formulating the hypothesis of a study and for interpreting the results of such studies.

Design of scientific studies with the help of user knowledge

To be a well educated and competent fisheries scientist one must explore in depth the wealth of information that individual fishermen possess. During my university study on age and reproduction in minke whales in Iceland, I conducted a detailed questionnaire survey among minke whalers that formed the basis of my understanding of the minke whale and helped me formulate hypotheses and interpret data (Sigurjónsson 1981, 1982). Here factors like history of catch operation (development of boat types, catch areas), the type of operation (gear, processing, marketing), factors affecting the fishery (weather, prey abundance, product demand, prices), minke whale biology and behaviour (seasonality in distribution, abundance and feeding) and time trends in abundance and other factors, were explored. Another example is a study where user knowledge was used to understand the relationship between catch per unit effort and the stock size of fin whales in the seas around Iceland, which became of fundamental importance for the management of the stock. In addition to getting the users' information via interviews, detailed log-books, and station records, the whalers provided guidance in the interpretation of the results and helped modelling and understanding the nature of the operation under study (Sigurjónsson 1988).

The fishermen's knowledge is therefore essential in developing many scientific resource studies but is of

Flensing a minke whale.
Photo: Jóhann Sigurjónsson

course not a substitute. The knowledge needs to be incorporated into the scientific process through an *a priori* exploration of traditional knowledge, through interviews/questionnaires, and not the least, where possible, to the scientists' participation in the fishing/hunting operation itself.

Communication of information and confidence building
Another very important and significant tool or element in the use of fishermen's knowledge in science is communication. Regular and frequent communication between scientists and fishermen is of vital importance because the resources and the operations are under constant change. This can take place by frequent meeting activities at all levels and on a variety of occasions all year round. And here mass media and dissemination of information through the use of internet can play an important role if specifically addressed.

The establishment of designated task forces of experts (fishermen and scientists) to deal with specific issues have also proven to be very useful. The members of a task force communicate with each other about the resource situation and recent developments, and plan and coordinate data collection and cooperation. Such task forces have been established in Iceland around all of the most important fisheries, such as the cod fishery, the red fish, saithe, flatfish, and Greenland halibut operations and the offshore shrimp fishery. A very active task force works on the capelin fishery, which requires almost day to day communication during part of the year since the fishery and stock assessment underpinning the decision taken on TAC are extremely critical in time (the fishery takes place at the end of spawning migration). The task forces contribute to confidence building between the two parties, and are important in developing a common understanding of the research objectives and management principles, a common interpretation of the results, and the development of a common terminology.

The direct involvement of the users in specific investigations or scientific projects can both provide value to the study in question and contribute to confidence building between the parties. One very successful project of this kind is the Icelandic bottom trawl survey, which involves several commercial trawlers that have during the last twenty years operated a standard sampling programme to monitor the demersal fish stocks around Iceland (Pálsson 1985). This study was instigated during a debate about the status of the cod stock and was planned by captains that selected one half of the standard trawling stations while the scientists determined one half of the stations based on a random sampling scheme. The annual standard survey, now conducted over a period of twenty years, has given rise to both increased confidence in the scientific results and has proved to be the single most important scientific element in the stock assessment of all principal demersal fish stocks off Iceland. Another example is the wide use of trained whalers in whale sightings surveys, which has proved essential for the successful conduct of the investigations themselves in many ocean areas such as off Iceland due to their great observational skill, but also for the sake of confidence building between the resource users and the scientists.

Finally, another example of the users' involvement is the development of a harvest control law for the cod fishery off Iceland, where scientists and representatives for the fishing industry took part and recommended a sustainable harvest strategy that was adopted and implemented by the authorities.

Incorporating fishermen's knowledge into the scientific process - Concluding remarks
An active dialogue between fishermen and scientists is essential for science, management and fishermen's success. A priori exploration of the users' knowledge and experience is a necessary first step in all resource studies; it can most often help in designing studies and in interpreting results, although it may usually not substitute for a well founded scientific investigation. An active dialogue/communication at all levels between scientists and fishermen is also very important to generate common understanding of objectives and principles (*e.g.* in developing harvest strategies), common interpretation of results, and development of common terminology, where scientists need to speak a clear and concise language. Direct involvement of fishermen and vessel owners in collecting data and in conducting routine research is well suited to build confidence between parties, which is essential for the implementation of a long-term sustainable/science-based harvest strategy.

References

Pálsson, Ó. K., Jónsson, E., Schopka, S. A., Steinarsson, B. Æ., Þorsteinsson, G.1985. Icelandic groundfish survey, 1985. NAFO SCR Doc. 85/79.

Sigurjónsson, J. 1981. Aldersstudier over vågehval (Balaenoptera acutorostrata Lacépède) i islandske farvann. (Age studies of minke whales in Icelandic waters). Cand real. Thesis, University of Oslo, 97pp.

Sigurjónsson, J. 1982. Icelandic minke whaling 1914-1980. Rep.int.Whal.Commn, 32: 287-295.

Sigurjónsson, J. 1988. Operational factors of the Icelandic large whale fishery.
Rep.int.Whal.Commn, 38: 327-333.

The role of scientific knowledge among hunters in Greenland
Kalle Mølgaard

Before Greenland Home Rule was introduced there was more collaboration between the hunters and the scientists. The biologists worked closely together with the hunters on different surveys of different species. Old hunters tell about times when biologists arrived and immediately headed up to the homes of the hunters and consulted with them about information on different species.

This is no longer the case. Biologists come from industrialised societies and are educated in thinking about and managing nature very differently from what the Greenlandic people are familiar with. In the eyes of the animal rights movement and others our Arctic home have become a marginal society, a place that has not yet been reached by pollution, a place not yet ruined by greed. These people are of the opinion that the Arctic environment including the fauna should be preserved and protected.

It is these people who have become the consultants that the government is listening to. Therefore it is to be admitted that, because of the different backgrounds and because of the lack of coordination between these two types of knowledge, differences of opinion often take place.

There are no existing mechanisms for the government and the biologists to gather and utilise the experience that has been accumulated by hunters in the different regions and through their different ways of life. It is widely accepted that this Nature in which we live, is very diverse. Should the knowledge of the hunters be gathered, it is going to be an undertaking bound to last for many years.

The endeavours of making surveys on the living conditions as well as the knowledge of the hunters are widely supported by the hunters themselves. But from the outset it is evident that it will be a very limited undertaking due to lack of funds to conduct such an undertaking.

We are aware of the effort to overcome this conflict by establishing a database that will combine the knowledge of hunters and the biologists. However the hunters are of the opinion that things are not likely to change for the better before the central administration changes its way of conducting its affairs.

It is based on this experience that little progress has been made for biologists and hunters to utilise their knowledge in Greenland.

On behalf of KNAPK
Svend Heilmann, Chairman of the Hunters Council, KNAPK
Jens Danielsen, Member of the Hunters Council, KNAPK
Kalle Mølgaard, Member of the Committee, KNAPK
Leif Fontaine, Chairman of KNAPK.

Photo: Grete K. Hovelsrud

CHAPTER 5 Management decision-making process

Different ways of knowing in fisheries: problems and possibilities

Kjellrun Hiis Hauge,

Introduction

"Scientists get it wrong" and "Feel robbed by the scientists" (author's translation) are two recent headings from the fisheries press where fisheries management and scientific knowledge is disputed. In the first story an Icelandic fisherman is opposing a scientific theory that fisheries management is based on (Fishing News International, 2003a). He suggests an alternative principle. The second story reflects some fishermen's rage over "lost" quotas (Fiskeribladet, 2003). The fisheries scientists' recalculations of the northeast Arctic cod had suggested what the fishers already had claimed at least a year before that the stock was in a healthier state than the scientists thought. With this knowledge a year earlier, the fishermen would probably have got higher quotas for 2003. Now they were angry with the scientists.

Headings like these are not at all uncommon and are examples of uncertain knowledge together with knowledge, interest and power conflicts between scientists and users. In this paper I discuss four aspects that reinforce disagreement between fisheries scientists and fishermen or other users. These aspects are (i) uncertain knowledge, (ii) different ways of knowing, (iii) different stakes in the fisheries and (iv) different language. Then I will suggest some ways that may help in reducing disagreements. As I have not been working with user knowledge, my focus in this paper will be on scientific knowledge.

Uncertain knowledge

How many fish are there in the ocean? How much of it can we take now and still ensure big catches next year and the years after? Obviously it is not straightforward to find precise answers. The ocean is huge, we can see the fish only through technical equipment, the fish move and their abundance can vary substantially depending on environmental conditions as well as fishing. The knowledge associated with the introductory questions is encumbered with uncertainty.

Through conventional use of the precautionary approach, a number of fish stocks are regulated with caution. To put it simply, the idea is to take the uncertainty into account by fishing less the more uncertainty there is associated with the scientific knowledge. This means that the decision-makers wish to be risk-averse when it comes to depleting a stock. This is operated by defined reference points on fishing pressure and spawning stock biomass. These so-called precautionary reference points take uncertainty into account by setting the limit on fishing pressure extra low and the limit for what should be left of the spawning stock biomass extra high.

The precautionary approach thus requires a focus on the uncertainty. This certainly breaks with the traditional understanding about what science is. The aim of science has been to produce knowledge and to reduce uncertainty rather than to focus on uncertainty. Uncertainty in science has been associated with low quality. However, the questions science tries to answer have changed from limited and well defined problems to save-the-world kind of problems. To measure the impact of human behaviour on natural resources may be almost impossible so that potential answers are necessarily uncertain. It may seem that science is not prepared to communicate uncertainty and the society is not ready for handling uncertain science. Instead of discussing how management should respond to the uncertainty, uncertainty is basically handled as something to be reduced.

"Is this science?" is a front-page story from Fishing News International (2003b). The Scottish fishermen's leader asks: "Can any discipline which tolerates a margin of error +/- 40% really be called science?" and calls for improved scientific advice. "The symbol of distrust" is a critical comment from another newspaper (Fiskaren 2003), this time on the scientific advice on blue whiting. The scientists had first advised to stop the fisheries on blue whiting. Two years later they had altered their opinion on the state of the stock and recommended a considerable quota. In the meantime there had been an enormous fishing pressure on this stock. The journalist denotes it a scandal and is concerned about the science's credibility and what will happen if a stock really is in danger and no one will listen. He blames the Norwegian authorities for not funding the science necessary in order to gain more knowledge and increase competence.

These two examples illustrate two general perceptions about science. One is that good quality science is not encumbered with uncertainty, that uncertainty cannot be accepted. The other is the optimistic view of science and the reduction of uncertainty.

Of course some of the uncertainty may be possible to reduce, either by improved knowledge, improved technology or improved mathematical models. However, a considerable part may well be irreducible. In my opinion, the examples above also suggest that science has not yet found a proper way to communicate uncertainty. We have failed to make it clear that an uncertainty of 40% is expected.

Not only is uncertainty in science difficult to accept it is also difficult to handle. Although the precautionary approach is supposed to take the uncertainty into account, it does not say how. How careful is careful enough? This is not only a matter of science but of ethics and politics as well. Which parties in a specific policy issue should take what kinds of risks? Which parties should benefit from the uncertainty? I will return to examples of how uncertainty is communicated in the next section. For now I will conclude that for policy issues where there are diverging interests, a proper communication of the uncertainty in both scientific knowledge and user knowledge is of crucial importance.

Scientific knowledge production

The purpose of knowing is not the same for a fisherman and a fisheries scientist, neither are the quality criteria of the knowledge. A fisherman aims at finding a decent catch in an efficient way. In order to decide where, when and how to fish, he needs local knowledge on where and when the fish migrate. Knowledge of local changes on a relatively small time scale is essential. Practical skills are crucial. A scientist on the other hand aims at getting the overall picture in time and space. This may imply that local differences fishermen need to know are regarded as irrelevant. While fishermen link success and quality to personal performance on the fishing ground, scientists associate quality with specific scientific criteria.

A major characteristic in science has been the aim of producing neutral knowledge; not influenced by political, religious or personal interests. The possibility of reproducing results has been a key criterion to achieve such knowledge, to make it possible for a scientist to test results and conclusions from any part of the world. In order to do so standards for making science have been developed where quantification of knowledge has been regarded as necessary and thus attained a higher status than qualitative knowledge. Physics with its precise knowledge, problem solving ability and predictive power has long been admired. The last century the global society has had faith in science as being the problem solver of global crises like famine, poverty, health problems and the global energy supply.

The perception of science as a neutral problem solver where results can be checked has certainly been important for its status in policy issues. Since fishermen represent an interest group in the fisheries, and since their knowledge is local and may be difficult to quantify and test, the status of this knowledge has not been comparable to science in a management context. However their influence on the management of some fisheries may be significant. I will now focus on the difference between traditional science and fisheries science and point to some problems where science and policy meet.

The science of physics is developed in laboratories where factors like temperature, pressure and friction are controlled. The resulting knowledge is thus valid in the limited case of ideal conditions. In nature you cannot control the environment like in a laboratory. The temperature is not constant, the fish will move and the degree of randomness is high. What traditionally is understood as high quality scientific methods thus becomes unsatisfactory in solving many of the societal problems. You cannot get exact answers to questions associated with the exploitation of renewable resources, environmental problems etc.

Nature is complex, so that a mathematical description of the nature requires idealisations and simplifications. Assumptions need to be made. Some assumptions are valid and some make no difference while others are violated and may not be testable. In scientific advice for fisheries management there are assumptions about survey coverage, natural mortality, stock definitions etc. It is not that making assumption is bad. After all, the decision-makers need to know something about the status of a certain fish stock and the scientists do their best. The problem arises when the society expects exact knowledge where this is not possible or when the scientists fail to communicate the uncertainty associated with the advice. As discussed earlier, the uncertainty aspects are equally important to the knowledge itself in management decisions. One useful uncertainty aspect is the rigidity of the advice, whether the results or the scientific advice will change if the underlying assumptions were altered. In the next few sections I will illustrate some problems using examples from fisheries science.

Normally, a mathematical or statistical model takes all available data sources into account. In cases with several data sources, it is common to use all of them in the mathematical or statistical model. This implies a way of averaging the information from the different sources. In the case of the northern cod stock the consequence was drastic. Before the collapse of the stock the scientific surveys showed a continuing declining trend in stock abundance while the CPUE (catch per unit effort) from the industrial fishing fleet gave a much more optimistic impression. Averaging these and other sources of information gave estimates and predictions of the stocks that encouraged the maintenance of high fishing activity (Finlayson, 1994). In the beginning of the 90's the stock was depleted. Ten years of fishing bans has seemed to be of little help in restoring the stock.

ICES (the International Council for the Exploration of the Sea) gives scientific advice annually on northeast Arctic cod, among several other stocks. Over the last few years ICES has expressed a clear concern in its reports about misreporting of catches and discards (ICES 2001, ICES 2002, ICES 2003). However, in the back-calculations of stock numbers and in the calculated forecasts, there are no numbers for under-reporting included, in spite of a belief that that this has been an extensive problem. This means that an underlying assumption in the calculations is that there are no discards or misreporting in this fishery. The scientists simply do not have numbers for these activities and guessing is considered to be unscientific. The advice for 2004 is to keep the catches below 398 000 tons (ICES 2003). If we had information on under-reporting, it would probably affect the advice. Following traditions in science it is preferable not to state irregularities if they are not proven. This is an example where traditional thinking makes advice less relevant. Another consequence is that it indirectly communicates that under-reporting is not considered a problem. The advice is precise in any case.

The studies on errors in quantified advice on northeast Arctic cod by Nakken (1998) and Sparholt (2001) suggest an historic error of around 50%. This implies no significant digits, which clearly shows that the precision level in presented stock numbers and predictions gives a false impression of the actual precision in the knowledge. A quick glance at other stocks where ICES gives advice confirms that exaggerated precision level in advice is quite normal. One should expect the contradiction between the precision level and the precautionary reference points to be rather confusing or misleading for many users.

Language

Not only have fishermen and fisheries scientists different ways of knowing, but different ways of expressing this knowledge. Language is an important tool for a scientist since the ability of presenting arguments in a clear, convincing and understandable way to the rest of the scientific society is crucial for achieving a scientific career. A fisherman is more dependent on fishing skill than on expressing his knowledge with words. While a fisherman probably will speak about personal experience or matters that are closely linked to his personal situation, a scientist will choose words and expressions that distance himself personally from the topic. While a fisherman may express anger, complaining about his personal situation, feelings are irrelevant for a scientist, who prefers facts and numbers. Scientists aim at achieving quantified knowledge. Numbers appear neutral and make it is easier for the managers to make decisions. Sometimes when fishermen complain about decisions they attack science, which illustrates the role and power of science in decision making.

Different ways of expressing opinions may eventually cause misunderstanding. Perhaps the most important reason is that within each group or community there exists a mutual understanding that is not necessarily shared with other groups. Fisheries scientists that carry out stock assessments, the basis for advice on catch quotas, know that the precision level in the presented numbers does not reflect their confidence in the numbers, they know that their knowledge is built on several assumptions and generalizations and they have a shared understanding of how to interpret words and expressions.

An example of a confusing expression used by ICES is "outside safe biological limits". The expression means that the productivity of the fish stock is not utilised. Some non-governmental organisations, however, have interpreted it to mean threatened by extinction (Sandberg et al. 2003). ICES is now trying to find expressions that are clearer to all parties.

Another example of misunderstanding is the dispute between Turkish fisheries scientists and fishermen in the Black Sea (Knudsen 2004). The fishermen believed that the sonar was harmful to the fish; that the fish exposed to the sonar beams died. The scientists ridiculed this fear accusing the fishermen of being ignorant in these matters. The study by Knudsen suggests that the two groups may have different understandings of what danger they were talking about. While the scientists limited the topic specifically to the rays from the sonar, the fishermen seemed, at least at times, to be concerned with the whole resource situation created by introducing sonar to the fisheries. They had observed that the sonar made fishing very efficient and that catches by traditional equipment had gradually declined. Not only does this story illustrate misunderstanding, but also it suggests that the two groups approach the problem differently. Typically, the scientists separate problems into smaller units and in this example they did not consider whether the resources were declining, only whether the fish died from the sonar beam. The fishers seemed to have a more holistic perspective, not separating the problem from their life situation.

Different stakes

The fishermen and the fishing industry are clearly stakeholders in the fisheries. Their income depends on the fisheries. A lower quota may decrease a fisherman's income or the viability of the industry. We should therefore expect the fishermen to oppose strict regulations from time to time. There is a general perception among fisheries scientists that fishermen more often try to convince authorities to set quotas higher than to reduce them.

The "green" organisations are also stakeholders, siding with the fish, marine mammals or the future generations of human beings and for their food supply. Their influence on decision-making is increasing, and the fishermen and the fishing industry have been somewhat sceptic to this development.

It is not so common to think about the scientists as stakeholders, but looking closer at our situation, we have different ways of winning and losing too. A scientist may have invested his/her career in a certain technical solution, a way of understanding the ecosystem or a mathematical model. Being an advisor for decision-makers implies influence and power, and it is clearly more satisfactory for the scientist when their advice is followed.

It is important to recognise that science may take different roles, whether this is done intentionally or not. Science aims at being objective, but there are many pitfalls to be aware of. In the dispute over the sonar in the Black Sea, part of the fear was linked to the sonar's efficiency and the concern about the resource situation. When the scientists concluded that the sonar was not harmful, this could be perceived as encouraging more intense exploitation. In the case of northeast Arctic cod and under-reporting, the scientists indirectly undermine the problem by how advice is presented. The precision in presented numbers in scientific advice fortifies this implicit message. Finlayson (1994) argues that the assessments of the northern cod stock before it collapsed were influenced by the general optimism after the extension of the fisheries jurisdiction in 1977. Canada's rights and responsibility for the stock increased as a result of the extension, and people had faith in a growing prosperity in the fisheries. Clearly, giving neutral scientific advice is a challenge.

Discussion

So far I have presented some aspects of fisheries management that generate disagreement between scientists and users: uncertain knowledge, different ways of knowing, language and stakes. Science will continue its attempts to reduce uncertainty, but some of the uncertainty, for example associated with the state of a fish stock, will always remain. Scientists and fishermen will continue to have different ways of knowing, different languages and will continue to be stakeholders in the fisheries. Thus, disagreements will still occur, but I think improvements are possible within two areas, common understanding and political power. In this section I will briefly discuss some suggestions: to improve communication, to make clear limitations in knowledge, and to improve awareness and social learning.

Some of the examples given earlier in this paper illustrate misunderstandings. The Turkish scientists were concerned about the beams from the sonar while the fishermen, or at least some of them, were concerned both about the beams themselves and the danger of depleting fish stocks as a consequence of using sonar. The expression "outside safe biological limits" was confusing because "safe" was interpreted in relation to a possible extinction of a fish stock rather than the viability of the fisheries. The exaggerated precision level in scientific advice gives an impression of a stronger confidence in knowing the exact status of a fish stock than what is actually the case.

Such misunderstandings can be reduced, but the problem may not be limited to unclear speech. It may also be necessary to increase awareness of the limitation in personal and institutional knowledge and awareness of unintentional roles. Although the advice on northeast Arctic cod includes a warning in the text about the under-reporting of catches, the advice may conceal the problem, although unintentionally, as it is not taken into account in the calculations. Including beliefs that are not quantified has been regarded as unscientific. The risk is of course that the provided numbers for the state of the stock may be less useful, possibly wrong and concealing a problem. "Zero discards" in calculations is in this case an assumption and, like for all assumptions, its influence on the advice should be explored. To present this problem in a neutral manner, one could give a range of results and consequences that correspond with different magnitudes of the problem. At least the precision level can be adjusted to reflect the uncertainty in the given numbers. The exaggerated level of precision strengthens the impression that under-reporting is not so serious. Remember that the historic error in the estimate of the spawning stock biomass is about 50% and that the catch statistics is believed to be too low. Still, the advice for 2004 is to keep the catches below 398 000 tons, which is very precise compared to the historic error. Although the scientists know that the uncertainty is taken into account in deciding the reference points, the appearance of the advice should also reflect the uncertainty.

Keeping the 50% error in mind, one should ask whether the scientists are trying to answer an impossible question. The fisheries managers want advice from the scientists on what total catch can be taken the following year without depleting the stock. They want to adjust the quota according to the stock size. Is our knowledge precise enough for such annual adjustments annually? No, for many stocks I would think that this is not the case.

The question asked decides what kind of answers you can get. If it is not possible to give proper answers, the question should be reconsidered. A management strategy with more stable quotas could compensate for some of the uncertainty. The joint Russian-Norwegian fisheries commission has decided to explore an alternative management strategy for some stocks in the Barents Sea. Too much fluctuation in the quotas may be disadvantageous for many fisheries. The commission thus tries to find decision rules where the quotas will not vary more than a certain percent from one year to another. It will be very interesting to see how this will develop and whether they will be able to handle the uncertainty in a better way.

The sonar dispute in the Black Sea is an example of a disagreement that partly may be explained by a misunderstanding or disagreement on what the concern was. The small-boat fishermen wanted a ban on the use of sonar while some larger fishing companies wished to use sonar. The authorities and the fisheries scientists understood the request to be about a possible danger from the sonar beams, while the small-boat fishermen seemed also to be worried about the whole resource situation resulting from the use of sonar. If the question or the fear had been phrased differently it could have initiated a totally different debate. The discussion in Turkey is probably also an example about political language and power. The small-boat fishermen in Turkey have no union to fight for their interests. Often there is a tendency to adapt scientific language since science has a high status in many situations. When users try to communicate their opinions and concerns through a more scientific language, they are likely to fail. In this example the fishermen tried to explain the danger by focusing on the rather technical properties and consequences of the sonar.

Funtowicz and Ravetz (1990 and 1991) emphasize the importance of including all parties when deciding what questions to pose. Moreover they argue that science cannot claim to be the objective answer producer to all problems where knowledge plays a part in a decision of societal concern. One should expect all science to be built on value-laden assumptions or choices in these cases. In policy issues where stakes are high, decisions are urgent and knowledge is uncertain, they suggest lay people to review scientific knowledge. Lay people may be able to discover societal aspects about the knowledge that the experts have not been able to see.

Jentoft and McCay (1995) illustrate that the degree and the form of user participation in fisheries management vary from fishery to fishery. They argue that user-participation is necessary because parties then feel more obliged to follow the decided rules. However, they also point to several difficulties. An agreement with participants from the fisheries will likely mean more fishing, and if scientists dominate the debate, their difficult language may exclude fishermen's participation. Fishermen's knowledge and views can thereby be lost in the debate. Also they point to the unfortunate experience that the more parties are involved, the more difficult it is to democratise the management process. Especially in international agreements, it is difficult to include many perspectives as the political game dominates.

Social learning aims at achieving an improved common understanding among different experts, stakeholders and lay people. The idea is that all parties can learn from each other's perspectives. Social learning can thus be a means to democratise a process toward a management decision. Not all controversies can be resolved by a more complete picture of the situation. However, true controversies are important to map.

In many cases it is not an easy task to create a constructive learning environment, but several tools have been or are being developed to help such a process. These tools are computer software that present knowledge and show different aspects of a certain policy issue. The graphics may be quite advanced in order to improve communication. The tools are made to enable stakeholders to inform, to learn, to discuss, to pose questions, to bring people together and to articulate controversies. Some tools enable the participants to define future scenarios and feed them into the software. SimCoast (Hogarth and McGlade 1998) is one such tool. It is a decision support system for improved coastal zone management where resource managers, resource users and scientists were involved, also in defining the key issues.

The ViRTU@LiS project is another example. This is a project aiming at developing computer-based tools for social learning within agricultural pollution, climate change, freshwater management, and marine fisheries. The focus is on creating learning tools for improving citizens' awareness of environmental management and risks, but the project also includes evaluation by experts and non-experts.

Summary:
In this paper I have presented some aspects of fisheries management that generate disagreement between scientists and users within the fisheries: uncertain knowledge, different ways of knowing, language and stakes. I have concentrated on scientific knowledge as that is my field of interest. I have argued that it is important to accept that science will not be able to eliminate uncertainty. Some of the uncertainty will always remain; scientists and fishermen will continue to have different ways of knowing, different languages and will continue to be stakeholders in the fisheries. Thus, disagreements will still occur. However, improvements can be made and I have presented some suggestions. These were: to improve communication, to make clear limitations in knowledge, and to improve awareness and social learning.

References

Finlayson, A.C. 1994. Fishing for Truth. pp 1-176, Memorial University of Newfoundland, Canada, ISBN 0-919666-79-5

Fishing News International 2003a. 'Scientists get it all wrong!' Fishing News International, May 2003 Vol.42 No. 5

Fishing News International 2003b. 'Is this science?' Fishing News International, May 2003 Vol.42 No. 5

Fiskaren 2003. Symbolet på ei mistru. Fiskaren, June 13th 2003, Bergen, Norway

Fiskeribladet 2003.Føler seg ranet av forskerne. Fiskeribladet, Tuesday, June 3rd, 2003, Harstad, Norway

Funtowicz, S.O. and Ravetz, J.R. 1990. Uncertainty and Quality in Science for Policy. Kluwer academic publishers, ISBN 0-7923-0799-2

Funtowicz, S.O. and Ravetz, J.R. 1991. The Emergence of Post-Normal Science. Ecological Physical, Chemistry, Elsevier Science Publishers

Hogarth, A.N. and McGlade, J. 1998. SimCoast: Integrating information about the coastal zone. EC Fisheries Cooperation Bulletin, CE Coopération Pêche Vol. 11 no 3-4, September-December: 29-33. http://europa.eu.int/comm/development/body/publications/fish/099829.pdf

ICES 2001. Report of the ICES Advisory Committee on Fishery Management. ICES cooperative Research Report No. 246, pp 3 – 10, Copenhagen 2001

ICES 2002. Report of the ICES Advisory Committee on Fishery Management. ICES cooperative Research Report No. 255, Copenhagen 2002

ICES 2003. Report of the ICES Advisory Committee on Fishery Management. ICES cooperative Research Report No. 126, pp 12-20, Copenhagen, 27 May – 05 June 2003

Jentoft, S. and McCay, B. 1995. User participation in fisheries management – Lessons drawn from international experience Marine Policy19(3): 227-246.

Knudsen, S. 2004 (in press). Situating technology; Confrontations over the use of sonar among Turkish fishermen and marine scientists. Perspectives on Global Development and Technology 2(1)

Nakken, O. 1998. Past, present and future exploitation and management of marine resources in the Barents Sea and adjacent areas. Fisheries Research 37 (1 – 3): 23 -36

Sandberg, P., Røttingen, I. and Gjøsæter, H. 2003. The language of fishery management advice offered by ICES. ICES CM 2003/Y:04

Sparholt, H. 2002. Quality of ACFM advice: How good have forecasts been since 1988? In Report of the Working Group on Methods on Fish Stock Assessments, Copenhagen 2001, pp 60 – 70, ICES CM 2002/D:01

ViRTU@LiS, Social Learning on EnVIRonmental Issues with the InTeractive Information and CommUnicAtion TechnoLogIeS

Controversy and complexity: user knowledge and the management of beluga whales in Cook Inlet, Alaska

Henry P. Huntington

In the late 1990s, the population of beluga whales in Cook Inlet, Alaska was discovered to be declining rapidly. (See Marine Fisheries Review 62(3), published in 2000, for a set of articles describing the situation and the knowledge available at that time about various aspects of the Cook Inlet population including population status, trends, harvests, and traditional knowledge.) The cause of the decline was not known with certainty, but increased harvests were regarded as a likely candidate. Contaminants, from municipal waste and runoff as well as from the oil industry operating in Cook Inlet waters, and competition from commercial fishing were cited as other possible causes. Several studies were undertaken to try to determine the status of the population, the causes of the decline, and the best course for helping the population recover. These studies included ongoing work on aerial surveys to count the number of whales, the attachment of satellite transmitters to map movements of whales, and the documentation of traditional knowledge.

Sewing bearded seal skins together to make the cover (hull) of an umiaq, a whaling boat used by the Inupiat when hunting bowhead whales.
Photo: Henry P. Huntington

Cook Inlet extends northwards from the Gulf of Alaska in the central southern coast of Alaska. Its basin contains more than half the human population of Alaska, including the largest city, Anchorage, as well as extensive industrial development in the form of offshore oil wells and pipelines, shipping, and commercial fishing. Two Alaska Native groups occupy the Cook Inlet area, the Alutiiq in the south and the Denaina Athabascans in the north. In addition, Anchorage is home to a large number of Alaska Natives who have moved there from other parts of the state. Small numbers of beluga whales have been traditionally hunted in Cook Inlet, but people who arrived in the area from marine mammal hunting communities elsewhere brought their own hunting traditions as well. The number of active beluga hunters is difficult to determine, because Anchorage has a population of a quarter million people and because beluga hunting can be done by a single boat anywhere in the large area of northern Cook Inlet where belugas are found.

When the population decline was first reported, it touched off a flurry of response that indicated divergent opinions on the existence, extent, and cause of the decline as well as on the best ways of ending the decline and helping the belugas recover. These responses by various individuals and groups drew on available scientific reports, personal and traditional knowledge, and assumptions and aspirations for using the decline to achieve desired objectives in the waters of Cook Inlet. In short, there was little agreement on the basic facts or on the conservation actions that should be taken.

In an effort to help gather additional information while also promoting the inclusion of hunters, the Alaska Beluga Whale Committee hired me to document traditional ecological knowledge (TEK, here an approximate synonym for user knowledge) about beluga whales in Cook Inlet. Accordingly, I interviewed several hunters and elders from the region, including those descended from the region's original inhabitants as well as recent arrivals from elsewhere in the state. In addition to the information I gathered, several Native leaders taking part in various discussions and debates about the proposed conservation actions drew on their own information to describe the situation as they saw it.

The debate concerning the belugas—carried out in public meetings, in private discussions, in the newspaper, and elsewhere—was complex, involved many groups and individuals, reflected concern about the animals, concern about Native hunting traditions, and a number of ulterior motives such as the desire to control industrial development in the region. Those taking part in the debate used a variety of sources of information to support their claims. Rather than attempt to describe or even to summarise all that was said, I will review three themes that were woven into the debate and which illustrate some of the complexity of this particular case. The themes are the size and range of the Cook Inlet beluga population, the role of industrial development, and the ability of the federal government to manage beluga harvests.

At the bottom of the decline, the population was reported as approximately 350 animals. The population estimate was challenged on two fronts, primarily by Native leaders and hunters. First, they questioned the methods, both the general idea that the surveys could actually find all the whales in Cook Inlet and the specifics of the counting procedure such as the correction factor that was applied to account for whales not at the surface and thus invisible in the muddy water. Second, some Native leaders and hunters questioned the premise that the Cook Inlet stock was isolated and small, suggesting that it was in fact just a small offshoot of a much larger stock in the Gulf of Alaska and thus far less vulnerable to overharvest than an isolated stock would be.

In this instance, there was no direct evidence for the existence of a large Gulf of Alaska stock of beluga whales. While belugas are occasionally seen elsewhere along the southern coast of Alaska, such as Yakutat Bay to the east of the mouth of Cook Inlet, there are no reports of observations of significant numbers of belugas anywhere in the Gulf of Alaska. Rather than reflecting user knowledge in the sense of direct observations or information passed down over generations, the reports of the large Gulf of Alaska stock appears to be a case of user belief or hope. I do not mean to imply anything about the motives of those who claimed that the larger stock existed. Merely, I mean to point out that statements by users are not infallible, and that citing user knowledge as the source for one's assertions is by no means definitive. Instead, user knowledge must be approached with the same scrutiny and care as knowledge from other sources. The question "How do you know?" is valid when decisions are to be based on the information thus presented.

The second theme is the role of industrial development. Here, too, many people cited a putative link between pollution from industry or municipal waste and the declining beluga population. Studies of contaminant burdens in the belugas actually found the belugas to carry lower concentrations of many contaminants than belugas elsewhere in the state (and apparently farther removed from industrial sites). Nonetheless, many environmental groups sought to take advantage of the opportunity to use the beluga situation to reduce or

Beluga are easily spotted in the water
Photo: Bjørn Krafft

limit industrial activity. Expressions of concern about the fate of Native hunting traditions and temporary alliances between hunters and environmental groups masked rather large differences of overall philosophy and motivation. The hunters did share many concerns about industrial development, but for them the end goal was to protect their hunting. Many of the environmental groups, on the other hand, had no particular interest in hunting and may even have opposed it in general terms, but instead had the end goal of reducing development and pollution. Sorting through the various claims of impacts or lack of impacts required careful attention to these sorts of ulterior motives.

The third theme is that of management. Under the Marine Mammal Protection Act, the federal government manages marine mammal stocks and prohibits hunting except by Alaska Natives pursuing traditional practices. In this context, the sale of marine mammal products such as meat and blubber to other Natives is legal in Alaska Native Villages. As mentioned above, Anchorage has a large number of Native inhabitants, and was thus deemed to qualify as an Alaska Native Village for this purpose. Some hunters in Cook Inlet were hunting not just for their own use, but for sale through a local grocery store. The presence of this economic incentive for hunting was, for some, all the proof that was needed to show that hunting was responsible for the decline. For others, the situation demonstrated the counterproductive aspects of the Marine Mammal Protection Act's exemption for Native hunting, in which restrictions on a hunt cannot be imposed unless the particular stock being hunted is found to be "depleted." In other words, preventive action is not possible; action can only be taken after the crisis has occurred. And even when the crisis has been reached, the administrative procedure for a "depleted" determination is not swift.

It is perhaps interesting to note that the hunters' knowledge that was documented shared few of the biases apparent in the preceding discussion. Most of the hunters were aware that the population was going down; they recognised that hunting might be one of the factors, and they made no claims for a large population nearby that could serve to replenish the group in Cook Inlet. Instead, they demonstrated a detailed knowledge of the movements and activities of belugas in certain parts of the inlet and were able to describe some of the changes that had taken place over time, particularly in response to increasing human activities.

In the quest for solutions to the problem, few groups were uniformly helpful and committed to the belugas. Instead, the efforts of a handful of Native hunters, government scientists and managers, and a few others were instrumental in persuading the U.S. Congress to pass a special measure limiting the hunt in Cook Inlet. But these individuals were the exceptions, willing to look beyond their own interests and work on behalf of the whales. Many Native advocates pointed fingers at others as the cause of the problem. Many environmental groups were willing to capitalize on the belugas' plight to seek 0other goals. Many managers were willing to look the other way until it was too late, hampered as well by their inability to react promptly when it became clear that there was a problem.

In this case, user knowledge was merely one of several sources of information that were used and misused throughout the debate. The ability to document that knowledge was important, but offered no simple solution to the problem. Often, examples of the use of user knowledge present a clear story in which user knowledge and the involvement of the users led to a much better result for both users and the species being harvested. This example is intended in part to show that happy endings are not the inevitable result of properly applying user knowledge. Instead, user aspirations and actions can be just as complex as the aspirations and actions of other interested groups, and the application of user knowledge by different groups can serve as a means of deflecting attention from more controversial positions such as opposition to development. User knowledge is an important contribution to conservation, but one that must be applied as cautiously and carefully as any other source of knowledge and perspective.

Background
On April 1, 1999, Nunavut became Canada's newest territory. Previously a part of the Northwest Territories, Nunavut was created as a result of the Nunavut Land Claims Agreement (NLCA). Nunavut occupies over 1.9 million square kilometers, or approximately 1/5th of Canada's land mass and covers the entire eastern portion of Canada's arctic.

In 1993, with the signing of the Nunavut Land Claims Agreement (NLCA), a new body was established to manage wildlife in Nunavut. The Nunavut Wildlife Management Board (NWMB or Board) was mandated to become the "main instrument of wildlife management in Nunavut" (NLCA, 1993). The NLCA is a constitutional document which prevails over legislation that is inconsistent or in conflict with it. The Board is an Institution of Public Government and a co-management board, but is not a part of the Federal or Territorial Government.

As the main instrument of wildlife management, the NWMB became responsible for setting all harvesting quotas and non-quota limitations (including seasons, equipment and locations). Under the NLCA, wildlife is defined as all flora and fauna, including all fish, birds and mammals and all plants. As a co-management board, half the NWMB members are appointed by Inuit organizations and half by the Federal and Territorial Governments. In addition an independent chairperson is chosen by the Board members.

Wildlife management in Nunavut
Wildlife management in Nunavut is based on the system of co-management, with Inuit and government working in partnership to manage Nunavut's resources. The primary organizations are the Nunavut Wildlife Management Board; Federal Government Departments of Fisheries and Oceans (DFO) and Environment – Canadian Wildlife Service (CWS); the Territorial Government Department of Sustainable Development (DSD – renamed Department of the Environment, March, 2004) and the Inuit organizations at the community level – Hunters and Trappers Organizations / Associations (HTOs) and at the regional level the Regional Wildlife Organizations (RWOs).

As the main instrument of wildlife management for Nunavut, the Board's functions include the authority to establish, modify or remove all limitations on wildlife harvest within the Nunavut Settlement Area, subject to the ultimate authority of the Minister of the respective Federal or Territorial department to accept, reject or vary NWMB decisions. However, a Board decision to restrict or limit Inuit harvesting may only be rejected or varied by a Minister: to provide for public health or safety; to effect a valid conservation purpose; or, to give effect to particular provisions of the NLCA. Likewise, the Board may only restrict Inuit harvesting for these same reasons.

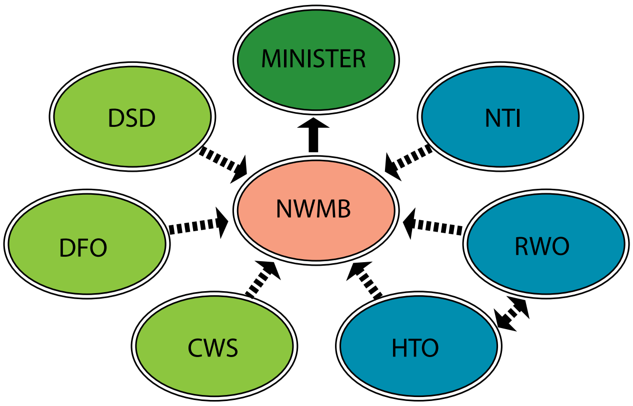


Figure 1. Structure of wildlife management in Nunavut. Dashed lines indicate advisory relationship, solid lines indicate decision authority. Arrows show the direction of flow.

Principles of wildlife management
Article 5 of the NLCA sets out the principles and objectives of the wildlife management system in Nunavut for Nunavut. The principles recognise that:
- Inuit are traditional and current users of wildlife;
- the system of wildlife management in Nunavut must recognise Inuit systems of wildlife management; and
- there must be an effective role for Inuit in all aspects of wildlife management.

In addition to the principles of wildlife management, the NLCA also outlines the Principles of Conservation, which guide the NWMB's decisions with respect to wildlife. The principles of conservation are:
(a) the maintenance of the natural balance of ecological systems within the Nunavut Settlement Area;
(b) the protection of wildlife habitat;
(c) the maintenance of vital, healthy, wildlife populations capable of sustaining harvesting needs as defined in this Article; and
(d) the restoration and revitalization of depleted populations of wildlife and wildlife habitat. (NLCA, 1993, Article 5.1.5).

These principles guide the management decisions made by the NWMB and our co-management partners within Nunavut.

Integrating science and traditional knowledge
In making wildlife management decisions, the NWMB relies on the best available knowledge – both scientific and traditional knowledge (Inuit Qaujimajatuqangit). For both types of knowledge, the focus is on subsistence species – those that are important sources of country food for Nunavummiut. While both types of knowledge are important in the decision-making process, due to availability of information, scientific information currently plays a greater role in decision-making than traditional knowledge. Research is ongoing to collect both scientific and traditional knowledge on a wide range of wildlife.

The largest study of traditional knowledge to date is the Inuit Bowhead Knowledge Study (IBKS), completed in 2000. This study provided information that was not previously known about bowheads and can now be integrated with recent population surveys. Traditional knowledge studies on other species have also been undertaken, but generally on a more local scale, such as Bathurst Caribou; narwhal in Repulse Bay; and M'Clintock Channel polar bears.

In addition to the collection and documentation of traditional knowledge, the NWMB also has other methods of ensuring that traditional knowledge is integrated into the NWMB decisions. The Inuit members of the NWMB, including several government appointees, ensure that their knowledge is shared with the Board during decision-making. The Board also establishes working groups or holds workshops with knowledgeable individuals and conducts consultations when needed to ensure that local and traditional knowledge is considered.

Decision making
There is a need for a co-ordinated, integrated approach to collecting traditional knowledge in Nunavut to complement the ongoing scientific research. There is a strong desire among the NWMB and its co-management partners to make greater use of traditional knowledge in wildlife management decisions. However, for traditional knowledge to be of the greatest use to the NWMB, it must be collected in a systematic way and ideally collection should take an ecosystemic approach to ensure that Inuit knowledge of the inter-relationships within the environment are documented. As more traditional knowledge is documented, its role in wildlife management in Nunavut will likely expand accordingly.

References
Minister of Indian Affairs and Northern Development and Tunngavik Federation of Nunavut. 1993. Nunavut Land Claims Agreement: Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada. Ottawa: Supply and Services Canada.

NLCA, 1993. See Minister of Indian Affairs and Northern Development, 1993.

The management decision-making process in NAMMCO member countries

Norway

Lisbeth W. Plassa

In the following I will give a brief presentation of the Norwegian decision-making process for the management of marine mammals. In Norway marine mammal management involves the minke whale hunt, the harp and hooded seal hunt in the Arctic and the coastal seal hunt (ringed, harbour and grey seal).

Types of information required as a basis for regulations and where it is obtained

In order to draft regulations certain types of information are required such as:

- **Management information**
  First of all we need information about the state of the stock so that we can decide the TAC (total allowable catch) and see whether it is necessary to restrict the hunting season or to establish protected areas. This kind of regulation is mainly based on information provided by the scientists. The scientists may get input not only from their own research but also from the fisherman/hunters through having access to catch logs and other reports prepared by the hunters.

  For the minke whale TAC is set by the Ministry of Fisheries based on advice from the Institute of Marine Research and other experts. For arctic seals the TAC is set by the Ministry of Fisheries after international negotiations, and is also based on scientific advice. For coastal seals the TAC is set by the Directorate of Fisheries based on advice from the Norwegian Institute for Fisheries and Aquaculture.

- **Requirements for participation**
  It is also necessary to evaluate whether requirements for participation in whaling or sealing are necessary. Information included in such evaluations is based on history (previous years of participation), ownership of a participating vessel and registration as a fisherman/hunter. This information is provided through a dialogue with the whalers and sealers. When deciding if regulations on participation are needed the views and knowledge of the users are important inputs. We have close contact and dialog with the hunters/fishermen. We participate at their annual meetings and seminars and we get all their resolutions forwarded to us. Thus we are quite familiar with their views/positions and this part of the regulation process will very often be based on the advice given by the users' organisations.
  In the traditional fisheries management these kinds of requirements are set in order to restrict the numbers of participants due to an overcapacity situation.

  The situation with management of marine mammals is different. With respect to the whale hunt newcomers have shown an interest in participating, but because there are enough vessels to take the annual quotas, restrictions on participation for newcomers have been set based on advice from the whalers' union.

  With respect to seal hunting we have not been able to take the annual quotas, and it has been difficult to get vessels to participate in the arctic seal hunt. So instead of aiming at restricting numbers of participating vessels we are looking for ways to get new vessels interested in the hunt. For the coastal seals the situation is much the same, the quotas have not been taken and we have no restrictions on participation. This year (2003) the hunters will even get a compensation fee of NOK 500 for each seal taken.

- **Technical regulations**
  Finally we need information to set technical regulations, such as requirements regarding which weapons to use and the shooting skills required to use them, hunting courses and training to ensure safety for the hunters and the best killing methods for the animals. Also here the users' knowledge is important to us because they have the necessary experience to give us the kind of information that we need. In addition we seek information from weapons experts and scientists.

The decision-making process

In 2001 the Ministry of Fisheries established an Advisory Board for the Management of Marine Mammals. The Board provides advice to the Ministry on whaling and sealing, based on input from scientists and users. The authorities are not required to follow the advice from the Board, but tend to do so especially if the advice has been reached by consensus. The Directorate of Fisheries is the secretariat for the Advisory Board and prepares the documents presented to the Board.

The Board consists of 11 members: the Norwegian Whalers Union (3 members), the Norwegian Fishermen's Association (2 members), the Seamen's Union (1 member), the Norwegian Association of Hunters and Anglers (1 member), the Federation of Norwegian Fishing Industry (1 member) G.C. Rieber AS (Seal Product buyer, 1 member), the Sami Parliament (1 member) and the Directorate of Fisheries (chair, 1 member).

The users are heavily represented on the Board. This is important to ensure that relevant information and views is presented and discussed before decisions are taken. It is furthermore hoped that through participation on the Board the users will better understand the reasons for the regulations, and maybe be more loyal to these regulations. The Board provides a dialogue that is essential for effective management, but it is also important to stay in contact through less formal fora.

In addition to the members of the Board, a number of advisers and observers are present at its meetings As advisors we have representatives from: The Institute of Marine Research, The Norwegian Institute for Fisheries and Aquaculture, Sales Organisations and others, and as observers we have representatives from: The Ministry of Fisheries, The Norwegian Coast Guard, The Directorate for Nature Management, The Ministry of Foreign Affaires, The Norwegian Society for Conservation of Nature and others.

Once or twice a year the Directorate of Fisheries will call for a meeting of the Advisory Board, and based on the various types of information described above the Directorate will draft the regulations and distribute them to the members of the Board one week prior to the Board's meeting. These documents will also be published on the Directorate's web site.

During the meeting (which often lasts 2 days) the Board will discuss all relevant issues concerning the management of marine mammals. The chair will try to have the Board reach a consensus, but if that is not possible there will be an open voting process where each member has one vote. The Board gives its advice to the Ministry of Fisheries, and the Directorate of Fisheries may give separate advice to the Ministry if the Directorate does not agree with the advice from the Board. In both cases the advice will include a complete text for the regulations. As it is an advisory board the Ministry can decide not to follow the advice of the Board or the advice of the Directorate if they so wish, but usually the Ministry will follow the advice especially if it is advice reached by consensus.

After the Ministry has established the regulations (some of the regulations are actually established by the Directorate after authorization by the Ministry) the Directorate will publish and implement these regulations.

Closing remarks

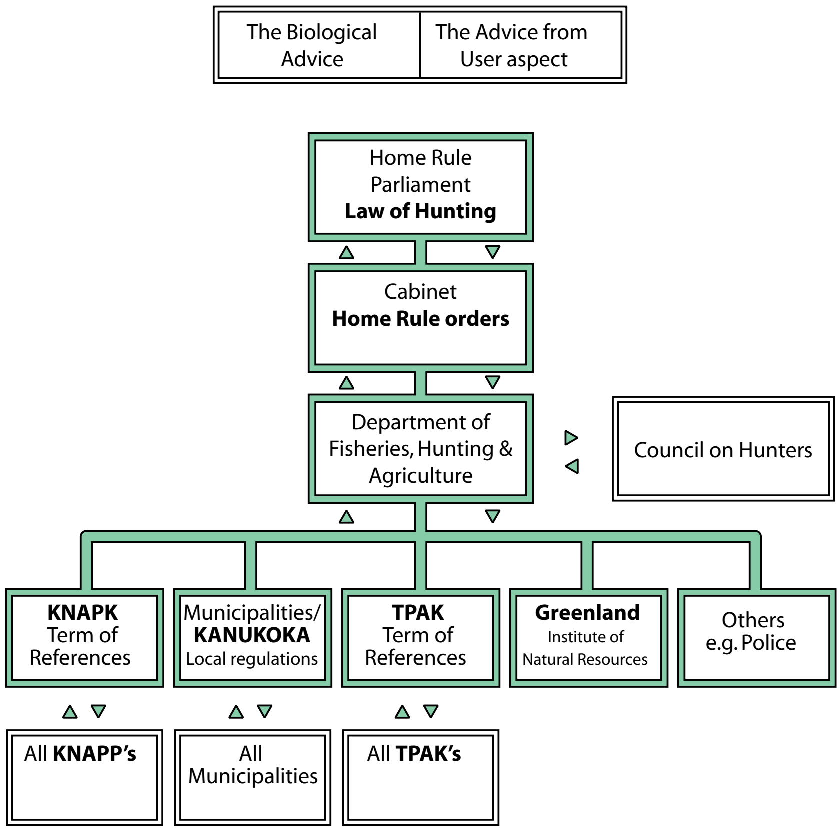
In our opinion the dialog between users, managers and scientists is essential for successful management. Therefore we have formalized the dialog by establishing the Advisory Board, but in addition we stay in close contact with the users and scientists by participating in annual meetings/seminars etc.

Greenland
Amalie Jessen

User knowledge in Greenland has existed ever since the country got inhabitants, and people lived off and survived by using the living resources. Today most people in Greenland live in towns, and there has been increased industrialisation. This of course has changed the nature of user knowledge.

Scientific knowledge was introduced more or less when the missionary Hans Egede came to Greenland in 1721, but the first formal research started with the Tjalfe-expeditions in 1908 and 1909. In 1994 the Greenland Institute of Natural Resources housing facilities were established in Nuuk after having been housed in Denmark for many years, and a new era started in Greenland.

Currently the Department of Fisheries, Hunting and Agriculture is the management body for marine mammals in Greenland. There are two streams of advice for managers: from the biologists and from the users. The biological advice come from different sources depending on the species; IWC gives advice on large whales, while NAMMCO, NAFO/ICES and Canada-Greenland bilateral relations gives advice on seals and small whales. A large proportion of the input comes from the users in the form of hearings, information meetings and through the regulatory process.



KNAPK=Fishermen and Hunters Organization in Greenland.
TPAK=The Organization of part time Hunters and Fishermen
KANUKOKA=Association of Municipalities in Greenland

Greenland
Kim Mathiasen

In the Coalition Government Agreement of December 2002, it is stated that traditional knowledge, in addition to biological and other scientific research, should provide input to management. Resource management is based on sustainable use and protection of the environment. Educational programmes focusing on basic principles of sustainable development will be a part of the curriculum.

The objective of the Hunting Act is to ensure an appropriate and biologically sustainable use of the hunting resources. The utilisation must be in accordance with biological advice and financial and occupational regards, and emphasis shall be on incorporating hunter and user knowledge within the relevant central organisations and the Council on Hunting.

The Council on Hunting was established in 1999, and includes among others KNAPK, the Association of Municipalities, the Organisation of Part-time Fishermen and Hunters, the department of Fisheries, Hunting and Agriculture, department of Environment and Nature and a number of non-voting members among them the Greenland Institute of Natural Resources.

The process of drafting regulations includes scientific advice from the Greenland Institute of Natural Resources and other advisory bodies consisting of users, hunters, scientists and managers. These advisory bodies have no decision-making power. There is a hearing process in which the draft regulations are submitted to a set of hearing partners. The Council on Hunting provides advice to the government, but the decision-makers do not always take the advice. The agreements are usually reached by consensus, with the possibility for minority statements.

Faroe Islands
Kaj P. Mortensen

The whale hunt in the Faroe Islands is regulated by government order, which stipulates in detail the requirements for the organisation, supervision and control of the whale drive, killing methods and equipment as well as rules for the distribution of the catch. The regulations are under constant review and update. The Ministry of Fisheries is responsible for the administration of the whale hunt, including drafting of regulations and participation in international bodies, such as NAMMCO.

In its management decision the Ministry seek cooperation and information from different sources such as the scientists, local authorities (district sheriffs) and the Faroese Pilot Whalers' association. This association serves as a forum for public debates and discussions on issues related to the hunt. Information and cooperation are also sought from and through national participation in international bodies be it scientific or conservational.

The Ministry is responsible for the administration of the Commercial Fishery Act of 1995. The objectives of the Act are sustainable and rational exploitation, and a maximisation of employment and income. To achieve these goals, the system must be monitored in terms of the number of fishing days, and for biological and economic sustainability. The Committee on Fishing Days under the Act serves as an advisory body to the government regarding allocation of the number of fishing days per year. The Committee consists of representatives from the ship owners and the fishermen's unions and a chairman selected by the government. Decisions are based on advice from scientists and an industrial advisory board that give advice on the state of the stocks.

Iceland
Kolbeinn Árnasson

The fisheries management system in Iceland is based on the concept of individual transferable quotas (ITQs). This means that each fishing vessel has been allocated a permanent quota share that is a percentage of the total allowable catch (TAC) for each species each year. An important element of this system is that the permanent shares and the allowable catches of each year can be transferred between vessels. The TAC decisions are taken annually, based on recommendations from the Marine Research Institute (MRI). Usually the advice is followed, but the Minister is not bound by it. Special catch rules have been developed and are still under development for certain species such as cod and capelin where species interactions are taken into account.

The system of ITQ's ensures a long term perspective for the user and thus seems to create a common goal of long term sustainable use of the living resources in question. In retrospect regardless of why – the majority of the fishermen have supported the advise given by MRI regarding the TAC of most stocks.

Although input from the users is highly valued in setting the regulations there are no formal channels of cooperation between the Ministry and the fishermen. In some instances information from users has been the basis for increased quotas. The interactions occur for the most part at the scientific level and the interaction between users and the MRI have been developing in a positive way, benefiting fisheries management.

Other aspects of fisheries management include control and enforcement. Cooperation between the authorities and the managers is essential in this regard.

Following the Reykjavik Declaration, management practices need to consider the ecosystem as a whole and take into account ecosystem relations, through a balanced use of resources and avoidance of disproportional use. Steps are being taken in this direction through the ongoing work on multispecies modelling. The active cooperation of the users of the resource, the scientists and the managers is of the greatest importance if our goals are to be achieved.

Iceland
Guðríður Margrét Kristjánsdóttir

User knowledge is important in Iceland, and linking it with scientific knowledge is the only way to ensure sustainable resource use. It is therefore important to link all collected data and make it available to scientists.

The Marine Research Institute (MRI) is the centre of scientific research for marine resources in Iceland. The institute undertakes a systematic assessment of the marine resources every year and has an advisory role for the management of fisheries, including making recommendations to the Minister. These recommendations are not binding, and the Minister may deviate from the recommendations based on other arguments. For example the TAC was increased for saithe and haddock at the end of the quota year 2002 based on input from the fishermen.

The data used by the scientists are collected in three ways: systematically from the landed catch, by the MRI research vessels and in the ground fish surveys. The fishing vessel logbooks are an important source of information with detailed information on fishing practices such as locations, dates, gear and catch quantity. Through the logbooks user knowledge is made available to the scientists.

There are other management measures than the quota system viewed as supportive technical measures such as area closure and prohibition on the use of fishing gear. The Fisheries Act of 1997 divided the fishing fleet into three groups based on vessel size. The permission to fish is further defined by or subject to special areas, sub areas, seasons and the use of fishing gear. The MRI now has the right to temporarily close a fishing area when at least three captains report an excess of juvenile fish in their catch, measured in a way the MRI has agreed to. This provision was introduced as a result of an initiative by the users to make an effort in ensuring sustainable utilisation of fish stocks. In ensuring sustainable utilisation of our marine living resources it is important to find a way to intertwine user knowledge with science.

COMMENTARY

Strengths and weakness of user knowledge in the management process

Milton M.R. Freeman

Earlier in this conference, Stefán Ásmundsson reminded us that the goal in management is to regulate the utilisation of the resources, and not attempt to manage the resource itself (which would be especially difficult in the case of a highly migratory marine resource species). Seeking to regulate the utilisation of resource stocks is something that both science-based management and indigenous systems of resource stewardship attempt in varying ways and with varying degrees of success. Management "success" is today usually assessed by the degree of biological sustainability of the targeted resource and also (in some cases) by considering the economic viability of the extractive enterprise. In other cases (e.g. aboriginal whaling in the IWC context) additional management outcomes are considered relevant, for example, satisfying the cultural and nutritional needs of the resource-user community.

Thus what appears to be especially important in management today is managing the relationship(s) existing between the user community and the resource population(s). Clearly these management activities meet with mixed success, and what may work well in some contexts, may work less well elsewhere. An extensive body of research suggests that managing these relationships may be particularly well served by many indigenous societies' systems of belief and cultural practices in maintaining a sacred relationship between the user community and what has been termed its empirical and non-empirical (i.e., its total) environment.

Thus, when speaking about maintaining relationships, we are speaking about something that permeates and indeed characterizes many indigenous peoples' cultures and social arrangements. For many indigenous and non-indigenous local rural societies, the notion of a continuing and profound dependence on the local resources remains fundamental. This is so because of the continuing dependence of these resource users with their resource base (for dietary, economic, social, cultural, and deeply personal reasons) such that the relationship retains an importance that may be lacking among many urban-centred industrialized peoples. Indeed, in the latter case, maintaining a sensible, if not respectful, relationship between people and the natural world appears to require elaborate legal structures, and even then such relationships often appear impermanent and brittle, rather than longer-term and resilient. Some leading environmental scientists (e.g. Fikret Berkes) have characterized indigenous peoples environmental relationships as sacred. Unfortunately sacred relationships, and the concept of sacredness itself, are not easily appreciated nor captured in the mechanistic models that remain the basis of most contemporary resource management science.

A strength of indigenous knowledge and management systems (a systemic linkage first written about by the late marine scientist Robert Johannes) is that these systems are profoundly ecological (or systemic) in nature. Lucassie Arragutainaq earlier spoke about the 40 or more named forms of sea-ice recognised by Inuit in the Hudson Bay region; more important than Inuit recognition of these subtly distinct states of sea-ice, is the accompanying understanding of the systemic processes that successively transform seawater and succeeding forms of sea-ice through time, driven by recognised changes in temperature, tide, current, wind, water depth, and salinity. The comprehensiveness of this knowledge allows those possessing it to make predictions that have, literally, life or death significance. Fred Roots, a distinguished polar scientist, observed over twenty years ago that although mathematical modelling of environmental processes is essential for good arctic marine engineering, "we should keep in mind that although we may dress up the estimates with numbers to make them look like data and conclusions, our general understanding of the overall relationship between arctic weather and arctic ocean behaviour is not demonstrably better than that of the Inuit… based on long and intimate observation." Surely such intellectual control over natural phenomena deserves environmental managers' serious attention and respect.

Fortunately for the improved management of living resources, adaptive management, which utilises the indigenous and local users' detailed environmental knowledge, is increasingly being adopted as the norm. Carl Walters, a distinguished fisheries scientist who twenty years ago championed adaptive management, observed that scientists try to hide behind vast tables of statistics and wield their professional status "like a club at very intelligent people who happen not to carry the standard credentials". Such a situation is changing, and adaptive management is increasingly recognising and utilising indigenous and local peoples' deep store of environmental knowledge. Some would say that "progress is inevitable", although it seems that progressive change does not occur at the same pace everywhere. Henry Huntington provided important guidance on how the process of change can be assisted: through engagement of the resource users with the entire research and management process and the need for discussions to be ongoing rather than the all-too-common (but unproductive) single-workshop approach that lacks credibility and accountability. This need for continuing engagement among the various players was also emphasized by Halvard Johansen, who stated that ultimately the validity and legitimacy of the management process is secured through collaboration.

We all recognise that environmental systems are incredibly complex, they are not linear and consequently simple cause-and-effect mechanisms do not apply. What exist in these complex systems are a large number of transformative events or forces (namely, the feeding, growth, reproduction, in- and out-migration and death of organisms) that influence other system components (e.g., individual organisms, populations and communities) as well as the system-as-a-whole. Heady stuff and hard to model and analyse given the diversity, complexity and continual change that characterize even the most "simple" ecosystems. Ecosystems then, are highly complex systems in which energy, matter and relationships are continuously transformed. Science-based management recognises the desirability of adopting a multi-species management approach, but as Einar Lemche reminded us, all too often management, in practice, appears to stubbornly cling to a more manageable single-species approach. Such practicality is understandable, given the need for timely answers to urgent and immediate management and political demands. Although it is relatively easy to obtain and represent in a quantitative form the relationship between, for example, cod and capelin, or polar bear and ringed seal, these species necessarily exist and are variously influenced by the total ecosystem (and not just the predators' obligate or primary prey). This total ecosystem includes various non-biological environmental changes that may not even be part of the management team's jurisdictional responsibility or scientific areas of competence.

Both Lucassie Arragutainaq and Monica Riedel reminded us that indigenous knowledge addresses not only the complexity of the bio-physical environment and its diverse biota, but also peoples' lives, thoughts and feelings. This complexity and diversity makes indigenous knowledge very vulnerable, because despite widespread concern that this system of knowing must be recorded and thereby protected against content loss, the very act of recording inevitably contributes to its transformation, its de-contextualization, with a consequent loss of a part of its essence and systemic integrity. In some respects, being experientially-based, indigenous knowledge is a living (gaia-like?) dynamic system of understanding that is learned and comprehended by experiencing it -- certainly not by reading about it in a detached manner. This strongly suggests that indigenous/user knowledge, if it is to remain informed and useful for management/stewardship purposes, must continue to be practiced, refined, and transmitted to future generations in a meaningful (i.e. practical and experiential) manner.

In this regard, Halvard Johansen observed that it might indeed be wise for Norway to maintain an uneconomic sealing tradition until the markets recover and the industry becomes economically viable, if not prosperous, again. Such policies and practices of maintaining uneconomic occupations, knowledge and skills are followed in Canada and Greenland, with short- and longer-term subsidies provided to seal hunters and associated enterprises, as well as to more broadly-based hunter support programs. In such cases, state policies and programs are justified by reference not just to occupational pluralism (arguably always good economic and social policy in rural areas), but for reasons of maintaining cultural diversity and vitality and the associated maintenance of important skills and knowledge about the environment.

PARTICIPANT LIST

Minister Olayuk Akesuk
Department of Sustainable Development
Government of Nunavut
Iqaluit, Nunavut X0A 0H0
Canada
Tel.: +18679755005
Fax: +18679755095

Mr Niels Lange Andresen
KNAPK
P.O.Box 386
DK-3900 Nuuk
Iceland
Tel.: +299322422/ +299482266
Fax: +299325715
Email: nla@knapk.gl

Mr Steinar Andresen
Department for Political Science, University of Oslo
P.O.Box 1097 Blindern
N-0317 Oslo
Norway
Tel.: +4722855241
Fax: +4722854411
Email: s.e.andresen@stv.uio.no

Mr Lucassie Arragutainaq
Sanikiluaq Hunters & Trappers Association
General Delivery
Sanikiluaq, Nunavut X0A 0W0
Canada
Tel.: +18672668709
Fax: +18672668131
Email: sanihta@polarland.com

Kolbeinn Árnasson
Ministry of Fisheries
Skúlagata 4
IS-150 Reykjavík
Iceland
Tel.: +3545458300
Fax: +3545621853
Email: kolbeinn.arnasson@sjr.stjr.is

Mr Stefán Ásmundsson
Ministry of Fisheries
Skúlagata 4
IS-150 Reykjavík
Iceland
Tel.: +3545458300
Fax: +3545621853
Email: stefan.asmundsson@sjr.stjr.is

Mr Steinar Bastesen
Stortinget
P.O.Box 207
N-0026 Oslo
Norway
Tel: +4723313163
Fax: +4723313823
Email: steinar.bastesen@stortinget.no

Mr Kelly Berthelsen
Interpreter
Lottesvej 14, st.th
DK-8220 Brabrand
Denmark
Tel.: +4586257060
Email: kullak@isummerit.zzn.com

Dr Rudolf G. Borodin
Russian Federal Research Institute of Fisheries and Oceanorgraphy
VNIRO
17, V. Krasnoselskaya
107140 Moscow
Russian Federation
Tel.: +70952649129
Fax: +70952649187

Ms Alisha Chauhan
Joint Secretariat
Inuvialuit Renewable Resource Committees
Box 2120 Inuvik
Northwest Territories X0E 0T0
Canada
Tel.: +18677772828
Fax: +18677772610
Email: igc-tech@jointsec.ca

Ms Beatrice Collignon
University Paris, Panthéon-Sorbonne
Via Sant'Isaia 39/3
40123 Bologna
Italy
Tel.: +390516493701
Email: Beatrice.Collignon@univ-paris1.fr

Ms Jane Cooper
Government of Nunavut
P.O.Box 2410
Iqaluit, Nunavut X0A 0H0
Canada
Tel.: +18679755005
Fax: +18679755095
Email: jcooper@gov.nu.ca

Mr Jens N. Dam
Ministry of Fisheries and Maritime Affairs
Yviri vid Srond 17 - 19, Box 87
FO-100 Tórshavn
Faroe Islands
Tel.: +298353030
Fax: +298353035
Email: jensd@fisk.fo

Mr Jens Danielsen
KNAPK
P.O.Box 386
DK-3900 Nuuk
Greenland
Tel.: +299322422
Fax: +299325715
Email: knapk@greennet.gl

Mr Terje Danielsen
Myrgata 25
N-9730 Karasjok
Norway
Tel.: +4799535750

Ms Karen Ditz
Fisheries Management, Eastern Arctic Area
Fisheries and Oceans Canada
P.O.Box 358
Iqaluit, Nunavut X0A 0H0
Canada
Tel.: +18679798002
Fax: +18679798039
Email: ditzk@dfo-mpo.gc.ca

Mr Greg Donovan
International Whaling Commission
The Red House, 135 Station Road, Histon
Cambridge CB4 4N
UK
Tel.: +441223233971
Fax: +441223232876
Email: gdonovan@iwcoffice.org

Mr Niels Einarsson
Stefansson Arctic Institute
Solberg
IS-600 Akureyri
Iceland
Tel.: +3544630580
Fax: +3544630589
Email: ne@svs.is

Mr Inge Arne Eriksen
Sametinget
Kautokeinoveien 50
N-9730 Karasjok
Norway
Tel.: +4778474000
Fax: +4778474091
Email: inge.arne.eriksen@samediggi.no

Ms Miriam Fleming
Environmental Committee, Municipality of Sanikiluaq
P.O.Box 51
X0A 0W0 Sanikiluaq, Nunavut
Canada
Tel.: +18672668929
Fax: +18672668837
Email: mbfleming@polarland.com

Ms Gry Fors
Seal Craft AS
Finnlandsveien 14
N-9730 Karasjok
Norway
Tel.: +4778466225
Fax: +4778466226
Email: sealcraft@sealcraft.no

Dr Milton Freeman
Canadian Circumpolar Institute
University of Alberta
Edmonton, Alberta, T6G 0H1
Canada
Tel.: +17804924682
Fax: +17804921153
Email: milton.freeman@ualberta.ca

Mr Rune Frøvik
High North Alliance
N-8390 Reine, Norway
Tel.: +4776092414
Fax: +4776092450
Email: rune@highnort.no

Mr Åke Granström
Swedish Association for Hunting and Wildlife Management
Aktorgränd 10
S-90364 Umeå
Sweden
Tel.: +4690144300
Fax: +4690144461
Email: ake.granstrom@jagareforbundet.se

Mr Jon Ánde Fors Grönmo
Ole Ravnnasvei 4
N-9730 Karasjok
Norway
Tel.: +4792823541
Email: jaf@online.no

Mr Pétur Guðmundsson
C/o Arni Snæbjörnsson
The Seal Farmers Association
P.O.Box 7080
IS-127 Reykjavík
Iceland
Tel.: 3545630300
Fax: +3545623058
Email: as@bondi.is

Mr Jon Gunnarson
Sjávarnytjar
Ocean Harvest
Fifuhjalli
IS-200 Kópavogur
Iceland
Tel.: +3548924277

Mr Gutti Guttesen
Grindamannafelagið
FO-386 Bøur
Faroe Islands
Tel.: +298333052
Fax: +298333995

Mr Sverrir Halldórsson
Marine Research Institute
P.O.Box 1390
IS-121 Reykjavík
Iceland
Tel.: +3545520240
Fax: +3545623790
Email: dalli@hafro.is

Mr Erlingur Hauksson
RANNSJA
Fornistekkur 14
IS-109 Reykjavík
Iceland
Tel.: +3548947891
Email: erlingurhauks@simnet.is

Mr Svend Heilmann
KNAPK
P.O.Box 386
DK-3900 Nuuk
Greenland
Tel.: +299322422
Fax: +299325715
Email: knapk@greennet.gl

Mr Hans Jacob Hermansen
Tórsbyrgi 16
FO-100 Tórshavn
Faroe Islands
Email: sigmo@post.olivant.fo

Ms Kjellrun Hiis Hauge
Marine Research Institute
P.O.Box 1870 Nordnes
N-5024 Bergen
Norway
Tel.: +4755238590
Fax: +4755238687
Email: kjellrun@imr.no

Ms Anne Kristine Hojholt Frie
Norwegian Institute of
Fish and Aquaculture Research
N-9291 Tromsø
Norway
Tel.: +4777629031
Fax: +4777629100
Email: anne-k.frie@fiskforsk.norut.no

Mr Per-Olof Hopfgarten
Swedish Association for Hunting and Wildlife Management
Aktorgränd 10
S-90364 Umeå
Sweden
Tel.: +4690144300
Fax: +4690144461
Email: per-olof.hopfgarten@jagareforbundet.se

Dr Henry Huntington
23834 The Clearing Dr.
Eagle River AK 99577
USA
Tel.: +19076963564
Fax: +19076963565
Email: hph@alaska.net

Ms Inga Hermansen Hætta
Duodjeinstitutta
Siinnaluodda 7
N-9520 Kautokeino
Norway
Tel.: +4778486618
Fax: +4778485775
Email: ingahermhetta@yahoo.no

Mr Hanus Højgaard
Grindamannafelagið
Fútalág 40
FO-100 Tórshavn
Faroe Islands
Tel.: +298312006

Dr Julia Jabour-Green
Institute of Antarctic and Southern Ocean Studies,
University of Tasmania
GPO Box 252-77
Hobart Tasmania
Australia
Tel.: +61362262978
Fax: +61362262973
Email: Julia.Green@utas.edu.au

Mr Regin Jespersen
Grindamannafelagið
Undir Bólheyggi
FO-380 Sørvágur
Faroe Islands
Tel.: +298213414
Fax: +298333157
Email: reginj@post.olivant.fo

Ms Amalie Jessen
Department of Fisheries, Hunting and Agriculture, Greenland Home Rule
P.O.Box 269
DK-3900 Nuuk
Greenland
Tel.: +299345304
Fax: +299323040
Email: amalie@gh.gl

Mr Gunnar Johannsson
Minke Whale Association
Ármúli 22
IS-108 Reykjavík
Iceland
Tel.: +3548928187
Fax: +3545878690
Email: donna@simnet.is

Mr Halvard P. Johansen
Royal Norwegian Embassy
2720 34th St. NW
Washington D.C. 20008-2714
USA
Tel.: +12023336000/+12029448981
Fax: +12023370870
Email: counselor.fish@norway.org

Mr Ingimar Jóhannsson
Ministry of Agriculture
Sölvholsgata 7
IS-101 Reykjavík
Iceland
Tel.: +3545459750
Fax: +3545521160

Mr Sören Johansson
Kvarken Council
Häggenvägen 6
S-90592 Umeå
Sweden
Tel.: +469030412
Fax: +4690144461
Email: soren.johansson@mail.bip.net

Mr Esbjörn Johansson
Swedish Fishermens Federation
Hallströmsgatan 23
S-59350 Västervik
Sweden
Tel.: +4649017626
Fax: +4649017626

Mr Charlie Johnson
Alaska Nanuuq Commission
P.O. Box 924
Nome Alaska 99762
USA
Email: cjohnson@nook.net

Ms Svanfríður Jónasdóttir
Althingi
Bragagata 30
IS-101 Reykjavík
Iceland
Tel.: +3548621460
Fax: +3545630730
Email: sij@althingi.is

Mr Jon Erlingur Jonasson
Ministry of Foreign Affairs
Rauðararstig 25
IS-150 Reykjavík
Iceland
Tel.: +3545459903
Fax: +3545459979
Email: jon.erlingur.jonasson@utn.stjr.is

Mr Michael C.S. Kingsley
Greenland Institute of Natural Resources
P.O.Box 570
DK-3900 Nuuk
Greenland
Tel.: +299321095
Fax: +299325957
Email: mcsk@natur.gl

Ms Makka Kleist
Sealcraft AS
Parkgata 13
N-9008 Tromsö
Norway
Tel.: +4777688203/ +4799644558
Email: makkakleist@hotmail.com

Ms Siri K. Knudsen
The Norwegian School of Veterinary Science,
Dep. of Arctic Veterinary Medicine
N-9292 Tromsø
Norway
Tel.: +4777665422
Fax: +4777694911
Email: Siri.K.Knudsen@veths.no

Mr Max Kotokak Sr.
Joint Secretariat, Fisheries Joint Management
Inuvialuit Renewable Resource Committees
Box 2120 Inuvik
Northwest Territories X0E 0T0
Canada
Tel.: +18677772828
Fax: +18677772610

Mr Lauritz Kreutzmann
Department of Fisheries, Hunting and Agriculture, Greenland Home Rule
P.O.Box 269
DK-3900 Nuuk
Greenland
Tel.: +299325000
Fax: +299324704
Email: lakr@gh.gl

Ms Emma Kristensen
Greenland Institute of Natural Resources
P.O.Box 570
DK-3900 Nuuk
Greenland
Tel.: +299321095
Fax: +299325957
Email: emma@natur.gl

Ms Guðfriður M. Kristjansdóttir
Ministry of Fisheries
Skúlagata 4
IS-150 Reykjavík
Iceland
Tel: +3545609670
Fax: +3545621853
Email: gudridur.kristjansdottir@sjr.stjr.is

Mr Andrey K. Krivorotov
Altufievskoe Chausse, 95b-6
127572 Moscow
Russian Federation
Tel.: +70959092860
Email: a_krivorotov@ftcenter.ru

Mr Bjørne Kvernmo
Myrullveien 31
N-9516 Alta
Norway
Tel.: +4778431367
Fax: +4778431367
Email: bjkvernm@online.no

Mr Einar Lemche
Greenland Home Rule Government, Denmark Office
P.O.Box 2151
DK-1016 Copenhagen K
Denmark
Tel.: +4532833800
Fax: +4532833801
Email: el@ghsdk.dk

Mr Kristján Loftsson
Hvalur H.F
P.O.Box 233
IS-222 Hafnafjordur
Iceland
Tel.: +3545550565
Fax: +3545551741
Email: kl@hvalur.is

Ms Anne Fenger Lynge
Myrgt. 25
N-9730 Karasjok
Norway
Tel.: +4778466028
Fax: +4778466226
Email: sealcraft@sealcraft.no

Ms Miillaaraq Fenger Lynge
Myrgt. 25
N-9730 Karasjok
Norway
Tel.: +4778466028
Fax: +4778466226
Email: sealcraft@sealcraft.no

Mr Kaspar Lytthans
NORA - Nordic Atlantic Cooperation
P.O. Box 259/ Bryggjubakki 12
FO-110 Tórshavn
Faroe Islands
Tel.: +298353111
Fax: +298353101
Email: kaspar@nora.fo

Mr Kim Mathiasen
Department of Fisheries, Hunting and Agriculture, Greenland Home Rule
P.O.Box 269
DK-3900 Nuuk
Greenland
Tel.: +299355343
Fax: +299323040
Email: kim@gh.gl

Dr Svein D. Mathiesen
Nordic Sami Institute
N9520 Kautokeino
Norway
Tel.: +4790524116
Fax: +4777694911
Email: Svein.D.Mathiesen@Veths.no

Mr Andrei Melnikov
Russian Embassy
Garðastræti 33
IS-101 Reykjavík
Iceland
Tel.: +3545515156
Fax: +3545620633
Email: russemb@itn.is

Ms Meeka Mike
Nunavut Wildlife Management Board
P.O.Box 1397
Iqaluit, Nunavut X0A 0H0
Canada
Tel.: +18679796962
Fax: +18679797785

Mr Bjarni Mikkelsen
Museum of Natural History
Fútalág 40
FO-100 Tórshavn
Faroe Islands
Tel.: +298318588
Fax: +298318589
Email: bjarnim@ngs.fo

Mr Kaj P. Mortensen
Ministry of Fisheries and Maritime Affairs
P.O.Box 347
FO-100 Tórshavn
Faroe Islands
Tel.: +298353030
Fax: +298353036
Email: kajm@fisk.fo

Ms Karen A. Motzfeldt
Department of Fisheries, Hunting and Agriculture, Greenland Home Rule
P.O.Box 269
DK-3900 Nuuk
Greenland
Tel.: +299345345
Fax: +299323040
Email: karm@gh.gl

Mr Ole Mindor Myklebust
N-6488 Myklebost
Norway
Tel.: +4771276024
Fax: +4771276069
Email: mylo@c2i.net

Mr Kalle Mølgård
KNAPK
P.O.Box 386
DK-3900 Nuuk
Greenland
Tel.: +299322422
Fax: +299325715
Email: knapk@greennet.gl

Mr Søren Stach Nielsen
Greenland Institute of Natural Resources
P.O.Box 570
DK-3900 Nuuk
Greenland
Tel.: +299321095
Fax: +299325957
Email: SorenSN@natur.gl

Mr Axel Nikulasson
Ministry of Foreign Affairs
Raudararstigur 25
IS-150 Reykjavík
Iceland
Tel.: +3545459940
Fax: +3545459979
Email: axel.nikulasson@utn.stjr.is

Mr Nils Jørgen Nilsen
N-8064 Røst
Norway
Tel.: +4794893188
Fax: +4794195838

Dr Kjell T. Nilssen
Norwegian Institute of Fish and Aquaculture Research
N-9291 Tromsø
Norway
Tel.: +4777629221
Fax: +4 777629100
Email: kjell-tormod.nilssen@fiskforsk.norut.no

Dr Mark Nuttall
Dep. of Anthropology, School of Social Sciences, University of Aberdeen
Edward Wright Building, King's College
Aberdeen AB24 3QY
Scotland, UK
Tel.: +441224272771
Fax: +441224273442
Email: m.nuttall@abdn.ac.uk

Dr Klaus Nygaard
Greenland Institute of Natural Resources
P.O.Box 570
DK-3900 Nuuk
Greenland
Tel.: +299321095
Fax: +299325957
Email: nygaard@natur.gl

Mr Natan Obed
Inuit Tapiriit Kanatami
Environment Department
170 Laurier W., Suite 510
K1P 5V5 Ottawa
Canada
Tel.: +16132388181 x 292
Fax: +16132332116
Email: nobed@itk.ca

Ms Eline Oftedal
Norwegian Parliament
Stortinget
N-0026 Oslo
Norway
Tel.: +4723313604
Email: eline.oftedal@stortinget.no

Ms Droplaug Ólafsdóttir
Marine Research Institute
P.O.Box 1390
IS-121 Reykjavík
Iceland
Tel.: +3545520240
Fax: +3545623790
Email: droplaug@hafro.is

Mr Jústines Olsen
Veterinary Service
Vardagøta 85
FO-100 Tórshavn
Faroe Islands
Tel.: +298315273
Fax: +2983178479
Email: justines@post.olivant.fo

Ms Peggy N. Osterback
Aleut Marine Mammal Commission
P.O.Box 920045
Dutch Harbor Alaska 99692
USA
Tel.: +19075815324
Fax: +19075815325
Email: pno@arctic.net

Mr Modulf Overvik
Directorat of Fisheries
P.O.Box 185 Sentrum
N-5804 Bergen
Norway
Tel.: +4755238000
Fax: +4755233090
Email: postmottak@fiskeridir.dep.no

Mr Gunnar Palsson
Ministry of Foreign Affairs
Raudararstigur 25
IS-150 Reykjavík
Iceland
Tel.: +3545459940
Fax: +3545459979
Email: gunnar.palsson@utn.stjr.is

Ms Tine Pars
Tusagassiivik, Department of Information,
Greenland Homerule
P.O.Box 1015
DK-3900 Nuuk
Greenland
Tel.: +299345000
Fax: +299328602
Email: tipa@gh.gl

Ms Lisbeth Plassa
Directorate of Fisheries
P.O.Box 185 Sentrum
N-5804 Bergen
Norway
Tel.: +4755238000
Fax: +4755238090
Email: lisbeth.plassa@fiskeridir.dep.no

Mr Jens Nytoft Rasmussen
Nordic Council
Store Strandstræde 18
DK-1255 Copenhagen K
Denmark
Tel.: +4533960387
Fax: +4533111870
Email: jnr@nordisk-rad.dk

Ms Monica Riedel
Alaska Native Harbor Seal Commission
800 E Dimond Blvd Suit 3-590
Anchorage AK 99515
USA
Tel.: +19073450555
Fax: +19073450566
Email: monicariedel@gci.net

Dr Frank Sejersen
Department of Eskimology, University of Copenhagen
Strandgade 100H
DK-1401 Copenhagen K
Denmark
Tel.: +4532880167
Fax: +4532880161
Email: sejersen@hum.ku.dk

Mr Raymond Sensmeier
Alaska Native Harbor Seal Commission
800 E Dimond Blvd Suit 3-590
Anchorage AK 99515
USA
Tel.: +19073450555
Fax: +19073450566

Ms Gay Sheffield
Alaska Department of Fish and Game
1300 College Rd.
Fairbanks 99701 Alaska
USA
Tel.: +19074597248
Fax: +19074526410
Email: gay_sheffield@fishgame.state.ak.us

Mr Jóhann Sigurjónsson
Marine Research Institute
P.O. Box 1390
IS-121 Reykjavík
Iceland
Tel.: +3545520240
Fax: +3545623790
Email: johann@hafro.is

Mr Speridon Simeonoff
Alaska Native Harbor Seal Commission
800 E Dimond Blvd Suit 3-590
Anchorage AK 99515
USA
Tel.: +19073450555
Fax: +19073450566

Mr Ólavur Sjurðarberg
Grindamannafelagið
Fútalág 40
FO-100 Tórshavn
Faroe Islands
Tel.: +298443192
Fax: +298443202
Email: leirskul@post.olivant.fo

Mr Duane Smith
Joint Secretariat Inuvialuit Renewable Resource Committees
Box 2120 Inuvik Northwest Territories
X0E 0T0
Canada
Tel.: +18677772828
Fax: +18677772610
Email: igc-c@jointsec.nt.ca

Mr Norm Snow
Joint Secretariat
Inuvialuit Renewable Resource Committees
Box 2120 Inuvik
Northwest Territories X0E 0T0
Canada
Tel.: +18677772828
Fax: +18677772610
Email: execdir@jointsec.nt.ca

Mr Stigur Stefansson
Althingi, International Department
Althingi
IS-150 Reykjavík
Iceland
Tel.: +3545630733
Email: stigur@althingi.is

Dr Garry Stenson
Marine Mammal Section, Science,
Oceans and Environment Branch,
Dept. of Fisheries and Oceans
P.O. Box 5667
St. John's, Newfoundland A1C 5X1
Canada
Tel.: +17097725598
Fax: +17097724105
Email: StensonG@DFO-MPO.GC.CA

Mr Tobias Frambe Svenningsen
Royal Norwegian Embassy
PO.Box 250
IS-121 Reykjavík
Iceland
Tel.: +3545200700
Fax: +3545529553
Email: embrek@mfa.no

Ms Arnbjörg Sveinsdóttir
Nordic Council
Althingi
IS-150 Reykjavík
Iceland
Tel.: +3545630500
Fax: +3545630460
Email: arnbjorg@althingi.is

Ms Despina Symons
European Bureau for Conservation & Development
10, Rue de la Science
B-1000 Brussels
Belgium
Tel.: +3222303070
Fax: +3222308272
Email: ebcd.info@ebcd.org

Mr Daniel Thorleifsen
Greenland Institute of Natural Resources
P.O.Box 570
DK-3900 Nuuk
Greenland
Tel.: +299321095
Fax: +299325952
Email: nygaard@natur.gl

Mr Joe Tigullaraq
Department of Sustainable Development
Government of Nunavut
P.O.Box 209
Igloolik X0A 0L0
Canada
Tel.: +18679342052
Fax: +18679342058
Email: jtigullaraq@gov.nu.ca

Ms Vicki Vanek
Alaska Dept. of Fish and Game - Subsistence Division
Alaska Native Harbor Seal Commission
P.O.Box 1163, 211 Mission
Kodiak 99615
USA
Tel.: +19074861833
Fax: +19073450555
Email: vicki_vanek@Fishgame.state.ak.us

Mr Gísli A. Víkingsson
Marine Research Institute
P.O.Box 1390
IS-121 Reykjavík
Iceland
Tel.: +3545520240
Fax: +3545623790
Email: gisli@hafro.is

Dr Lars Walløe
The Faculty of Medicin, University of Oslo
P.O.Box 1103 Blindern
N-0317 Oslo
Norway
Tel.: +4722851218
Fax: +4722851249
Email: lars.walloe@basalmed.uio.no

Ms Annette Watson
Geography Department, University of Minnesota
3539 15th Ave.S
55407 Minneapolise
USA
Tel.: +16128897542
Email: wats0148@umn.edu

Dr Michelle Wheatley
Nunavut Wildlife Management Board
P.O.Box 1379
Iqaluit, Nunavut X0A 0H0
Canada
Tel.: +18679796962
Fax: +18679797785
Email: Mwheatley@nwmb.com

Mr Glenn Williams
Nunavut Tunngavik Inc.
P.O.Box 638
X0A 0H0 Iqaluit, Nunavut
Canada
Tel.: +18679754924
Fax: +18679754949
Email: glennw@tunngavik.com

Mr Vladimir Yetylin
Association of Traditional Marine Mammal Hunters of Chukotka,
The State of Duma
2, Georgievsky per.
Moscow, 103265
Russian Federation
Fax: +70952926955

Dr Egil Ole Øen
The Norwegian School of Veterinary Science
Department of Arctic Veterinary Medicine
N-9292 Tromsø
Norway
Tel.: +4777665421
Fax: +4777694911
Email: egil.o.oen@veths.no

Ms Hanne Østgård
Directorat of Fisheries
P.O.Box 185 Sentrum
N-5804 Bergen
Norway
Tel.: +4755238000
Fax: +4755238090
Email: hanne.ostgard@fiskeridir.dep.no

NAMMCO Conference Staff

Dr Grete Hovelsrud-Broda
Ms Nina Larsen
Mr Daniel Pike
Ms Charlotte Winsnes

NAMMCO
Polar Environmental Center
N-9296 Tromsø
Norway
Tel.: +4777750180
Fax: +4777750181
Email: nammco-sec@nammco.no