REPORT OF
THE NAMMCO WORKSHOP TO ADDRESS THE PROBLEMS OF
"STRUCK AND LOST" IN SEAL, WALRUS AND WHALE HUNTING

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CONTENTS

Executive summary

Introductory remarks ........................................................................................................ 10
Introduction
Egil Ole Øen ..................................................................................................................... 10

Keynote addresses
The significance of struck and lost in marine mammal hunting and management
Daniel Pike ....................................................................................................................... 13
Struck and lost from a hunters perspective
Kale Mølgaard .................................................................................................................. 21

Factors that may influence struck and lost
Some factors that may influence the struck and lost rate in marine mammal hunting
Egil Ole Øen ..................................................................................................................... 23

Anatomy and physiology of marine mammals important for struck and lost
Siri K. Knudsen ............................................................................................................... 26

Monitoring of struck and lost marine mammals
Stefan Romberg ............................................................................................................... 28
Struck and lost in the harp seal hunt in Greenland: a questionnaire survey
Fernando Ugarte and Jens Jacobsen ................................................................................ 31
A study of struck and lost in the whale drive hunt in the Faroe Islands
Jústines Olsen ................................................................................................................. 38

Status of struck and lost in Japanese research whaling
Hajime Ishikawa ............................................................................................................... 44

Working Groups and specific recommendations ......................................................... 46

Working Group on seals ................................................................................................. 47
Working Group on large whales ..................................................................................... 51
Working Group on small whales .................................................................................... 57
Working Group on walrus ............................................................................................... 63

General overall recommendations ............................................................................... 67

Workshop Closure ........................................................................................................... 68

Appendix 1 Programme ................................................................................................. 69
Appendix 2 List of Participants ....................................................................................... 71
Appendix 3 List of Participants Working Groups .......................................................... 76
EXECUTIVE SUMMARY

The Workshop event:
This document represents the report from the NAMMCO Workshop to address problems of “struck and lost” in seal, walrus and whale hunting that was held in Copenhagen, Denmark 14 – 16 November 2006. The Workshop attracted 50 hunters, managers, scientists and interested participants from 11 countries.

Terms of Reference:
The Workshop was organised by the NAMMCO Committee on Hunting Methods and had the following terms of reference:

- To review hunting methods for seal, walrus and whale with respect to the problem of “struck and lost” (S&L)
- To identify possible studies of S&L to be undertaken in cooperation between researchers and hunters, in order to achieve accurate and reliable estimates of S&L
- To identify the reasons why some hunts have a high or low S&L rate
- To make recommendations on how to reduce S&L, in consideration of hunting techniques, equipment modifications, season, locality and reduction of animal suffering.

Goals of the Workshop:
The overall goal of the Workshop was to improve catch relative to effort, to reduce animal suffering and improve public image, and to formulate recommendations on methods, techniques and equipment to reduce struck and loss that are applicable at the local level.

The Workshop is the fourth in a series (1999, 2001, 2004 and 2006) that the Committee on Hunting Methods has organised to deliberate and review various issues related to the hunting of marine mammals. All workshops have resulted in recommendations. Reports from all workshops may be downloaded at www.nammco.no or may be obtained by contacting the NAMMCO Secretariat.

Structure of the Workshop:
The Workshop on Struck and Lost was structured into plenary, and working group sessions that were specific for Seals; Large Whales; Small Whales; Walrus.

All working groups addressed the same agenda and began with an invited presentation from an experienced hunter. All working groups formulated specific recommendations that are presented as part of the report from the working groups.

In addition, a set of general recommendations was formulated by the Drafting Committee based on the presentations and discussions of the plenary and working group sessions. These recommendations were presented in plenary and adopted by consensus for implementation by management authorities, hunters and researchers.

1. GENERAL RECOMMENDATIONS

1.1 Minimize animal suffering
The Workshop recommended that the hunters should make every effort to reduce unnecessary suffering by hunted animals, by minimizing killing times to the extent that is feasible. However this must be balanced by consideration of the safety of the hunter, and the risk of losing the animal.
1.2 Monitoring

The Workshop noted that the present information on struck and lost is outdated or inadequate for several species and areas, and that accurate estimation of struck and lost is important for effective management and essential to improve hunting practices.

The Workshop recommended that new monitoring programmes that are appropriate for local conditions should be developed that could produce accurate information that will be accepted by hunters and managers. Such monitoring programmes should be developed in full cooperation between hunters, managers and researchers.

1.3 Proper training of hunters

The Workshop recommended that hunters should be trained in both the theoretical and practical aspects of hunting, and that training materials and programmes should be appropriate to local conditions.

1.4 Hunting equipment

The Workshop recommended that hunters should always carry weapons and equipment appropriate to the target species and local hunting conditions, and that the equipment should be properly maintained and renewed when necessary.

1.5 Cooperative management

The Workshop recommended that the hunters should be involved in the marine mammal management process, including the development of regulations pertaining to hunting.

The Workshop furthermore recommended that the design, development and testing of new weapons and hunting equipment should be done in cooperation with hunters.

1.6 Sharing of technology and knowledge

The Workshop recommended that there should be open exchange and sharing of information about new weapons, equipment and hunting techniques, and that this should be done on both the national and international levels.

2. SPECIES-SPECIFIC RECOMMENDATIONS

2.1 SEALS

2.1.1 Hunter training

- Develop suitable training materials for each area and hunt. These could use various media, *e.g.* audiovisual presentations on DVD or broadcast locally; written materials, and internet sites.
- In areas where hunting is practiced, courses in hunting should be available in the school curriculum. This is already the practice in some areas, *e.g.* Finland. A comprehensive and advanced hunting education programme is under development in Greenland. In Norway it is mandatory to undertake a training course set up by the authorities before going hunting.

2.1.2 Techniques and equipment

- The type of equipment that is suitable depends on the area, species, season and local environment. Descriptions of suitable equipment for each situation should be developed by local authorities, and made available to hunters and educational institutions.
- Hunters should always have suitable equipment, in good working order, readily available when hunting.
- In situations when seals usually sink after death, it may be advisable to use small-calibre weapons and shoot to injure, not to kill. The injured seal can then be secured using a hook.
or harpoon, and then killed. This technique is effective in reducing struck and lost, but does likely result in greater animal suffering.

2.1.3 Regulatory measures
- In some areas it may be advisable to stipulate the minimum equipment that must be at hand when hunting. This is already done in most areas.
- In some areas, seasonal closures could be used to forbid hunting in seasons when seals usually sink after death. Such closures are used in Norway and Finland, but may not be suitable in areas where hunters must take seals year-round.

2.1.4 Monitoring
Independent observers and governmental inspectors have been effective in monitoring hunts for harp and hooded seals in Canada and Norway. However, it is not possible to use independent observers to monitor all seal hunts. The following alternatives were recommended:
- Self-reporting systems such as Pinniarneq in Greenland could possibly be modified to provide information on struck and lost;
- In other areas, community-based monitoring using post-hunt interviews, as used in Chukotka, may be effective;
- A programme using “index” hunters, trained and contracted to provide information on their hunting activities, which is later extrapolated to the entire hunt, may be effective in some situations.

2.2 LARGE WHALES

2.2.1 Hunters training
- To encourage training, in practice and in theory with: experienced hunters, experts on weapons and experts on anatomy;
- To produce educational material, including anatomical charts designed for whaling;
- In order to learn and improve, feedback to whalers should be improved, including feedback on: successful kills, problematic kills, cases of struck and lost and their causes.

2.2.2 Techniques and equipment
- To ensure that adequate equipment for securing and killing is well maintained, functioning and at hand;
- Time to death should be as short as possible, once the whale has been effectively secured;
- In order to prevent whales sinking when using harpoon cannon, it is recommended to:
  1) Cause instantaneous death
  2) Keep the back-up rifle at hand
  3) Keep harpoon and attachment points well maintained
  4) Use forerunners of adequate strength
  5) Replace forerunners at regular intervals
  6) Keep a back-up forerunner ready
  7) Use the air pump to inflate the whale where legally feasible
  8) Use grappling irons to secure the carcase.
- To improve the Norwegian penthrite grenade used for hunting fin whales in Iceland and in Greenland, in order to increase the rates of instantaneous death or unconsciousness.
- To facilitate access to good weather forecasting for whalers working from small boats;
- To avoid killing the whale before it has been secured sufficiently. This is especially true when using small boats to hunt whales that may sink.

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1 The workshop did not discuss the Japanese Fin whale hunt
To develop a gun to deploy harpoons attached to floats. This would shorten the time needed to secure whales that may sink when hunting from boats without a harpoon cannon.

2.2.3 Regulatory measures
- To strengthen international cooperation in order to facilitate: a) access to information and technology and b) purchase and transport of equipment, including weapons and explosives;
- Development and implementation of ways to reduce struck and lost should be done in close collaboration with the whalers.

2.2.4 Monitoring
- Reporting of the causes of struck and lost is needed to provide feedback to whalers.

2.3 SMALL WHALE

2.3.1 Hunter training
- Training is paramount – it should be community based and species specific. Local experienced hunters who are familiar with local environment should be employed to train.
- Traditional knowledge should be taught in high schools.
- Ways have to be found to counteract the negative effects of diminishing quotas and hunting restrictions on the acquisition of hunter skills in future generations.

2.3.2 Techniques and equipment
- Using more efficient equipment still does not necessarily diminish struck and lost. Thus a combination of suitable equipment and training is needed in the use of rifles and appropriate ammunition.
- Methods of improving access to long-range forecasting of weather conditions need to be found as weather is a very important factor in affecting struck and lost.
- Develop a weapon that could improve the range of strike, e.g. an air gun that could be modified to incorporate firing of a harpoon head. This could improve the firing / strike range and the securing of the whale.
- In hunting communities, suitable ammunition designed for marine mammals should be made more readily available.
- Use of high velocity rifles can result in hearing loss and steps should be taken to minimise this problem and disseminate technical information for user safety.

2.3.3 Regulatory measures
- The users (hunters) should be involved in decision-making processes concerning the hunt such as the planning of hunting quotas and in the areas of operation. User knowledge should be used in management in conjunction with science.
- Establishing formal meetings with local government officials on all aspects of hunting - equipment, safety, training, etc. where reduction of struck and lost can also be discussed. These meetings could establish local hunting rules and regulations, the required equipment, etc. that would help to mitigate struck and lost.

2.3.4 Monitoring
- All parties (hunters, administrators, managers, biologists) have to get together to find a way forward on the matter of recording and reporting stuck and lost. One route could be to establish local sub-committees to work out an acceptable and appropriate monitoring system in hunting areas.
2.4 WALRUS

2.4.1 Hunter training
- Walrus hunters should be properly trained and their training should be appropriate for the local environment. Such training can occur through traditional methods, formal schooling and other media such as video and the internet. It was specifically emphasized that inexperienced hunters should accompany experienced hunters on hunts.

2.4.2 Hunting techniques
- When hunting walrus on ice floes, the hunter should approach as closely as possible before shooting. The hunter should shoot animals in the centre of the group first so that killed animals won’t be pushed into the water by the others.
- In open water hunts, it is best to harpoon before shooting, but this is not always feasible. It may be necessary to shoot the walrus in the body and lungs to disable it so that it can be harpooned, and then shoot it lethally. This will reduce the incidence of struck and lost and the chance of the walrus attacking the hunter.
- Hunters should obtain the best available forecasts before setting out, only initiate hunting if the weather conditions are right, and abandon hunting if the weather deteriorates.

2.4.3 Hunting equipment
- Hunting equipment is often specific to particular regions and seasons, and is adapted to local conditions. Local authorities should compile descriptions of equipment suitable for each area and make these available to hunters and teachers.
- Hunters should ensure that proper equipment is available and well maintained.
- Technological innovation could reduce the incidence of struck and lost in some hunts. A harpoon gun that would be effective at a range of 10-15 m would be particularly effective in walrus hunting.

2.4.4 Monitoring
- The importance of monitoring must be explained to hunters so that they can “buy in” to a monitoring programme.
- A monitoring system should provide feedback to hunters so that they can improve their hunting techniques.
- Community-based monitoring, based on a combination of hunt observation and post-hunt interviews, has been effective in Chukotka and could be adapted to other areas.
- A system based on “index hunters” may be effective in some areas.
INTRODUCTORY REMARKS

Dr Christina Lockyer, General Secretary to NAMMCO, welcomed the participants and expressed gratitude for the financial support to the Workshop from the Nordic Council of Ministers, the North Atlantic Cooperation (NORA) and Indigenous Survival International Greenland. Finally she thanked the Representation Offices of Greenland and the Faeroes for hosting a reception on 14 November for the workshop participants.

Workshop structure and Drafting Committee

Dr Egil Ole Øen from the Norwegian School of Veterinary Science, Section of Arctic Veterinary Medicine, Norway, chaired the Workshop. Dr Øen was also the present chair of the NAMMCO Committee on Hunting Methods which has initiated and organised the Workshop. Mr Glenn Williams, Wildlife Advisor to the Wildlife Department of the Nunavut Tunngavik Incorporated (NTI), Canada served as co-chair and chair of the Drafting Committee. The Drafting Committee was established to facilitate the work with formulating recommendations from the Workshop. Christina Lockyer, Daniel Pike and Charlotte Winsnes from the NAMMCO Secretariat acted as rapporteurs.

The Workshop was divided between plenary sessions and four working group sessions of which two ran in parallel.

INTRODUCTION

By Egil Ole Øen, Norwegian School of Veterinary Science, Section of Arctic Veterinary Medicine

“It is my pleasure as Chair of the Workshop to welcome you all and to say a few words as an introduction to the next three days here in Copenhagen.

At its 14th Annual Meeting in March 2005 the NAMMCO Council agreed to the recommendation from the Committee on Hunting Methods to hold a Workshop addressing the problems of struck and lost in seal, walrus and whale hunting. The Workshop was given the following terms of reference:

- To review hunting methods for seal, walrus and whale with respect to the problem of “struck and lost” (S/L)
- To identify possible studies of S/L to be undertaken in co-operation between researchers and hunters, in order to achieve accurate and reliable estimates of S/L
- To identify the reasons why some hunts have a high or low S/L rate
- To make recommendations on how to reduce S/L, in consideration of hunting techniques, equipment modifications, season, locality and reduction of animal suffering.

The overall goal of the Workshop was stated as: To improve catch relative to effort, to reduce animal suffering and improve public image, and

the Workshop objective: To formulate recommendations on methods, techniques and equipment to reduce S/L that are applicable at the local level.

Coastal people's right to hunt and utilise marine mammals has always been a firmly established principle in NAMMCO. Embedded in this right is also an obligation to conduct the hunt in a sustainable way and also in such a way that it minimizes animal suffering.

The Committee on Hunting Methods was established in 1994 to facilitate NAMMCO's work in this field and to give advice on hunting methods to the Council and the member countries.
A prerequisite has always been that the advice given must be based on the best available scientific findings, technological developments and user knowledge with due consideration to safety requirements / hunters safety and the efficiency of the utilisation.

The Committee on Hunting Methods has chosen to organise most of its work through the convening of international workshops. Over time the workshop series has in my mind quite successfully developed into an arena where hunters, managers and scientists sit together and openly discuss issues of common interest. To ensure the “usability” of the workshops in the real world, an important aspect has always been that a given workshop should result in recommendations on both a general and more specific level.

The first Workshop was held in Nuuk, Greenland in 1999 and addressed different hunting methods for different species of whales and seals under various conditions. The second was held in Sandefjord, Norway in 2001 addressing ballistics, ammunition and weaponry and the third was held in Copenhagen in 2004 where we discussed hunting methods for seals and walrus under different seasons and conditions.

This present Workshop on stuck and lost is therefore the fourth in the series, and as such is very much an extension of the previous three. At the last Workshop in 2004 it was clearly recognised that we know too little about struck and lost estimates, more so in some hunts than others, and that we need to develop methods, techniques and equipment to reduce struck and lost that are applicable at the local level in order to ensure that these are functional in a given locality.

In the coming days we will review various hunting methods from the perspective of struck and lost (S&L). How successful the workshop will be is entirely up to us all. As participants you are asked to share your knowledge to provide a basis for exchange of information and for an evaluation of the different hunting methods in relation to the S&L rates. Our overall aim for the workshop is to create a dialogue and openness around an important and sensitive issue in order to improve catch relative to effort, reduce animal suffering and improve the public image of hunting, and we want to end up with some recommendations on methods, techniques and equipment to reduce S&L that are applicable at the local level.

I think we can agree that S&L is perceived as a problem for the hunters, the managers and the concerned public. To lose an animal is clearly not optimal for the hunter. In order to make sustainable estimates when setting quotas, the managers need reliable information on S&L, and we live in a world where it is widely held that reducing animal suffering is both important and ethical correct. In fact this represents the very rare situation where all of us have everything to win and nothing to lose by taking part in the debate and discussions with an open mind and an eye for being constructive. To achieve our goals we need to give credit where credit is due and be respectful of the multitude of living conditions that we, as a group, represent.

In my view this workshop represents so much expertise on the various aspects of hunting that I am quite optimistic that we as a minimum will be able to bring with us some new thinking and possible solutions on how to reduce struck and lost when we return home. We will not, during these three days, be able to solve the issue of S&L for all hunts but we will as a minimum know a lot more that we hopefully can use in our effort to reduce the problem in our daily lives.

We must bear in mind that this arena and this Workshop will only be as constructive and successful as we make it. Let me therefore end this introduction by a word of caution.
In order to make good recommendations we need to keep the discussion on a general level, and work towards identifying the strong and weak points connected to a certain hunting activity. By this I mean that one-time incidents seldom contribute constructively; on the contrary, they often misinform and delude more than they clarify.

I also want to stress and underline that the question we discuss at this Workshop is NOT whether hunting should be conducted or not, but rather how in respect to factors like hunters economy and safety, full utilisation and suffering of animals, the hunt can best be conducted.

Furthermore, let us keep in mind that NAMMCO is a totally different organisation with a very different attitude and debate than what we have experienced in the International Whaling Commission (IWC). The tendency in IWC has been that the hunter in some quarters is looked upon as the "enemy", whereas in NAMMCO the hunter has always been an important co-player."
KEYNOTE ADDRESSES

THE SIGNIFICANCE OF STRUCK AND LOST IN MARINE MAMMAL HUNTING AND MANAGEMENT
By Daniel Pike, NAMMCO Secretariat

Introduction
The loss of animals that have been struck by a weapon or projectile (struck and lost- S&L) is a problem that occurs in all types of hunting, but one that is particularly prevalent in hunts for marine mammals. Unlike land animals, marine mammals can sink after death and become irretrievable for the hunter. Consequently loss rates tend to be higher for sea hunts than for land hunts. S&L has consequences both for the hunter, and for the management of hunting in general. For the hunter S&L represents a loss of income and is problematic in terms of ethics and public image. Particularly, unreported S&L can lead to the mismanagement of hunting and possibly to rates of removal that are unsustainable by the population.

What is it?
To understand the phenomenon of struck and lost, we must first look at the words themselves. An animal is said to be “struck” when it is hit by a weapon, such as a harpoon, or by a projectile, such as a bullet or grenade. This can have several outcomes, not mutually exclusive:

1. Animal is injured, and continues to be pursued by the hunter;
2. Animal is injured and escapes the hunter;
3. Animal is killed but not landed, or lost during the landing process;
4. Animal is killed and landed by the hunter.

Cases 2 and 3, where the animal is “lost” to the hunter, are cases of S&L.

The fate of animals that are injured but escape the hunter (case 2 above) is usually uncertain. If the injury is slight it may be of little consequence for the animal. At the other extreme the animal may die shortly after it escapes the hunter. In other cases the animal may be seriously injured but survive, and the injury could have long-term consequences for the health of the animal and its reproductive success. Thus even injuries that are not fatal to the animal can have population-level effects, in terms of reproductive losses.

For the hunter, the immediate consequences of an S&L event are more straightforward. The hunter may spend a substantial amount of time and effort in searching for the animal, but eventually must give up the search and either continue hunting or stop for the day. In either case S&L represents an immediate loss to the hunter.

Consequences of struck and lost
Struck and lost has consequences over and above the injury or death of an animal and the immediate loss to a hunter. S&L must be considered in any programme of wildlife management to ensure sustainability of harvests. While most would consider hunting an activity with ethical justification, it becomes less defensible if the quarry is lost. This can have consequences to the public image of hunters in society as a whole.

Wildlife management
The concept of managing the hunting of animals to ensure long-term sustainability is simple in theory. The number of animals in a particular population at any point in time depends on three things (Fig. 1):

1. The rate of natural death, through predation, disease, old age, etc.;
2. The rate of reproduction;
3. The rate of death by hunting activities, including animals that are killed but lost.
Usually, at any one time, a wildlife manager will have direct information on the number of animals in the population (abundance) at one or more times in the recent past, and the number of animals that have been landed by hunters in recent years. Rates of natural death and reproduction are usually taken from other studies and assumed to apply to the population in question. Estimates of abundance are generally derived from surveys carried out at intervals of 1 or several years. Estimates of landed catch come from harvest monitoring programmes. In almost all cases, monitoring programmes provide estimates of landed catch, not including animals that are struck and lost. This is important because some proportion of the animals that are struck and lost die, and are lost to the population in the same way that landed animals are.

“Sustainable catch” can be defined as the number of animals that can be removed from the population over time without reducing the population below a pre-defined target level. It depends on the productivity of the population, which is itself a result of the interplay between the rates of natural reproduction and natural death. These are themselves affected by the current abundance of the population relative to the number the environment can support (carrying capacity), in that a population at carrying capacity has no net productivity over time. This occurs because the increasing scarcity of resources, such as food, as the population approaches carrying capacity can decrease the rate of reproduction and increase the rate of natural death. All these factors must be included in a mathematical model of the population that can predict the future abundance of the population, depending on the observed abundance in the recent past, and recent harvests (Fig. 2). Such a model can also predict a level of harvest that will result in a stable abundance over time - a sustainable catch level.

Problems arise when the reported catch that is used in modelling does not include animals that are struck and lost, but die and are lost to the population. In terms of modelling these are the same as landed catch in that they are lost to the population and cannot contribute to future reproduction. Therefore, if the reported catch that is entered into the model is in a sense erroneous in that it does not include all animals removed from the population. We can consider the effects of this by looking at two cases.

Case 1
In this case, the sustainable catch is estimated using recent abundance estimates and assumptions about the productivity of the population in a population model. Hunters are then allowed to take animals up to the sustainable catch level. However, the hunters also lose animals, and some of these die. These are not reported. As a result, the actual removal of animals from the population is higher than the sustainable catch level, causing the population to decrease over time.

Case 2
In this more complex case, the sustainable catch is estimated using a series of population estimates, and a history of the landed catch for as far back in time as is available. The productivity of the population is estimated by the apparent effect of these catches on the abundance of the population over time. For example, if the population has decreased over time, we would conclude that the catch has exceeded the productivity of the population, and set levels of sustainable catch that are lower than recent catch levels in order to stop the population decline. However, past catches have included an unknown and unreported level of struck and lost animals which die and are also lost to the population. Therefore the actual removals from the population have been higher than reported, which means that erroneous data have been used in the population model. As a result, the productivity of the population is underestimated, and the sustainable catch level is also set too low. In this case, catch levels for hunters would be set at a level lower than they could have been if the actual levels of removal (including S&L) had been known.
In summary, unreported S&L can result in a population being over-harvested and consequently lead to depletion over time. Perhaps counter intuitively, it can also lead to sustainable catch being underestimated and consequently lost harvesting opportunities for hunters.

**Ethics**

Ethics can be defined as the moral values and rules which govern our conduct. Simply put, our ethics tell us what is right and what is wrong. Of course this can vary between cultures, religions and even individuals. However, most of us can agree on two central points that go right to the heart of hunting and wildlife management:

1. The sustainable use of marine mammals is ethically defensible;
2. Causing unnecessary suffering to animals is ethically wrong.

Acceptance of the first point is a prerequisite for all hunters, and the second derives from our respect and concern for our fellow creatures. Indeed in 2004, a NAMMCO Workshop on seal hunting methods recommended that “…hunters should make every effort to reduce unnecessary suffering by hunted animals, by minimizing killing times and avoiding letting injured animals escape. Such efforts should have priority for all hunts.” Therefore it seems logical and ethically correct to suggest that hunters should strive for an instantaneous or quick kill under every circumstance.

Unfortunately a discussion of ethics is rarely so simple. In many cases, the goal of minimizing S&L conflicts directly with the goal of minimizing animal suffering by killing the animal quickly. All seal and whale hunters know that one of the best ways of preventing struck and lost is to “secure” the animal, usually using a harpoon, before it is killed. This makes it possible to retrieve the animal should it sink in deep water. However it is obvious that this prolongs the period between when the animal is first injured by the harpoon and when it is killed, and thus the suffering of the animal.

An illustrative example of this is the rifle hunt for minke whales (*Balaenoptera acutorostrata*) carried out in West Greenland and documented by Larsen and Hansen (1997). Typically a whale is sighted and pursued by several small boats. Shots may be fired at the whale to tire it by preventing it from breathing at the surface and sometimes to injure it to slow it down. Hand harpoons, with floats attached, are thrown at the whale until it is judged that the flotation is sufficient to prevent the whale from sinking. Only at this point do the hunters attempt to make killing shots on the whale. The entire process can last a considerable period of time, during much of which the whale is presumably suffering intensely from its injuries.

This basic method of hunting, by securing the animal with one or more harpoons before killing it, is widely practiced and applied to seals, walrus and small whales such as narwhal and beluga. Also the practice of shooting an animal with the intent to injure it to slow it down, is common. Such techniques obviously reduce the risk of struck and lost and increase the chance that the animal will be landed. But they do conflict with the objective of killing animals quickly to minimize their suffering.

Indeed killing an animal quickly can be directly detrimental to the objective of reducing struck and lost. A quote from Fay *et al.* (1994) regarding walrus (*Odobenus rosmarus rosmarus*) hunting is illustrative of this: “During our 21-year period of observation, we also saw the firepower of the hunters improve markedly, with old weapons … gradually replaced by newer, higher-powered rifles…. Our data indicate, however, that while the hunters’ ability to kill walruses increased steadily during that period, this only increased the proportion of outright kills among the struck and-lost animals; it did not increase the proportion retrieved of the animals that were shot”. Similarly it is well known among hunters that shooting a seal
NAMMCO Workshop to address problems of "struck and lost" in seal, walrus and whale hunting

Lethally in open water during seasons in which they sink (spring and early summer) increases the chance of losing the seal. For this reason many seal hunters prefer smaller calibre weapons that do not kill the animal outright, allowing the hunter to secure the seal with a harpoon or hook before it sinks.

Ideally then, the hunter would achieve the two objectives of minimizing struck and lost and minimizing animal suffering by securing and killing the animal simultaneously or nearly so. This has been largely achieved in vessel hunts for minke and larger whales, where the whale is secured by the harpoon cannon and the grenade is fired into the whale at the same time, usually resulting in instantaneous or rapid death (Knudsen 2004). While similar technical innovation may be possible for small whale, walrus and seal hunts, there is little evidence that it is occurring. For the time being, hunters will have to balance these two objectives. It is likely that the appropriate balance will depend to some extent on the conservation status of the stock in question. For example, in cases where harvesting opportunities are limited by quotas, minimizing struck and lost is a paramount objective, and every effort should be made to secure the animal to prevent loss, even if this results in a less rapid kill. For other stocks where conservation is less of a concern, for example Northwest Atlantic harp seals, a higher loss rate may be an acceptable price to pay for causing less suffering to the animals.

Waste

It is obvious that an animal that is struck and not landed by the hunter results in a loss of meat, skins and other valuable products that the hunter would have had if the animal had been landed. If the animal subsequently dies, it can be said to have been killed needlessly, in that the hunter derives no benefit from its death. While this might be thought of in terms of ethics, it is also a question of economics. The hunter has likely used up a considerable amount of time, as well as fuel, bullets, food, and wear on equipment. These resources have therefore been “wasted” in that their expenditure has produced no benefit to the hunter. In addition the hunter must now continue hunting, and will perhaps take an animal in addition to the one that has been lost.

It cannot, however, be said that an animal that is shot and sinks before it is retrieved is “wasted” in an ecological sense. Death is the fate of all animals, and death at sea is the norm for marine mammals. Therefore, the cycling of animal carcasses is a natural part of all ecosystems. In contrast an animal that is landed and its remains disposed of on land may constitute more of a loss to the marine ecosystem

Public relations

The general public in most countries is uninformed about the hunting of marine mammals. What they hear is often the rhetoric of anti-hunting groups campaigning to end all hunts of marine mammals. The fact that some animals are shot but escape, only to die long, painful deaths, provides potent ammunition to these groups. Animal suffering has been an important component of campaigns to stop commercial whaling and sealing. While most people are willing to accept the sustainable use of natural resources, they expect it to be done in a responsible manner, both in terms of conservation and the minimization of animal suffering. Put simply, struck and lost gives hunters a bad name. By minimizing it, and being seen to be making real efforts to do so, hunters can demonstrate that they are responsible and make progress in the field of public opinion.

What can be done?

Strategies to address the problem of struck and lost can be divided into two categories: those that deal with the consequences of struck and lost to wildlife management, and those that attempt to reduce or eliminate struck and lost. Given that the problem will likely never be entirely eliminated, effort is needed in both areas.
Reporting and monitoring
As discussed above the estimation of sustainable catch becomes unreliable if the levels of removals, including struck and lost animals, are not known. Monitoring of struck and lost, including an estimation of the numbers of animals that are likely to die from their injuries, is therefore crucial to successful wildlife management. Monitoring is also necessary to ensure that sustainable removal levels that have been set are not exceeded.

Monitoring systems are part of a separate presentation (see presentation by Romberg) and will not be covered in detail here. It is generally the case that harvest monitoring programmes for small whales, seals and walrus do not include estimates of struck and lost. It is in fact very difficult to monitor struck and lost effectively. Those few studies that have been done, cover only a small area or a short period of time, and often do not cover all types of hunts. Despite these limitations, wildlife managers often have no alternative but to use the information that is available, and therefore make use of the studies that have been done. This often leads to criticism from hunters that the data used are outdated and erroneous. An effective monitoring programme requires cooperation and trust between hunters, researchers and wildlife managers; something that is all too often in short supply.

Most monitoring programmes, other than those for large whale hunts and large-scale commercial hunts, rely on some type of self-reporting by hunters, either through hunters keeping records in a standardized format or through post-hunt interviews. In both cases it is assumed that the hunter will report the information honestly and accurately. But hunters may not feel it is in their best interests to report accurately or to report at all. Hunters are aware that, if the existence of a significant level of struck and lost becomes known to wildlife managers, it may lead to lower levels of allowable catch in the future. If it becomes known to the public, it will give ammunition to the anti-hunting lobby. Also, hunters often find struck and lost to be an embarrassment because it reflects badly on their skill as hunters. Therefore they may be reluctant to report struck and lost, or may report falsely if they perceive it is in their best interest to do so. As a result, estimates of struck and lost from such programmes tend to be negatively biased.

Another problem common to all monitoring programmes is that a degree of judgment is required to predict whether or not an animal that has been struck has been seriously injured and is likely to die. While in some cases this will be obvious, in many it is not, and it is indisputable that some animals do survive being wounded by hunters. Objective criteria must be established and applied to standardize this assessment to the extent possible.

Robust management system
It is feasible to design a management programme that will provide estimates of sustainable catch under conditions when estimates of struck and lost are not available or are not reliable. In fact, to the extent that struck and lost is considered at all, most marine mammal management is presently done using such a procedure.

Under such a system, it is recognized that the reported catch does not include all removals and is therefore negatively biased. Modelling is then carried out under several reasonable assumptions about the levels of struck and lost, to determine how sensitive the estimation of sustainable catch is to this factor. If the estimation is sensitive to struck and lost, estimates of sustainable catch under all plausible levels are provided, and the most appropriate one is chosen depending on the conservation status of the stock in question. For example, if a stock is already known to be depleted, high levels of struck and lost may be assumed so that the risk of further depleting the stock is minimized. Procedures akin to this have been used by the NAMMCO Scientific Committee in their assessments of West Greenland beluga and narwhal (NAMMCO 2001, 2004, 2006).
Because struck and lost is not actually monitored, the actual removals from the population are not well known (greater uncertainty), so the estimation of sustainable catch will also be less certain. Under such conditions there will be a tendency to err on the side of caution and choose a lower level of sustainable catch than might be advisable if the prediction of sustainable catch was more precise. Therefore it is likely that less catch will be available to hunters under such a management system. It will also be necessary to monitor the population more frequently, by conducting surveys at more frequent intervals. Despite the problems inherent in monitoring struck and lost, it is generally less expensive to do so than to mount a large scale population survey. Therefore monitoring of struck and lost can be cost effective when the entire management system is taken into consideration, and result in generally higher levels of catch available to hunters.

**Reduce or eliminate struck and lost**

Clearly the best way to deal with any problem is to reduce or eliminate it. Given the expertise available at this conference I will not attempt to specify in detail ways to reduce or eliminate struck and lost, but merely point out some general avenues that could be pursued to do so.

**Hunter training**

It is clear that some hunters are more skilled than others. It is also very likely (although this has not been studied) that skilled, experienced hunters strike and lose fewer animals than those who are less so. This is at least partly a matter of judgment: knowing when to take the shot, and knowing when not to. Most hunters learn by accompanying more experienced hunters on hunts. However, in some areas, with the breakdown of traditional societies, the opportunities for doing so may have become fewer. It may be necessary to at least partially institutionalize some aspects of hunter training, by teaching hunting skills in the schools or as separate programmes. It may also be possible to use other media, such as television and the internet, to teach some hunting skills. There is no substitute for experience however, so skilled hunters should be encouraged to allow less experienced hunters to accompany them on hunts.

**Proper equipment**

The equipment used by hunters must be suited to local conditions and maintained in good condition. Hunters should not hunt if they do not have proper, functional equipment on hand. Equipment to secure the animal before or after it is killed, such as a harpoon, line and float or a grappling hook, is especially important to prevent struck and lost.

**Technological innovation**

Marine mammal hunters are not numerous, and therefore not a large potential market for manufacturers and developers of weapons and equipment. Consequently most hunters use basic equipment that would be recognizable to a hunter a hundred years ago. There have been some exceptions to this. The development of reliable harpoon gun technology by Sven Føyn in the 1860’s made hunting for the fast rorquals, such as blue (*Balaenoptera musculus*) and fin whales (*Balaenoptera physalus*), possible (Tønnessen and Johnsen 1982). More recently there have been developments in the type of grenade used in minke (Norway and Greenland) and bowhead (Alaska and Canada) whale hunts that have shortened time to death and reduced the incidence struck and lost (Øen 1995). Unfortunately there has been no recent development in techniques and equipment for securing and killing small whales, seals and walruses. The development of equipment that can simultaneously secure and kill the animal is an obvious goal for technological innovation. Such development requires funding, however, and there is little likelihood that it will occur without external support.

**Regulation**

Hunting regulations can proscribe the equipment and techniques that must be used in hunting and therefore can have a direct effect on the incidence of struck and lost. A recent example of
this are the new regulations for hunting walrus in Greenland, which require the hunter to harpoon the walrus before the killing shot is made (Grønlands Hjemmestyre 2006).

**Conclusion**

Hunters are in general proud of their way of life and their skills, knowledge and experience. No hunter wants to lose an animal that he or she has injured, and most consider it a matter of honour and conscience to retrieve every animal they kill. Struck and lost means more than an immediate loss of income for the hunter. It has implications for wildlife management that can lead to unsustainable harvesting and a long-term reduction in catch for hunters. The ethical issue of animal suffering also has ramifications for the prevention of struck and lost. While the escape of an injured animal can lead to suffering and a slow painful death, it is also the case that the securing of an animal before it is killed slows down the process of killing and therefore increases suffering. Hunters, managers and researchers should use every means available to reduce struck and lost, preferably without unduly increasing killing times. However it is probably inevitable that some marine mammals will be struck and lost in all hunts. It is therefore crucial that hunters and managers should cooperate to ensure that accurate and complete data on struck and lost are gathered and used in wildlife management. Only in this way can we ensure the long term sustainability of animal populations, and thus of hunting itself.

![Diagram of population dynamics with arrows for reproduction, natural death, and hunting](image)

**Fig. 1.** The abundance of a population is dependent on reproduction, natural death and death from hunting.
Fig. 2. The estimation of sustainable catch is usually done using a population model with the input of information on past abundance and catch.

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STRUCK AND LOST FROM A HUNTER'S PERSPECTIVE
By Kale Mølgaard, The Organisation of Fishermen and Hunters in Greenland - KNAPK

In terms of struck and loss of marine mammals, I believe that I have to explain both the different causes as well as the vital importance of hunting for the Greenlandic people - and their problems in pursuing this profession in today's world.

Ever since our country was first populated, our sole source of survival came from marine mammals. This is still the case in certain areas where marine mammals are the primary source of income. Living off animals in the Arctic is crucial because farming is not an option. Especially in the northern regions it is very cold and the land is covered with a thick layer of snow for most of the year. If we are to sustain ourselves physically we have to use meat and blubber from seals, whales and other animals with red meat. Outsiders who have come to appreciate the terms of living in our region can very well understand what we are talking about.

In the past, children were brought up to become hunters from an early age as hunters were the pillars of our society. In recent years, however, only a limited number of school children also participate in hunting activities, and it is these children who choose to become hunters. Because of the increasing amount of rules and regulations, only a small number of children and youth who are interested in becoming hunters actually choose this profession in the end.

Animals migrate through our land at different times of the year. During the winter narwhal, beluga, walrus and ringed seals frequent our regions. During the summer and the fall harp seals, young harp seals and others are hunted. The beluga (Delphinapterus leucas) arrive in the Disko Bay region in the month of November, where they are hunted if weather permits. Half a month later, the narwhal (Monodon monoceros) arrive south of the Disko Island. These too are hunted, if weather permits. Often they are not hunted at all throughout the fall because the weather is unstable during this period. Thus nature and weather are key factors in our lives as hunters. During the fall other animals, especially larger whales, migrate to the south and will not be back until next spring.

It has been a growing trend in the last years to make scientific abundance estimations and counts. Often it seems like a mere fad, where everyone wants to ‘pitch in’ because it is ‘fashion’. Narwhal and beluga have been counted for two consecutive years, and it has been declared that they are in danger of extinction and dubious results have been presented to the hunters. The fact is that there is a growing number of lean whales because they simply have become too numerous. This is also the case with seals. The number of beluga and narwhal being caught has declined due to regulation. In previous years, several thousands have been caught with no impact on their numbers in general, and now that we catch less than 500, it is being declared that their numbers are decreasing!

Let me take the minke whale count a few years ago as an example. It was reported that only two had been sighted. If this case was to be taken seriously the future would indeed be very grave. It was quickly deduced that minke whales were in danger of extinction. But we hunters deduce otherwise by watching them – even though we do not count them – their numbers are indeed increasing.

When counts and surveys are being conducted, the Greenlandic hunters are not consulted about where and when it would be best to conduct such surveys. It is therefore understandable that hunters and others who are knowledgeable about the animals and their migration patterns are not satisfied with these activities. Things have to change.
I have to say that if the number of regulations increase this will be very hard for coming generations. Since scientifically questionable regulations are being sanctioned and biologists produce questionable results and advice to the Government that are not in “harmony with reality”, we feel that the hunting profession is in danger of extinction. This is because an excessive love for animals prevails over our very lives as hunters.

If one is to adhere to the belief that hunters conduct their profession in an unsustainable manner, I would dare to say that such an observation is false. A hunter, in my opinion, respects his profession and is a strong proponent for sustainable harvest of the animals. A hunter does not kill for the sake of killing. A hunter does not take more than he needs and is mindful of the needs of the generations to come. But ever since regulations took effect over the last few years, we have had no choice but to take all the animals that we have been allowed to catch.

With regard to struck and lost, I cannot fully support the estimates that the public administration and biologists have calculated over the recent years. If one looks back 50 years, it is not possible to compare those data with the data today, bearing in mind how technologically advanced we have become in this day and age. The estimates given then and the estimates given today seem to contradict one another. Today we are able to travel with speeds up to 30-40 knots in fast dinghies, thus we are able to reach a lean animal that would otherwise have sunk in previous years - we are able to reach it very fast, and if it is a seal, we are able to hook it before it sinks. Many people now use lances with iron harpoon heads and we are able to harpoon the animal before it sinks too deep. According to my estimations struck and lost rates do not exceed 5%.

In terms of struck and lost, we have become so technologically advanced that the number of animals struck and lost are fewer as compared to previous years. Animals struck and lost is of course in no one’s interest, especially during the spring seal migrations. This spring migration lasts a short period, and from experience I believe the number to be less than 5%.
FACTORS THAT MAY INFLUENCE STRUCK AND LOST

SOME FACTORS THAT MAY INFLUENCE THE STRUCK AND LOST RATE IN MARINE MAMMAL HUNTING

By Egil Ole Øen, Norwegian School of Veterinary Science, Section of Arctic Veterinary Medicine

Summary prepared by the Secretariat.

Hunting methods and hunting gears are at some level adaptations to biology and logistics.

Marine mammals are characterised by the fact that they spend their whole lives in the water or close to the water edge and as a result may be difficult to approach by humans. They are able to make themselves inaccessible for long periods of time by diving. Furthermore most marine mammal species are in a negative state of buoyancy in water, and with a few exceptions they therefore sink after being rendered unconscious or dead.

Many species are impossible or dangerous to approach closely before they are immobilised or rendered unconscious or dead. Hence the stunning and killing device must in general be applied at some distance from the animal.

Some hunting gears are designed to stun, kill, secure and retrieve the animal in more or less one and the same operation. In order to achieve this effect the stunning and killing device must be able to inflict so much damage to vital organs that, as a result, the animal dies fast. Some types of hunts make it necessary to combine different gears and methods to obtain these results.

There is a variety of weapons and gears used to kill and retrieve the animals: Harpoons, explosive grenades, firearms, lances, knives, hakapik, clubs, and nets. For some types of weapons the design might vary somewhat depending on which species they are used for, traditions and locality. For some weapons the principal design might sometimes be very old. There are also different types are harpoons. They can be delivered either by harpoon guns or thrown by hands.

Likewise, there are numerous factors that will influence the hunter's choice of weapons such as: species, traditions, environmental conditions, availability of weapons, economy etc.

The presenter then gave a brief overview of the various hunting characteristics of the different species large whales, small toothed whales, seals and walrus.

WHALES

Larger whales are commonly hunted from boats. The boats may very in size and/or type depending on the species and/or environmental conditions. Some species are also hunted from the ice edge. With a few exceptions large whales are to day traditionally harpooned simultaneously with the delivery of a detonating device (exploding grenade).

Fin and Minke whale

The fin whale sinks upon death, and is hunted from larger whaling boats (Iceland) or smaller fishing boats (Greenland). Minke whales also sink upon death and are traditionally hunted from small fishing boats rigged for whaling in the season (Greenland, Iceland and Norway), but also from larger boats (Japan).
Fin and minke whales hunted from larger boats and fishing boats are killed using harpoon guns with harpoons carrying detonating grenades, and with rifles used as back-up weapons.

**Collective hunt (rifle hunt) of minke whales in Greenland**
The exception is the collective hunt of minke whales in Greenland, which is carried out using (dinghies) speedboats with outboards motors. The whale is wounded by rifle shots directed to the abdomen, lungs and spinal cord when surfacing in order to avoid that the animal sink before it the whale is harpooned with a hand held harpoon and killed using rifle or lances.

**Bowhead whale** (*Balaena mysticetus*)
The bowhead whale floats upon death (right whale) and is hunted in Alaska (USA), Chukotka (Russia) and Nunavut Canada. Traditionally it is hunted from skin boats using sail or outboards, at the ice edge (Alaska) or from speedboats using outboard motors (Alaska, Chukotka and Nunavut). The whales are secured and killed using the traditional darting gun, which delivers a harpoon connected to a float simultaneously with the delivery of an exploding grenade. Both darting guns and shoulder guns delivering exploding grenades might be used as back-up weapons.

**Grey Whale** (*Eschrichtius robustus*)
The grey whale sinks upon death, and is mainly hunted in Chukotka. Speedboats with outboards motors are used for the hunt, and the whale is harpooned with several hand held harpoons connected to floats to prevent it from sinking. After harpooning the whale is killed using firearms, often in combination with darting guns or lances. Great care must be taken when approaching a wounded grey whale as it is likely to attack and damage the boats.

**Humpback whale** (*Megaptera novaeangliae*)
The humpback whale floats upon death and is hunted in St.Vincent and the Grenadines. Boats with outboards motors and/or sails are used for the hunt. The whale is first harpooned with hand held harpoons connected to floats, and then killed using lances.

**Small toothed whales**
The hunting methods and gears vary considerably. In the traditional Arctic hunt the whales are harpooned with hand held harpoons from the ice edge, from small boats or kayaks. The whales are killed using lances or firearms. In some hunts the animals are shot with firearms first and harpooned afterwards. If the animal is not dead from the rifle shot it is killed using lances.

**Pilot whale** (*Globicephala melas*) **hunt in the Faroe Islands**
The whales are herded ashore using different types of small fishing or speed boats. When the school of whales is sufficiently close to the beach the hunters enter the water. The whales are rendered unconscious and dead on the beach using a knife to cut and severe the spinal cord and the vertebral arteries that support brain with oxygenated blood.

**SEALS**
The hunting methods vary considerably throughout the world, but in general, seals are hunted both on ice, on dry land (islets, beach etc.) and in the water. The method used depends on i.e. species, hunting traditions, time of year and environmental conditions.

Seals hunted on the ice are usually shot using firearms and/or clubbed with hakapik or other types of clubs. Further information and details were left to the working group.
WALRUS

The walrus generally sinks upon death. In traditional hunting practices walruses are hunted cooperatively by several hunters using harpoons and lances. The walrus is stalked at land haulouts or along the flow edge, or by approaching them in kayaks while they are hauled out onto ice pans.

When hunting walrus in the water, it will usually first be wounded by shots to the lungs and/or spinal cord when it surfaces for air. The injured animal is then harpooned before a killing shot is made. Modern hunters usually prefer to target walruses hauled out onto large flat ice pans. The animals are usually killed using high powered rifles. Some hunters prefer full metal jacketed bullets for maximum penetration of dense bones.

Care must be taken approaching a wounded walrus in the water; because they can be dangerous and have been known to attack and damage boats.
ANATOMY AND PHYSIOLOGY OF MARINE MAMMALS
IMPORTANT FOR STRUCK AND LOST
By Siri K. Knudsen, Norwegian School of Veterinary Science, Section of Arctic Veterinary Medicine

This lecture focuses on some anatomical and physiological features that may influence struck and lost in marine mammal hunting. This includes some general aspects common for all marine mammals and all hunts as well as some more specific features of different marine mammal species and different hunts.

In principal two major categories of struck and lost in marine mammal hunting exist: either an animal can be struck, injured and lost; or it can be struck, dead and lost. Physiological and anatomical features may affect both categories. From an animal welfare point of view, the first category is the most significant. Causing instantaneous or very rapid death of the animal will during most circumstances reduce the chances of struck and lost in this category.

In order to cause instantaneous or very rapid death of the animal it is important for the hunter to know the internal placement (the anatomy) of the vital organs like the brain, heart, major vessels and lungs. There is a lack of literature on anatomy of internal organs in marine mammals and few anatomical charts of different species are available, but some schematic illustrations are available and some were presented for whales and pinnipeds demonstrating the placement of the vital organs.

In general, the anatomy of the central nervous system (the brain and spinal cord), the circulatory system (heart and blood vessels) as well as other internal organs have many similarities with what can be found in other mammals. A general rule complies with marine mammals as in other mammals: the brain is always situated behind the eyes. In the thorax the heart can be found, as in other mammals, in the lower foremost part of thoracic cavity, while the lungs occupy the rest of the space of this cavity.

In marine mammals, the nervous system is built and functions in the same manner as in other mammalians and it consists of a central part, which is the brain and spinal cord, and a periphery part which are the nerves and nerve cells in the rest of the body, i.e. the nervous system is in principle built like a telecommunication network: The brain is the central; the spinal cord is the main cable; the nerves out to the body acts like the distributing cables, and the periphery nerve cells acts like the telephone with incoming and outgoing information. The spinal cord is enclosed by the spinal vertebra and the brain is enclosed and protected by the heavy bones of the cranium. The brain can be regarded as the true centre of the body responsible for survival, consciousness and the maintenance of physiological conditions. In generally it can be said that during marine mammal hunting the same applies as for other mammals: in order to render the animal instantaneously unconscious some specific brain areas have to be put out of function, which includes the cerebral cortex, deep central parts of the cerebrum and/or the brain stem, which contain the centres for consciousness and control units for respiration and heart activity.

Marine mammals have, however, some specific physiological characteristics that may affect struck and lost. Being diving mammals, they have increased storage capacity of oxygen in their musculature, which leads to possible muscular movement persisting long after the animal is dead. This may be observed as general muscular tremors in the flesh during skinning and slaughter, or the movements can also be very violent and give the impression that the animal is still alive. These movements, called agonal reflex movements, may also contribute to struck and lost as they can be very violent in nature. It is the brain and spinal cord that are responsible for the agonal reflexes and involuntary reactions in dead animals. A reflex can be
defined as a stereotyped response mediated by the nervous system. Most of such reflexes do not require cerebral coordination and thus it can be elicited in the insensible animal. The basis for this process is very complex and it would take too long to go into detail. Roughly it can be said that reflex activity in an unconscious animal is a result of the spinal cord losing its chief commander, namely the brain. When the higher control centre has been put out of function, the spinal cord starts to “work on its own” resulting in uncontrolled movements of for instance the torso and limbs.

Another anatomical factor that may influence struck and lost is the animal’s locomotory ability. For instance in seals, the anatomical modifications of the limbs for aquatic motion have lead to them having limited mobility on land. However, during some circumstances they may also be quite agile ashore. Otariids are the most agile on land of the pinnipeds as they can walk by moving their fore flippers alternately. The phocids though, crawl on their bellies when they are on land, heaving themselves forward with a “humping action”, but they can travel much more economically on ice. This is important to take into consideration when seals that are lying near the ice edge are shot: if the animal is wounded, and not dead, it can move quite quickly into the sea.

A biological factor that may also influence struck and lost is the animal’s behaviour. Species like walrus, grey whales and hooded seals (*Cystophora cristata*) may be aggressive and very dangerous to approach before they are rendered unconscious or dead.

One of the most important biological factors that contribute to that struck and lost of dead animals is the negative buoyancy of the carcasses of many species. In seals, the nutritional status is decisive, i.e. fat animals float, while thin ones sink. Except for smaller toothed whales, the nutritional status does not seem to affect the buoyancy of cetaceans. A table was presented on buoyancy in whales showing that bowhead whales, fin whale species and grey whales usually sink after death, while humpback whales and toothed whales usually float.

In conclusion, several biological and anatomical factors may affect struck and lost in marine mammal hunting. Some factors are due to circumstances beyond our control (the animal’s nutritional status, buoyancy, behaviour, reflex movements etc). One decisive biological factor that can be influenced to reduce the risk of losses is to secure a rapid kill of the animal.
MONITORING OF STRUCK AND LOST MARINE MAMMALS
By Stefan Romberg, Fisheries and Oceans Canada

Monitoring of struck and lost marine mammals is an important component in helping to manage marine mammal populations.

There are three methods that are commonly used to monitor struck and lost marine mammals:
1) self reporting;
2) interviews; and
3) independent monitors.

With self reporting, it is up to the hunter to report struck and lost marine mammals. In some cases reporting is mandatory (e.g. Greenland) while in other cases it is voluntary (e.g. Canada).

Interviews consist of individuals interviewing hunters either out at the hunting location or upon the hunters return to the community.

Independent monitors are hired to follow hunters as the hunt takes place and record their observations. These monitors can also supplement the information by conducting interviews of the hunters. Therefore, there is a forth method that combines the independent monitor with interviews.

Each of these methods have there own biases in the data collected. For example, with self reporting and interviews, under/over, double reporting is a concern. With the presence of independent monitors, there is a concern of hunter behaviour being altered and biased interpretation by the independent monitor. For instance, how is a whale that is wounded by one hunter but harvested later by another hunter recorded? These are just some of the issues that confront managers in collecting accurate data on struck and lost marine mammals.

The following are just a few examples of struck and lost rates for various marine mammals with a focus on Canadian examples.

**Harp seals (Phoca groenlandica) (Canada)**
Struck and lost rates were estimated during commercial hunts off the east coast of Canada in 1998-99. Independent monitors collected data by accompanying the hunters and by conducting interviews. Depending upon the hunt and the age of the seal, the struck and lost rate varied. Struck and lost rates for adult seals varied between 0-21.6% on ice and 5.0-50.0% when taken in water. For seals aged one month, the struck and lost rate varied between 0-2.0% on ice and 0-10.0% in water (Sjare and Stenson 2002).

**Walrus (U.S.A. and Canada)**
The spring walrus hunts were monitored from 1952-72 in select western Alaska villages. Hunters were accompanied by independent monitors and activities were recorded. An average of 42% struck walruses were lost during the study period (Fay et al. 1994).

Summer walrus hunts from 1982-84 were observed by independent monitors in a Baffin Region community in the eastern Canadian arctic. An estimated 32% of walruses struck were lost (Orr et al. 1986).

**Beluga (Canada)**
In the western Canadian arctic, beluga hunters themselves are hired to act as monitors of the hunt. These monitors interview the captain of each hunt following the completion of hunting
activities. Struck and lost rates ranged from 5.4 to 25% between 1977-99 (Harwood et al. 2002). This monitoring still continues.

Struck and lost information is provided on a self reporting basis in both the eastern Canadian arctic and northern Quebec. One of the primary differences between the two areas is that in northern Quebec, struck and lost whales are counted against the quota while this is not the case in the eastern Canadian arctic. However this does not seem to have an impact on the reporting between the two areas since both areas have limited levels of information provided.

**Narwhal (Canada)**

Narwhal hunts were observed by independent monitors in 1983 and 1986-89 in a Baffin Region community in the eastern Canadian arctic. Struck and lost rates varied over the years and depended upon the type of hunt. For the floe edge hunt, the struck and lost rate averaged 31.7%, ice crack hunt averaged 23.8% and the open water hunt averaged 7.4% (Roberge and Dunn 1990).

Struck and lost information for narwhal continues to be self reported by hunters on a voluntary basis in the eastern Canadian arctic. Any struck and lost whales reported do not count against the community quota.

**Community Based Management**

In an attempt to give communities more control of narwhal management (and beluga in some cases), community based management was initiated as a pilot project in 1999 in selected communities in the eastern Canadian arctic. To participate in the program communities had to develop hunting rules that their hunters would abide by (e.g. minimum caliber of rifle, safety gear in boat, whether whales had to be harpooned first etc.). As part of the program, struck and lost information was to be collected by the local Hunters and Trappers Organization. There has been annual variability in the consistency and quality of the struck and lost information collected has since the program was introduced. This pilot is to be re-evaluated in 2007.

**Bowhead (Canada)**

Hunts have been successfully conducted in both the western and eastern Canadian arctic. In the eastern Canadian arctic, a hunt plan is developed by the host community and it is approved prior to the hunt taking place. There have been five bowhead hunts which have taken place in the eastern Canadian arctic since 1996 during the open water period of August. All hunts have been observed by independent monitors and there have been no struck and lost whales.

**Minke whale (Norway and Greenland)**

Average struck and lost rate for the Norwegian minke whale harpoon hunt has been 1% over the past 12 years. These hunts are observed by independent monitors. Lost whales in this hunt are most commonly caused either by the harpoon pulling free or the harpoon line breaking (Øen personal communication 2006).

There are two types of hunts in Greenland:

1) harpoon hunt; and
2) collective hunt

These hunts have mandatory self reporting and any struck and lost whales are counted against the quota.
The harpoon hunt has a struck and lost rate that averaged 1% from 2001-06. This hunt utilizes a penthrite grenade.

The collective hunt utilizes both rifles (minimum caliber of 7.62 mm) and harpoons. From 2001-06, this hunt had a struck and lost rate of 6.1% (Ugarte personal communication 2006).

**Fin whale (Greenland)**

Once again this hunt has mandatory self reporting and any struck and lost whales are counted against the quota. The number of grenades used by each boat can be checked. Each grenade has a serial number and the government has the list of the serial numbers of grenades sold to each boat. The catch as well as struck and lost reports from the boats have to include the serial number of the grenades used. An average struck and lost rate of 10.7% was observed over the period of 2002-06 (Ugarte personal communication 2006).

The following are some examples of factors which were identified as influencing struck and lost rates:

1) Type of hunt – on ice vs. open water  
   deep water vs. shallow water  
   floe edge vs. ice crack vs. open water  
   harpoon vs. rifle

2) Hunters - judgment  
   experience

3) Equipment - having the appropriate gear for the hunt

4) Weather conditions - presence of waves preventing clear shot, lack of visibility  
   swaying/surging of boat

5) Time of year - body condition of animal, weight

6) Reporting inconsistencies

Studies are required to get more recent and reliable information on struck and lost rates for some populations of marine mammals that are of concern (e.g. heavily hunted). Some of the data presented is over twenty years old and the values may no longer be accurate. This information will help to make better management decisions.

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STRUCK AND LOST IN THE HARP SEAL HUNT IN GREENLAND: A QUESTIONNAIRE SURVEY
By Fernando Ugarte and Jens Jakobsen. Hunting Division, Greenland Ministry of Fisheries, Hunting and Agriculture

Hunting in Greenland
Nowadays, Inuit people live in Chukotka, Alaska, Arctic Canada and Greenland. About half of the approximately 90,000 people that speak one of the Inuit languages today are from Greenland. Greenlanders emigrated from Arctic Canada over 1,000 years ago. Inuit people could spread and thrive over the Arctic because they were a hunting culture. Hunting is still very important in Greenland, as we can see from the demographic data published by Greenland Statistic and from the number of hunting licences issued by our Ministry in 2005. Out of 35,673 residents over 16 years old, approximately 24% had a hunting license (Fig. 1, left). Of those with a hunting license, approximately 21% were women, 14% were men under 30 years and 64% were men 30-70 years old. If we look only at the male population aged 30-70, we found that about 44% have a hunting licence (Fig. 1, right). This means that almost every other adult-male in Greenland goes hunting. We could safely say that there are more hunters per capita in Greenland than in most parts of the world.

Fig. 1. Percentage of residents in Greenland with a hunting license in 2005. Left column: out of 35,673 residents over 16 years old, approximately 24% had a hunting license. Right column: from the male population aged 30-70 (N= 12,484), an estimated 44% have a hunting licence. Sources: Greenland Statistic (http://www.statgreen.gl/) and Hunting Division.

Harp Seals
Much of the hunt in Greenland is directed to seals which are valued for mainly for their meat and skin. Over 150,000 seals are taken every year, with most of them being ringed seals and harp seals (Fig. 2); about 70,000 harp seals and a similar number of ringed seals are taken every year.

Harp seals are spread over the northern part of the Atlantic during summer and winter and gather in 4 main breeding grounds during spring. The breeding grounds are:

1) The White Sea (west of Russia). Outside the breeding season, these seals use the Barents Sea and adjacent waters and are not hunted by Greenlanders.
2) The West Ice (east of Greenland). When not breeding, these seals are taken by Inuit hunters in open water in east Greenland. They are also subject to a Norwegian catch during the breeding season.
3) The Gulf and 4) The Front (both east of Canada). Seals from West Greenland, Nunavut and east Canada breed in Newfoundland, where commercial hunters from Canada take them. When not breeding, these seals are taken in open waters by Inuit hunters.
The Struck & Lost (S&L) rates for the Inuit open water hunt of harp seals are not known. However, based in very rough estimates, the Canadian National Marine Mammal Review Committee endorsed the use in population modelling of a loss rate of 50% during their 1999 Harp Seal Review meeting (DFO 2000). The ICES/NAFO Working Group on Harp and Hooded Seals also uses the loss rate of 59% when assessing the population of harp seals (ICES 2006). This means that the biological advice is based on the assumption that one seal is S&L for every seal caught by local hunters in Greenland and Arctic Canada.

The aim of this study was to compare this number with the experience of the Greenlandic hunters.

Methods
In order to renew the hunting licence, every hunter has to report his or her catch once a year to the hunting division. From our database, we could see that the majority of harp seals are caught between June and December (Fig. 3). We sent questionnaires to hunters at the end of September and beginning of October (2006), when the harp seal hunt is at its highest level. We chose about 1,000 hunters that had reported harp seals in 2004. We sent questionnaires together with pre-paid envelopes and asked to return them by mid-October. As an incentive, a hand-held GPS was drawn among those who answered. The project was announced with a press release, which was picked up by the national radio.

A total of 976 questionnaires were sent, of which 313 questionnaires (31%) with meaningful answers were returned to us. Three quarters of those who answered were full-time hunters, while the remaining were leisure hunters. The questionnaires included 10 main questions, and several hunters did not answer all 10 questions. In this presentation we will discuss the answers to the questions that have been analysed so far.

Fig. 2. The yearly catch of seals in Greenland, 1994 – 2004. Source: Hunting Division
NAMMCO Workshop to address problems of "struck and lost" in seal, walrus and whale hunting

Question: Do you report S & L as part of your catch?
As mentioned above, every hunter needs to send a catch report to our office in order to renew his or her license. Hunters were asked if they include harp seals that were S&L as part of this report. We received 285 answers. A surprisingly high number (34%) do report S&L animals as part of their catch (Fig. 4). This means that part of the S&L is already incorporated into the catch statistics from Greenland. This is important because it was previously assumed that the catch data presented by Greenland did not include S&L animals at all.

Question: Do you remember the outcome of your last 10 hits?
Hunters were asked to remember their last ten seal strikes and fill a table. For each strike they were asked to report the month and tick whether the seal was caught or S&L. Some hunters accounted for only one or two seals shot, while others presented data from their logbooks containing information from several hunts (up to 114 seals in one case!). Selecting only data from hunters who reported outcomes of three or more strikes, we ended with a sample size of 131 answers, accounting for 1,354 strikes. Leisure hunters had a mean S&L rate of 0.26 (N = 37 hunters, SE = 0.04), while full-time hunters had a mean S&L rate of 0.21 (N = 94 hunters, SE = 0.02) (Fig. 5). This means that leisure hunters recalled missing about 1 out of 4 seals, while full-time hunters recalled missing about 1 out of 5. Combined, full-time and leisure...
hunters had a mean S&L rate of 0.22 (N = 131, SE = 0.02) (Fig. 5). We can assume that the S&L rate of the harp seal hunt in Greenland lies within the values given above. A more accurate estimate should take into consideration the fact that the majority of the hunters in Greenland are spare-time hunters, but the majority of the harp seal catch is taken by full time hunters.

![Fig. 5. Mean S&L rates and standard errors for leisure hunters (left), full-time hunters (middle) and leisure hunters and full-time hunters combined (right). Numbers in the X-axis indicate sample size. N = 131 hunters (1,354 strikes)](image)

The data included information about the month when the animals were shot, allowing us to estimate the monthly S&L rate from May to October (Fig. 6). S&L rates were higher from May to July and lower from August to October.

![Fig. 6. Mean S&L rates and standard errors for every month between May and October, 2006. Numbers in the X-axis indicate sample size (i.e. number of hunters that provided data for the month in question). N = 131 hunters (1,354 strikes)](image)
**Question: Does seal buoyancy change according to the time of the year?**

We chose 3 time periods that correspond to changes in the physical condition of the seals described by Rosing-Asvid (unpublished data):

1) May - June: During this period the harp seals have arrived to Greenland after breeding, and are extremely thin. Adults gain up to 20 kilos of weight during June.

2) July – September: During the start of this period the growth stops for a couple of months, while the seals’ favoured prey, the capelin, is in poor condition after the spawning. The biomass of the prey is also likely to be smaller as a high fraction of the adult fish die during the spawning period (early May-late June).

3) October – March: During this period the capelin has a high caloric value and the growth of juvenile capelin has increased the fish biomass. As a consequence, the seals gain weight once more.

For each period, hunters were asked whether the majority of dead seals would float or sink, or whether some would float and some would sink. A fourth option was to admit not knowing the answer, but hunters preferred not to answer, rather than ticking the “I don’t know” box. Therefore, although 290 hunters answered this question, not all answered for all the three periods.

The results of this question are shown in Fig. 7. Hunters were of the opinion that seals would either sink (39% of the answers) or some would float and some sink (47 %) during May – June. Only 3% thought that seals would float at this time of the year.

For July – September, most hunters (74 %) wrote that some seals would float and some would sink, while 23% thought that seals would float. Only 3% were of the opinion that seals would sink at this time of the year.

Most hunters (83 %) agreed that harp seals tend to float from October to March, while 17 % thought that some seals would float and some would sink. Nobody answered that seals tend to sink at this time of the year.

![Fig. 7. Seasonal variation in seal buoyancy. Hunters were asked whether the majority of seals would float or sink, or whether some would float and some would sink for each of 3 time periods. Numbers in the X-axis are numbers of hunters answering for the corresponding period. N = 290 hunters (not all hunters answered for all 3 periods)](image-url)
Question: Are 50 % of the seals struck in Greenland lost?
Hunters were asked whether they thought that a 0.5 S&L rate was appropriate for the Greenland harp seal hunt. For this, we asked the hunters to choose the sentence that they agreed with:

1) The number of harp seals S&L equals the number of harp seals caught
2) The number of harp seals S&L is larger than the number of harp seals caught
3) The number of harp seals caught is larger than the number of harp seals S&L

A total of 256 hunters answered this question. Most of them (77%) were of the opinion that the number of seals caught in Greenland is larger than the number of seals S&L (Fig. 8)

Fig. 8. Answers to the question about the proportion of harp seals caught and proportion of harp seals S&L in Greenland. N = 256 answers

Summary and concluding remarks
The main findings of this study are:

- About 34% of the hunters do report S&L as part of their catch
- The S&L rate from the period between May and October lies between 0.21 (full time hunters) and 0.26 (leisure hunters)
- The S&L rate is higher in May - July than in August – October
- Seals seem to sink more during May - June and float more from October to March
- Most hunters believe that there are more seals caught than S&L in Greenland

Our study suggests that the S&L rate of 0.5 used by the bodies providing international management advice may be an overestimation.

A more accurate estimate of the rate of S&L in the harp seal hunt in Greenland than the ones presented here would require an analysis that takes into consideration the proportion of the catch taken by full-time hunters and leisure hunters. The seasonal variation should also be taken into consideration.

It should be mentioned that the S&L rate does not greatly affect the outcome of the models used for management advice. Those models are based on seal counts made at regular intervals, and factors such as the natural mortality and the mortality due to hunting in open waters have a minor effect on the outcome of the model.

Finally, we would like to stress that harp seals are currently abundant and S&L is not a problem for conservation. It is more an issue of hunting ethics and animal welfare.
Acknowledgments
We would like to thank the hunters who answered the questionnaires. The staff from the Hunting Division helped throughout the work. Special thanks to Jeanette Pettersen and Karl Kristiansen for inputting all the data. Aqqalu Rosing-Asvid, from the Greenland Institute of natural Resources shared information and made valuable comments throughout the study. The NAMMCO Committee of Hunting Methods inspired and facilitated this study.

References

A STUDY ON STRUCK AND LOST IN THE WHALE DRIVE HUNT IN THE FAROE ISLANDS JUNE 2005 – SEPTEMBER 2006
By Jústines Olsen, Veterinary Service, Faroe Islands

Introduction
Small whales have been driven into bays and killed for food in the Faroes since the islands were first settled twelve hundred years ago. Today the drive hunt involves pilot whales, *Globicephala melas*, but also bottlenose dolphins, *Tursiops truncatus*, which are at times mixed with schools of pilot whales, as well as white-sided dolphins, *Lagenorhyncus acutus*. As in every type of hunt, struck and lost has also been a factor in this type of whaling. The organisation of the whale drive has been such that this could not be avoided. In the early days, bays used for whale drives were not all suited to the purpose. In some bays it was not possible to beach the whales properly. Instead, many of the whales were killed with spears, after which they sank, and were then fished up from the sea bed when the hunt was over. In such circumstances many whales were not retrieved in time to be butchered, but were found later when they floated up in a spoiled condition.

Another reason for struck and lost was when whales which were speared during the hunt escaped into open water with wounds and apparently died shortly after.

Other elements of the hunting structure could also affect the struck-and-lost figures. If a pod of whales could not be driven and beached properly at a whaling bay, the executive order on the drive hunt stipulated that the authorities could allow the hunters to harpoon whales in open water with hand-held harpoons. In this type of hunt many whales were struck and lost. The main reason for this was broken lines.

Steps have been taken to improve the organisation of the hunt to avoid struck and lost for the above mentioned reasons and others as well. Today only authorised whaling bays can be used which fulfil the requirement that whales can be properly beached. The spear and the harpoon are now strictly forbidden in the hunt. During the last twenty years several amendments have been made to the whaling regulations. Despite this, there can still be problems with struck and lost in the Faroese whale drive hunt. This study evaluates the struck and lost problem based on investigations from eight different hunts in the period from June 2005 to September 2006. It has not been possible to collect information from all drive hunts in this period.

Elements of the hunt affecting struck and lost figures
In open water the drive hunt is organized in such a way that the boats form a semi-circle between 50 and 100 metres behind the whales. Under these circumstances no whales will be physically damaged or wounded, Fig. 1.

Fig. 1. Whale drive in open water. Photo: J.K. Vang
It is only during the beaching that the whales can be wounded apart from the killing as such. They may hit the bottom and get skin scratches or wounds. If the whales are not all properly beached in the first attempt, some of the whales may swim in between the boats and can be hit by keels and propellers, Fig 2. If these whales are killed, there will not be any loss for that reason. If not, they might escape wounded into open water. Some times it can be impossible to beach a school or part of a school and some of the whales or all have to be driven out again into open water. In such circumstances, some whales which are let out into the open water might be wounded. There is no information about how often this happens. The study below tries to highlight this problem.

Whales can also be lost after the killing is completed. Dead whales might slide from the beach out into deeper water in the whaling bay, and be swept out by tides. When the killing is over, the visibility in the bay is bad due to the blood in the seawater. It can take hours to wash out again. Because of this it can be very difficult to retrieve whales that have sunk.

After the killing, all the whales are hauled off the beach, attached to participating boats and towed to the nearest suitable harbour to be butchered on the quay, Fig. 3. The distance from the whaling bay to the quayside may vary from a few hundred metres up to ten kilometres. During this towing, lines can break and whales can be lost. The same can happen when the whales are hoisted by crane on to the quayside, Fig. 4.
Dead whales that have sunk and are not retrieved immediately will float to the surface at a later stage and will be spoiled and for that reason are lost.

With respect to struck and lost elements a whale drive hunt can be presented as in the chart below:

**Chart 1:** Schematic description of struck and lost elements in the drive hunt
Elements for investigations in the struck and lost study
During the period from June 2005 to September 2006 different elements with respect to the occurrence of struck and lost in the Faroese whale drive hunt were analysed. In this period it was possible to collect data from eight hunts with a total number of 762 whales killed and registered. In this period there were 24 drive hunts with a total number of 1800 whales, both pilot whales (902), as well as bottlenose dolphins, *Tursiops truncatus*, and white-sided dolphins, *Lagenorhynchus acutus* (898).

Total number of whales registered in each single hunt
In connection with each hunt the number of whales was registered. This is a mandatory procedure for the division of shares from the hunt between the participants and the people in the respective district. These figures are listed in Table 1.

Number of whales reported escaped in connection with the beaching
Before the investigations in this study started, the sheriffs, who are the officials in charge of the whale drive hunt, were informed about the project and were asked to report if any whale escaped in connection with the beaching. No whales were reported to have escaped in these eight hunts. See Table 1.

Number of whales reported found after the butchering was completed
The sheriffs were also asked to report if any dead whale was found after the butchering was completed. As mentioned before, dead whales can be lost during beaching, towing and hoisting on to the quayside. If such whales are not found immediately after the killing they will very likely be seen some days later, when they float to the surface. There was no report of any such whale in any of the actual drives.

Number of butchered whales with wounds inflicted during beaching
In the executive order for the Faroese whale drive hunt it is stipulated that if it is impossible to beach all the whales, the remaining whales must be driven out into open water again. This can occur if there are more whales than can be beached, or if the whales are impossible to beach properly. In such circumstances it can happen that whales are wounded when they return to open water.

**Fig 5.** Dead whale with characteristic superficial incisions in the skin from a boat's propeller. Photo. J. Olsen
Fig 6. Dead whale with deeper incisions in the blubber tissue   Photo: J. Olsen

To estimate the level of occurrence, a comparison can be made by inspecting all the whales that are brought to the dockside to be butchered and count those wounded in connection with the beaching. The same proportion of wounds can then be assumed for the whales that might have escaped during the beaching. This was done by inspecting every single whale that was brought to the dock side in the actual eight whale drive hunts. The total number of whales registered was 762, see Table 1. The inspection was performed in connection with the hoisting of the whales to the quayside where it was easy to inspect each separate whale in detail, Fig. 4. The only wounds that could be identified were on whales hit by the boat propellers. These wounds were easy to identify because of the characteristic pattern with several repeated incisions in the skin. In total such wounds were found in 29 whales. In 16 of these, the incisions were only in the skin or penetrated a few millimetres beneath the skin, Fig. 5, while in the remaining 13 whales the incisions penetrated deeper into the blubber tissue, Fig 6. One of these 13 whales was wounded in the left mandible, which was broken when it was hit by a propeller. If this whale had escaped when injured, it would have died of starvation because food intake would not have been possible.

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<th>Escaped during beaching</th>
<th>Lost after killing</th>
<th>Wounded total</th>
<th>Killed with epidermal wounds</th>
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</table>

All bays 762 0 0 29 16 13

Table 1: Results of investigation of struck and lost elements in the Faroese whale drive hunt. * White-sided dolphins, L. acutus, only.

Discussion

The whales registered are presented in the diagram of struck and lost elements, Chart 1. In this diagram it is not possible to determine precisely how many dead whales are lost and they cannot therefore be registered. If dead whales are found while the division of the catch is still under way, these will be registered, but if whales are found two hours after the division of the
NAMMCO Workshop to address problems of "struck and lost" in seal, walrus and whale hunting

catch is completed, they will not be registered and, depending on the time span after the killing, they will become spoiled and must be considered as lost. As mentioned above, dead whales can be lost at different stages after the killing, but it is not possible to have a clear indication of the extent of such loss until whales have floated to the surface in spoiled condition. During the 15-month observation period (May 2005 – September 2006) there was no report of floating dead whales, so it is very unlikely that any dead whale was lost in any drive hunt in this study. With reference to Chart 1 it is also likely that the figures for killed and registered whales are the same.

With reference to Table 1, no whale escaped in any of the drive hunts in the observation period. Since all the whaling bays were authorised some twenty years ago with the requirement to have a gently sloping seabed from deeper water to the shore, it is very rare that any whales escape or are driven back out to open water again. If this should happen it might be possible to ascertain how likely it is that any escaped whale is wounded by using the data in Table 1 and assuming the same proportion for escaped whales. This would give a total number of wounded whales of 29/762 or 3.8 %. For whales with deeper wounds in the blubber tissue this would be 13/762 or 1.7 %.

In this study the number of wounded whales is perhaps too high, because some of the whales registered as wounded might have been damaged after the killing, during the hauling and towing. It is very difficult by inspection alone to determine whether these wounds in the skin and blubber are inflicted pre- or post mortem. The reason for this is that any bleeding from the wounds in the blubber tissue is washed away by sea water during hauling and towing. It actually occurred in one drive hunt that the hunters became aware of this problem because the propeller of their boat was broken while towing two dead whales to the dock side. These two whales were eliminated from the data of wounded whales in this study.

There is some variation in the number of wounded dead whales between the different hunts, from none to eleven, Table 1. This variation is mainly due to the different size of the pods, but other factors such as the number of participating boats, tides and weather conditions may contribute as well to this variation. There may also be variation in the behaviour of the whales in general. One reason for this could be various driving distances from the place where the whales were spotted to the bay where they were beached.

**Conclusion**

The analysis of eight whale drives in the Faroe Islands shows clearly that struck and lost is not a problem in this hunt. In total 762 whales were registered, no dead whale was reported as lost and no whale escaped during the beaching. After a whale drive, divers often search the bottom of the whaling bay and along the dock wall where the whales are hoisted. If this procedure is made mandatory after each single hunt, any loss of dead whales, although at present not a problem, may be reduced further.
STATUS OF STRUCK AND LOST IN JAPANESE RESEARCH WHALING
Dr Hajime Ishikawa, Institute of Cetacean Research, Japan

Summary prepared by the Secretariat

The Japanese Whale Research Programmes in the Antarctic (JARPA) and the Western Northern Pacific (JARPN) have been carried out since the 1987/88 season and the 1994 season respectively. In compliance with Article VIII of the International Convention for the Regulation of Whaling, JARPA and JARPN are conducted under special permit. They are authorized by the Government of Japan and planned and implemented by the Institute of Cetacean Research (ICR). JARPA and JARPN were subsequently followed by the second phase programmes, JARPAII from 2005 and JARPNII from 2000, respectively.

Target species with catch figures from the 2005/2006 JARPAII were 853 Antarctic minke whales (*Balaenoptera acutorostrata*) and 10 fin whales, and from the 2005 JARPNII 220 common minke whales, 100 sei whales (*Balaenoptera borealis*), 50 Bryde's whales (*Balaenoptera edeni*) and 5 sperm whales (*Physeter macrocephalus*).

In JARPA and the pelagic operation of JARPN, three catcher boats are used as sighting and sampling vessels and one mother ship as a research base ship. In the coastal operation of JARPNII, four additional small catcher boats are also used. There are no freezers or refrigerating facilities on board the catcher boats as the whale carcasses are transported as soon as possible to the mother ship or land bases.

The vessels used for the pelagic operation are equipped with one grenade harpoon cannon, two whaling winches and a whaling sonar system. If the first harpoon makes an inadequate shot, a backup harpoon attached to the second winch can be fired quickly. The cannon size was changed in the early 1970's from 90mm to 75mm. The explosive grenade was developed for minke whale hunting in the 1980's and has been constantly improved. Today it consists of 30 grams of penthrite cartridge, fuse and steel top case. For larger whales (sei and fin) the penthrite charge is 60 grams. The Japanese grenade is simple and inexpensive but cannot be reused after a miss-shot. Large calibre rifles are used as secondary killing weapons. For minke whales .375 round nose solid bullet is effective, for sei and Bryde's whales .458 round nose solid bullet is effective to penetrate the skull. It seems the large calibre rifle is ineffective for fin and sperm whales as the secondary killing weapons.

Animals that are stuck and lost (S&L) in the Japanese hunt are either a result of the harpoon dislodgement (pulling out) or that the harpoon line is broken. The dislodgement of the harpoon makes for a higher percentage of the struck and lost rate than a broken line. Every effort is made to recover an animal that has been struck and where the harpoon has dislodged or the line is broken. In the 2005/2006 Antarctic season 26 animals of 29 cases of harpoon dislodgement or broken line were recovered. The three non-recovered animals died instantaneously and sank quickly. The very rare occurrence of struck and lost animals that are still alive occurs when the whales escape into pack ice or rapidly changing weather conditions make visual contact with the animal impossible.

During the seasons 1993/94, 1994/95 and 2001/02 the S&L rates were high and efforts have been made to reduce the problem.

The following practical measures have been identified as reducing the problem:

To avoid the harpoon dislodgement from the animal:
Aim to shoot at the optimal position on the whale. Through an information feedback system the gunners’ shooting skills have improved. Soon after the killing, a researcher or veterinarian performed a necropsy on all whales and reported this to the gunner. With the shoot still fresh in the memory, the gunner learned the details of the shot. Do not winch the whale hurriedly after having shot the animal. If the targeted position on the whale is not optimal, shoot the second harpoon immediately, or if the gunner has any doubts that the harpoon will stay in the animal fire the second harpoon immediately.

To avoid the harpoon line breaking:
- Navigate the vessel carefully to avoid contact between the line and an iceberg or rudder.
- Do not winch the animal hurriedly after having shot the animal.
- Improve the design of the harpoon head to prevent the line being cut by large shrapnel from the grenade inside the body of the whale.

However, the most effective method to reduce struck and lost has been repeated meetings with the ship crew. Such meetings create both an awareness of the problems and a motivation for the crew to do their outermost at all levels of the hunting activity (shooting, heaving and retrieving the whale) to avoid losing an animal.

There is no official penalty for striking and losing a whale in Japan, and it can be said that the ultimate motivation for the crew and their supervisors not to lose an animal is deeply embedded in the Japanese culture in the concept of honour.
WORKING GROUP REPORTS AND RECOMMENDATIONS

Following the plenary session, workshop participants joined two of the following four species specific working groups:
- the Working Group on Seals,
- the Working Group on Large Whales,
- the Working Group on Small Whales and
- the Working Group on Walrus.

Appendix 3 gives the list of participants for the four working groups.

All working groups had the following common agenda:

- Description of various hunting techniques
- Factors contributing to struck and lost
- Ways to reduce struck and lost
- How to monitor struck and lost

The rationale for splitting into working groups was to facilitate a more thorough discussion and active participation within the smaller group.

Each working group started with an invited presentation from an experienced hunter to initiate the discussions in the group. The presenters had been asked to describe one particular hunting activity taking note of the common agenda for all working groups. After the presentation working group participants were asked to describe how in their experience hunting methods and techniques differed or were similar to the one presented, and give their views on aspects of importance to the issue of struck and lost.

All working groups formulated species specific recommendations on various aspects on how to reduce struck and lost. These recommendations were presented as part of the report from the working groups. After the working group sessions the Workshop participants met in plenary to hear and discuss the presented working group reports.

In addition a set of general recommendations were formulated by the Drafting Committee based on the presentations and discussions of the plenary and working group sessions. These recommendations were presented and discussed one by one in plenary and finally the presented general recommendations were adopted by consensus.
WORKING GROUP ON SEALS

The Working Group was chaired by Simeonie Keenainak from Nunavut Tunngavik Inc. (NTI) and the rapporteur was Daniel Pike (NAMMCO Secretariat). The Working Group began with a presentation by Ole Petersen (KNAPK) on seal hunting in Greenland.

SEAL HUNTING IN GREENLAND

Seals are the most important animal to Greenlandic hunters. Seal hunting occurs year round, and seal meat is an important source of food for both people and sled dogs. Seal skins are used to make clothing and other crafts, and the sale of seal skins is an important source of income in some areas.

The methods used by seal hunters vary by both season and location. In the winter (January to March), hunters use nets set under the ice to catch seals. They are also taken at breathing holes in new ice. In areas with open water, they are hunted from small boats using rifles. This type of open water hunting occurs in all seasons where open water is found.

During the early spring (March to June), seals come up onto the ice to bask and moult, and they are shot by hunters on the ice. Seals are also hunted in open water, but they tend to sink during this season, so special care must be taken to avoid struck and lost situations.

During the summer (July to September), open water hunting from small boats is the most common method used. Seals are fatter at this time of year and tend to float in the later part of this period, making retrieval more reliable. Later in the season (October to December), seals are again taken using nets set under the ice, and in open water.

Rifles used in seal hunts include .222 and .223 calibre. Hunters must use the ammunition that is available in their community, but generally prefer full metal jacket or soft point bullets. Hunters also carry equipment to retrieve shot seals. Depending on the conditions, both a grapnel hook and rope, a gaff hook on a pole, or a harpoon and line are used.

WORKING GROUP DELIBERATIONS FOLLOWING THE PRESENTATION

Descriptions of hunting methods
Seals are hunted in many ways, depending on the species, season, local environment and available equipment. Seal hunting methods were described in detail in the Report of the Workshop on Hunting Methods for Seals and Walruses (NAMMCO 2005) and will be only briefly categorized here.

Open water hunts
All species of seals are hunted in open water in all seasons when it is present, usually using small boats, rifles and retrieval equipment.

Ice hunts (harp and hooded seals)
Larger vessels are used to take pups and adult harp and hooded seals where they breed on the ice in March and April. The Canadian hunt is conducted at the Front and the Gulf using vessels of 65 feet (19.9 metres) or less, while the Norwegian hunt is conducted in the Greenland Sea or eastern Barents Sea, usually using larger vessels. Seals are generally shot from the vessels, and then clubbed with the hakapik if necessary before being skinned. In some cases the hakapik is used as the primary killing method. The vast majority of seals taken are newly moulted seal pups.
Ice hunts (other)
Ringed (Phoca hispida), bearded (Erignathus barbartus) and grey seals (Halichoerus grypus) are also hunted in the ice. During the spring, ringed seals haul out onto the ice to bask and moult, and are stalked by hunters using rifles. The seal must be killed instantly or it will slip down the hole and be lost. Seals are also hunted at their breathing holes, by shooting them when they come up to breath. In addition, ringed seals are taken during the winter dark season using large mesh nets set under the ice. Seals blunder into the nets, become entangled and drown. In the Baltic Sea, grey seals are shot on the ice floes from small boats or adjacent ice floes.

Struck and lost rates
The only estimates of struck and lost rates available to the Working Group were those from the recent questionnaire survey covering the Greenlandic open water hunt (see page 24), estimates from the vessel hunts for harp seals at the Gulf and Front (Sjare and Stenson 2002), and the presented estimates on the grey seal hunt in Finland (less than 8% in winter and approx. 20% in summer). The Greenlandic hunters in the Working Group considered that the rates estimated from the questionnaire study of 25% to 50% were too high and contrary to their own experience. (The estimate of 50% was due to failure in methodology; hence the estimate is not included in the report from the questionnaire).

Based on their own experience and observations, the Working Group agreed that struck and lost was likely very low in vessel-based hunts for harp and hooded seals (also confirmed by Sjare and Stenson 2002), low in other ice hunts, and highest in open water hunts. Struck and lost is essentially non-existent in cases where seals are taken using nets set under the ice, although it is possible that some seals may fall out of the net before it is retrieved.

Factors contributing to struck and lost
The Working Group emphasized that hunters want to minimize struck and lost and consider it to be in their own best interests to do so. However it was recognized that some struck and lost was likely inevitable, given the conditions of hunting. The Working Group identified several factors that can contribute to the incidence of struck and lost in seal hunts.

Seals sink (sometimes)
Seals shot in open water sometimes sink, making retrieval difficult or impossible. This depends primarily on the condition of the seal, i.e. the relative proportion of body fat. Fat seals float while thin ones sink. Seals tend to be in poor condition in the spring, especially during the pupping, mating and moultting periods when feeding opportunities may be limited. Consequently seals shot in the spring and early summer often sink and can be easily lost. The salinity of the water also plays a role in the buoyancy of the seal. The surface layers tend to be fresher in the spring, making the seal less buoyant. It was also noted that grey seals shot in the Baltic almost invariably sink, presumably because the water has a relatively low salinity. Shooting a seal lethally can also lead to it sinking, as the animal will sometimes float if it is able to take a breath before it dies.

Rifle/Ammunition
As mentioned above, killing a seal instantaneously can lead to the animal sinking before it can be secured. Some hunters use small calibre weapons to deliberately wound seals when hunting in open water. This allows the hunter to approach the seal and secure it with a hook or harpoon before it is killed.

Equipment
Hunters must have the right equipment to retrieve shot seals, and it must be in good working order. Lack of proper equipment or equipment failure was considered to be a common cause
of struck and lost. Equipment varies between areas, but can include a harpoon and line, grapnel hook and line, and/or gaff hook.

**Hunter experience**

Inexperienced or poorly trained hunters lose animals more frequently than experienced ones. A hunter must have the judgment to know when to take the shot, and when not to. There are also some special techniques that can be used to reduce struck and lost that are practiced by knowledgeable hunters.

**Monitoring struck and lost**

At present old and possibly unreliable estimates are being used in management, and the Working Group agreed that up to date and more reliable information is needed. There continues to be barrier of mistrust between hunters, scientists and managers in some areas, and this is problematic for gathering information on struck and lost. Many hunters have the perception that information on struck and lost will be used against them, for example by imposing restrictive quotas or other hunting regulations. Most hunters do not understand the need for this information, and in some cases this has not been explained properly to them by management authorities. In some cases hunters consider it embarrassing to report struck and lost. There is also a need to create incentives for hunters to provide information on struck and lost.

Three methods of monitoring struck and lost were known to the Working Group: self-reporting, either mandatory or voluntary; post-hunt interviews or questionnaires; and independent observation of all or a portion of the hunts. Observer programmes have been used mainly on the larger scale hunts for harp and hooded seals, and are probably not suitable for the small scale, scattered hunts prevalent in other areas. Therefore self-reporting or post-hunt interviews were considered to be most suitable for this type of hunt.

An alternative proposal was to use a small number of “index” hunters, who are specially trained to record details of their hunting activities, including struck and lost. The estimates from the index hunters would then be expanded to cover the entire hunt. Such an approach has been used successfully to monitor fishery by-catch in some areas.

**RECOMMENDATIONS**

The Working Group identified several measures that could be taken to reduce struck and lost in seal hunts.

**Hunter training**

- Develop suitable training materials for each area and hunt. These could use various media, *e.g.* audiovisual presentations on DVD or broadcast locally; written materials, and internet sites.
- In areas where hunting is practiced, courses in hunting should be available in the school curriculum. This is already the practice in some areas, *e.g.* Finland. A comprehensive and advanced hunting education programme is under development in Greenland. In Norway it is mandatory to undertake a training course set up by the authorities before going hunting.

**Techniques and equipment**

- The type of equipment that is suitable depends on the area, species, season and local environment. Descriptions of suitable equipment for each situation should be developed by local authorities, and made available to hunters and educational institutions.
- Hunters should always have suitable equipment, in good working order, readily available when hunting.
In situations when seals usually sink after death, it may be advisable to use small-calibre weapons and shoot to injure, not to kill. The injured seal can then be secured using a hook or harpoon, and then killed. This technique is effective in reducing struck and lost, but does likely result in greater animal suffering.

**Regulatory measures**
- In some areas it may be advisable to stipulate the minimum equipment that must be at hand when hunting. This is already done in most areas.
- In some areas, seasonal closures could be used to forbid hunting in seasons when seals usually sink after death. Such closures are used in Norway and Finland, but may not be suitable in areas where hunters must take seals year-round.

**Monitoring**
Independent observers have been effective in monitoring hunts for harp and hooded seals in Canada and Norway. However, it is not possible to use independent observers to monitor all seal hunts. The following alternatives were recommended:
- Self-reporting systems such as Pinniarneq in Greenland could possibly be modified to provide information on struck and lost;
- In other areas, community-based monitoring using post-hunt interviews, as used in Chukotka, may be effective;
- A programme using “index” hunters, trained and contracted to provide information on their hunting activities, which is later extrapolated to the entire hunt, may be effective in some situations.

**REFERENCES**


WORKING GROUP ON LARGE WHALES

The Working Group was chaired by Fernando Ugarte (Greenland) who also acted as rapporteur together with Christina Lockyer (NAMMCO Secretariat). The Working Group began with a presentation by Eugene Brower from Barrow Whaling Captains Association on bowhead whaling in Alaska.

BOWHEAD WHALING

In northern Alaska, 8 – 10 villages hunt bowhead whales during the spring migration. Villagers often have to travel several miles over the frozen sea, crossing pressure ridges, in order to find open water suitable for bowhead hunting. They drag light boats made with the skin of bearded seals, called umiaqs. An 8 m long umiaq can be used to take whales up to 15 m long and 50 tons in weight. The people establish whaling camps near leads in the ice edge. This kind of whaling is dangerous because the ice is constantly shifting with the wind. Fatal accidents are not uncommon, and safety is an important priority for the whalers.

The primary weapon is a wooden shaft with a darting gun assembly attached to one end. The assembly consists of a detachable harpoon and a darting gun barrel. The detachable harpoon is attached to a line and a float. The darting gun barrel contains an explosive projectile and a triggering mechanism. Whalers thrust the wooden shaft into the whale, so that the harpoon pierces the whale’s body and the projectile is shot into the whale. The function of the harpoon, line and buoy is to mark the whale, as a help in keeping track of the animal. The projectile explodes inside the body of the whale, about 3.5 seconds after being fired. If the whale does not die shortly after the explosion, a shoulder gun is used to fire a second explosive projectile into the whale’s body. Once killed, the whale is dragged to the whaling camp, and hauled by hand with ropes into the ice, where it is butchered. Several hands are needed in order to haul a large whale, so it is easy to see that the event is important at the community level. Besides its cultural importance, whaling provides vital nutrients to the people.

WORKING GROUP DELIBERATIONS FOLLOWING THE PRESENTATION

Description of various hunting techniques

Darting gun / shoulder gun

This was the method described above, as used in Alaska to hunt bowhead whales. Similar methods are used for hunting bowhead whales in Chukotka and in Arctic Canada.

Gennadi Inankeuyas and Eduard Zdor (Russian Federation) explained, with the help of a Powerpoint presentation, the way grey whales are hunted in Chukotka. There are about 25 villages in Chukotka, all of which harvest whales. About 75% of the grey whales are killed using a darting gun similar to the one used for bowhead whaling in Alaska. The darting gun has been adapted for use with grey whales. As in Alaska, the explosive charge is usually black powder, but the projectiles are sometimes used without black powder. One or two projectiles are usually enough to kill a grey whale.

Approximately 60% of the grey whales sink when dead, so it is important to secure the animals with several hand harpoons attached to floats before killing it. About 12 floats are required for large whales and 7-8 for small ones. Because grey whales can be very aggressive, rifle shots are used to debilitate the animals before approaching close enough to use the hand harpoons and the darting gun.

Harpoon cannon

Dr. Egil Øen (Norway) and Dr Hajime Ishikawa (Japan) described this method in some detail.
during their presentations in plenary. A harpoon cannon rigged into the deck of a boat is used to fire a harpoon with an explosive grenade into the body of the whale. The harpoon is attached to a forerunner, which is in turn attached to a winch in the boat. This kind of whaling requires a boat large enough to carry a harpoon cannon. In Greenland, the minimum boat length required to install a harpoon cannon is 10 m. At the other end of the spectrum, ocean-going vessels 100 m long are used by Japan for whaling offshore and in the Antarctic. Whaling with a harpoon cannon is carried out legally by Greenland, Iceland, Norway and Japan. Several species of large whales are targeted, including fin, minke, Antarctic minke, humpback and sperm whales, however the targeted species may vary from country to country. In most cases, whaling with a harpoon cannon has relatively low S&L rates.

Back-up weapons for minke whales are usually either a high-powered rifle or a second harpoon grenade. For larger whales, such as fin whales, the backup weapon is usually a second harpoon grenade. Leif Fontaine (KNAPK) explained that in Greenland it is required that all boats smaller than 12 m should work as a team with other boats in order to capture fin whales. If the whale does not die instantaneously, the second boat fires a second harpoon grenade. This is because a wounded fin whale is too large and dangerous for a single small boat. In Greenland, the numbers of whales S&L were reduced considerably after the introduction of the Norwegian penthrite grenade.

**Rifle / hand harpoon**

This is a relatively inexpensive method used to catch whales from fast, small boats. It is used for minke whales in Greenland and for grey whales in Chukotka. The method used in Chukotka is similar to the one described above under the darting gun section, with the difference that the killing shots are not delivered with a darting gun, but with rifles.

Kalle Mølgård (KNAPK) explained that, in Greenland, communal hunts are strictly regulated and are carried out by a minimum of 5 skiffs working together. Hunters use rifle calibre 7.62mm (30.06) or larger, with full mantled bullets. They shoot first into the water in order to steer the whale towards the coast and into fjords. At the first opportunity, hand harpoons with floats are attached into the whale. In order to attach the floats, the whale is often forced to slow down by wounding it. Floats are necessary because the majority of minke whale carcases sink. Once the whale has been secured with a sufficient number of floats, it is killed with shots aimed at the head. Killing shots are often delivered using rifles of higher calibre, such as .375 and round-nosed bullets. The chase and kill usually take 5 minutes or more.

**Factors contributing to struck and lost**

Most of the participants were very active during the discussion. For the sake of simplicity, we will now present a summary of the discussion, without mentioning the names of the persons providing the information.

**Darting gun / shoulder gun**

Common causes of S&L include:

- Whale diving under pack ice
- Weather turning bad
- Whale sinking (in Alaska, this happened to one out of 20 in 2006)
- Malfunction of explosive.

Contributing factors include: body site of strike, depth of penetration, size of whale, etc.

In Chukotka, access to penthrite projectiles and black powder projectiles can be difficult. Hunters may be forced to use rifles, instead of darting guns and shoulder guns.
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**Harpoon cannon**

By far the most common cause of S&L for large whales hunted with the harpoon cannon is when a whale already dead breaks from its attachment and sinks. This is especially common in bad weather, when the swell causes the forerunner to slack and tense repeatedly. There are several “links” in the chain connecting the harpoon to the boat: the arms of the harpoon, the connection of the harpoon to the forerunner, the forerunner itself and the connection of the forerunner to a winch in the boat. These “links” may be subject to tonnes of pressure, and if any of them breaks suddenly, the whale may sink into deep water and be lost.

Another cause of S&L is when wounded whales break loose. This is more common among the larger and stronger whales, such as fin whales. There is an increased risk of the whale breaking loose and escaping when the explosive malfunctions.

**Rifle / hand harpoon**

The main causes identified for S&L in this type of hunt were:
- Weather changing and forcing whalers to abandon the chase
- Whale sinking when killed before being secured with sufficient floats
- Wounded whale escaping

**Ways to reduce struck and lost – specific for types of whaling**

**Darting gun / shoulder gun**

In the 1970’s, more than 50% of the struck whales were lost. There have been serious efforts to reduce the losses, and the numbers have gradually improved. The mean loss rate for 1995-2004 was 21%. The improvement is due to a number of factors, which include a coordinated community effort, better training for whalers, improvement of equipment and limits to the number of whales that can be struck in one given day. The reduction of the S&L rate is an ongoing process.

In recent years, there have been quite successful experiments using the more powerful penthrite, instead of black powder as the explosive in the projectiles. Penthrite projectiles are of Norwegian design, but have been further developed locally in Alaska. There is still room for improvement in weaponry design, and the whalers are looking forward to “off the shelf” penthrite projectiles.

**Harpoon cannon**

**Whales sinking**

In order to avoid the loss of dead whales, it is very important to give proper maintenance to the harpoon and attachment points. It is also important to check that all the components are mounted properly before firing the harpoon. Forerunners should have an adequate strength to support the weight of the animal being hauled. Likewise, forerunners should be replaced at regular intervals. A smoother outline in the harpoon can help to reduce risk of wearing the forerunner.

In Iceland and in Japan, air pumps are used to inflate baleen whales and increase their buoyancy. In addition, grappling irons can be used to secure the whale carcases.

**Wounded whales breaking loose**

In order to reduce the number of wounded whales that escape it is important to minimise the time to death as much as possible. The best way to do this is to cause instantaneous death by ensuring well-placed harpoon shots at relatively close range.

Bringing the whale rapidly close to the boat may facilitate using the back-up weapon before the animal fully regains consciousness. This requires strong forerunners and fast winches.
Keeping the back up rifle prepared and at hand may help to reduce the time to death. If the back-up weapon is a second harpoon fired from the same cannon, keeping a second forerunner winched and ready to use can reduce the time to death. Of course, this is only possible on boats with two winches.

A modified harpoon grenade for fin whales, able to deliver a larger charge deeper into the whale’s body could help to increase the instantaneous death rate and reduce the time to death.

**Rifle / hand harpoon**

When hunting from small boats, it is important to consult reliable weather forecasts in order to avoid having to abandon a chase if the weather turns bad. However, in some areas such as Chukotka this is easier said than done, since access to reliable weather forecasts is difficult.

In order to avoid losing whales because of sinking, it is important to avoid killing the whale before it has been secured with sufficient floats.

A factor that limits the efficiency of rifle hunts is that boats have to be very close to the whales in order to attach hand-held harpoons. A way to overcome this problem could be to develop a weapon able to deploy harpoons attached to floats to distances larger than a couple of metres. There were a number of suggestions about ways to modify already existing technologies. Prototypes that could be modified included crossbows, biopsy guns, guns used to deploy satellite senders, firemen guns and shark guns.

**Ways to reduce struck and lost – general for all types of whaling**

**Training**

Training is essential for improving the hunt and reducing S&L. Ideally, young whalers should learn from several teachers, including more experienced whalers, experts on weapons and people with knowledge of anatomy and physiology.

Training should be carried out in several places: empirically, on the whaling grounds; theoretically, through seminars and lectures and practically, through hands-on workshops and *in-situ* necropsies.

Whalers should learn how to use and maintain the equipment, how to strike the whales and how to handle the animals that have been struck. There is a need for educational material, such as anatomical charts designed for whaling.

**Equipment**

S&L can be kept to a minimum by using adequate equipment for securing and killing the animals. The equipment has to be well maintained and functioning. It is also important to have the equipment at hand and ready to use. This includes items such as back-up weapon, extra harpoons, extra floats, etc.

**Time to death and handling of killed animals**

Once the animal has been effectively secured, time to death should be reduced as much as possible. This is important not only to minimise animal suffering, but also to reduce the risk of losing the animal.

In order to reduce the risk of losing a dead animal, it is important to minimise the time needed to bring the animal to where the flensing will take place. For this, it is important to handle the killed whales effectively and quickly.
Feedback
In order to learn and improve, it is important to know what went well and what went wrong. It is important to know the reason why some hunts go well, and why some cases end in cases of S&L. It is possible to learn from one’s own experience and from the experience of others. Therefore, feedback communication is important at all levels: within a whaling crew or team, within a whaling fleet, and internationally, through exchange of information with colleagues.

International cooperation
The international exchange of information, technology and experience can greatly improve whaling techniques and help to reduce S&L.

There are logistical issues concerning transport of equipment, including weapons and explosives across international borders that can only be overcome with international goodwill and cooperation.

Whaler’s participation
Development and implementation of ways to reduce S&L should be done in close collaboration with the whalers.

How to monitor struck and lost
In Alaska, monitoring is done in close cooperation between community and authorities. Since much of the community is involved, it would be almost impossible to fabricate a story. Each captain reports directly to the Alaska Eskimo Whaling Commission. Reports of S&L include, among other things, the reason why the animal was lost.

Chukotka and Greenland rely on self-reporting systems. Here, the motivation to report is important. The fact that S&L animals are taken from the quotas does not help in this respect. In both areas, there are only a few inspectors monitoring the catch over a very large area.

In Greenland, because there are several boats participating in each collective hunt, and the communities are small, it is unlikely that a case of S&L would go unnoticed by the authorities. For the harpoon cannon hunt, each penthrite grenade has a serial number, and whalers have to account for the grenades bought and used on every kill. It is therefore possible to check the fate of the grenades and track potential unreported strikes. Reports include causes of S&L. There is a higher rate of S&L for fin whales than for minke whales.

In Norway, there used to be observers monitoring whaling on all boats, but now observers have been replaced by the “Blue Box”. Nowadays, records of S&L depend on self-reporting, but there are ways to check if the reports are reliable.

Accurate descriptions of S&L cases are needed in order to provide feedback and to improve hunting methods. Accurate numbers of removals are useful to determine catch limits. However, when the catch is well within sustainable levels, and the S&L rates are very low, it may not be necessary to report every single case of S&L.

RECOMMENDATIONS

Hunters training
- To encourage training, in practice and in theory with: experienced hunters, experts on weapons and experts on anatomy.
- To produce educational material, including anatomical charts designed for whaling
- In order to learn and improve, feedback to whalers should be improved, including feedback on: successful kills, problematic kills, cases of struck and lost and their causes
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Techniques and equipment
- To ensure that adequate equipment for securing and killing is well maintained, functioning and at hand
- Time to death should be as short as possible, once the whale has been effectively secured
- In order to prevent whales sinking when using harpoon cannon, it is recommended to:
  - Cause instantaneous death
  - Keep the back-up rifle at hand
  - Keep harpoon and attachment points well maintained
  - Use forerunners of adequate strength
  - Replace forerunners at regular intervals
  - Keep a back-up forerunner ready
  - Use the air pump to inflate the whale where legally feasible
  - Use grappling irons to secure the carcase
- To improve the Norwegian penthrite grenade used for hunting fin whales in Iceland and Norway, in order to increase the rates of instantaneous death or unconsciousness\(^2\).
- To facilitate access to good weather forecasting for whalers working from small boats
- To avoid killing the whale before it has been secured sufficiently. This is especially true when using small boats to hunt whales that may sink.
- To develop a gun to deploy harpoons attached to floats. This would shorten the time needed to secure whales that may sink when hunting from boats without a harpoon cannon

Regulatory measures
- To strengthen international cooperation in order to facilitate: a) access to information and technology and b) purchase and transport of equipment, including weapons and explosives
- Development and implementation of ways to reduce struck and lost should be done in close collaboration with the whalers

Monitoring
- Reporting of the causes of struck and lost is needed to provide feedback to whalers

\(^2\) The workshop did not discuss the Japanese Fin whale hunt.
REPORT OF THE WORKING GROUP ON SMALL WHALES

This Working Group was chaired by Justines Olsen (Faroe Islands) and the rapporteur was Christina Lockyer (NAMMCO Secretariat). The Working Group began with a presentation by Simeonie Keenianak from Nunavut Tunngavik Inc.

PRESENTATION ON NUNAVUT HUNTING CULTURE

A pictorial history was presented illustrating a variety of hunting targets from seals, walrus, and polar bear to beluga. The purpose was to demonstrate the hunting community life style in the region. The presentation then continued with the beluga hunting.

Beluga hunting
There is a long history of whaling in the Cumberland Sound area of Nunavut involving the Inuit. Different stocks of beluga whales can be distinguished by their head shape and other characteristics. The beluga whales spend the summer time in Clearwater Fjord to breed, but hunting is not carried out until the whales leave the fjord, to avoid hunting females and young. In fact the hunters believe that calving is annual in the beluga. There is an annual quota of 40 belugas in Cumberland Sound – this quota is usually taken in just one (or two) day(s). The hunters do not compete with each other as the whales are shared communally. Narwhal hunts were conducted in April and fall times. The whales were hunted primarily for mattak. The areas of hunting were also influenced by the floatability of the dead whales. In Cumberland Sound for example, the whales float better than in Clearwater Fiord were there is more freshwater in the ocean. Whales tend to be leaner in the fall.

Hunting gear used – a harpoon with line, float and hooks and also rifle. The harpoon head attaches onto an iron shaft, and has a line with large float attached. The harpoon head attaches to the whale by detaching from the iron shaft and the harpoon head toggles under the skin to hold fast to the whale. For shooting, .303 rifles with full metal jacket bullets and .30-30 with full metal jacket bullets were used in the past, but nowadays .375, 338 and 6.5 x 55 are used. The bullet shape was round in the past; but in the 1960s and 1970s this was changed to a sharp pointed bullet. The .375 uses a rounded bullet.

Share-out of meat – there is sharing of the whales caught so that each person gets at least part of a whale. The whale skin was used for making whips and also the harpoon line in the past, but not so much now.

Site of shooting and harpooning - when a whale is shot, the aim is for the head or backbone (head end) or lungs. In shallow water the harpoon and line is used first, as soon as one gets close to the whale. In deep water, the whale is often wounded first with a sub-lethal shot before harpooning. The harpoon is then used to prevent sinking. Floats on the harpoon line also prevent sinking. Nowadays large commercially available orange plastic floats are used. The whale is ultimately killed with a rifle shot.

Discussion on the presentation
Could sinking contribute to struck and lost? In the spring after feeding – May-June – the dead whale does not sink at all except maybe the young males. In September all whales are leaner.
WORKING GROUP DELIBERATIONS FOLLOWING THE PRESENTATION

Description of various hunting techniques

Open water hunt with rifle

- Narwhal
  Arctic Canada – in summer the whales are generally seen in hundreds in the fjords in Nunavut. In other years there are none at all. In some years, the quota is exceeded because so many whales occur in the area, and there is a frantic activity during one to two days. Narwhals usually go to shore when chased with motor boats; the harpoon and high power rifles are used to secure and kill. During the rest of the year the animals are not hunted. They are not hunted in Cumberland Sound like beluga, as the timing is different. Smaller rifles are used to scare the whales and keep them underwater and to minimise air intake. The same ammunition is used for narwhals as beluga, and the same method is used for killing as in beluga. Again the harpoon is used first in shallow water or whenever possible to secure the whale before being killed.

- Beluga
  Arctic Canada - see notes earlier under the presentation by Simeonie Keenianak for Nunavut.
  In Nunavik, Inuit traditionally used kayak and harpoon to hunt all marine mammals in the past. Today the harpoon is used before shooting to avoid carcass loss through sinking. Outboard motors are used on freighter canoes for the hunt; the harpoon is used first. In deep water, if one shoots first and then the animal dives, it can be lost. Thus the harpoon is again used first. The rifle and ammunition is similar to Greenland, and the calibre is high power – .303 and the bullet shape is pointed full metal jacket. Greenland – usually the harpoon is used first to secure the whale in open water before shooting and killing. The whales used to be driven into shallow water but now boats are used in open water. There was some discussion as to whether the whales should first be recommended to be secured by harpoon and line before shooting in open water. Since 1998, new stocks of larger size whales with slower movement and longer diving capacity – different habits – more like narwhals in size, have been around. For shooting, the Greenlandic bullet is by new laws, from a rifle of 30.06 minimum calibre with pointed full metal jacket bullets.

- Harbour porpoise (Phocoena phocoena)
  Greenland – no information was available on struck and lost, but ca 2,000 porpoises are taken every year (NAMMCO, 2005). No hunters were available at the workshop to report on this matter. Those present came from areas too far north where porpoises do not occur. The hunting technique in mid-West Greenland is to use boats and rifle. The carcasses are rather fat and tend not to sink (Lockyer et al, 2003). Carcasses observed in the market in Nuuk have bullet holes and testify to shooting as the killing method.

Drive hunt

- Pilot whale
  Justines Olsen provided details of the “grindedrap” in the Faroe Islands in his presentation on day 1 of the Workshop (see page 25). A ball-pointed hook is inserted into the blowhole to haul the animal in to shore after driving, and then a knife is used to kill. The traditional knife took 30 sec. to kill the whale. Recent experiments with a new design of knife that kills more quickly – more like a spear on a rod: 12 – 15 mm thick and 35 cm long with two handles positioned at 90° (like a shovel) so one can use both hands in the application, have been successful. This new knife is being
introduced gradually. The relationship between hunters and administrators is currently good with collaboration, training, education and gear development.

**Harpoon hunting from Kayak**
- Narwhal and beluga
  
  See information about the historic and current use of kayaks and harpoons under the section on [Open water hunt with rifle](#).

**Land / Ice edge rifle hunting**
- Narwhal
  
  In North Baffin, whales are hunted in cracks and leads in the ice and from the ice edge. Whales are very wary and listen and cannot be easily approached, so hunters will wait for days on the ice near leads and the ice edge. Narwhals dive deep and before a deep dive there is a series of shallow dives as the whale swims towards the ice edge, the last breath is a long deep breath where the head and neck area of the animal rise above the waterline exposing this vital area to the hunter. At this moment, the animal is shot in the head/neck, which immobilizes the whale with the lungs full of air to ensure that it will float. The shooting takes place within a 10 m range, and is very effective with low loss rates. As the whales are killed at close range it is easily retrieved with a harpoon or a throwing line and hook.

**Factors contributing to struck and lost**

**Greenland**

A kind of hunting “university” exists with learning taking place from other older hunters by example. With growing quota restrictions and less hunting, there are fewer opportunities for the youth to learn hunting techniques. Hunting in Greenland often starts at an age as early as 12 yr. The present generation cannot or do not teach their sons as formerly in Greenland. This is a disadvantage as in order to learn how to avoid problems of struck and lost, one must be out there on the hunt learning. In the Faroes, learning about the “grindedrap” is also by example. However, the practice is changing and schools now tend not to allow children to leave for the beach if a “grindedrap” occurs. These restrictions will increasingly have an adverse effect on the acquisition of hunter skills in future generations.

**Canada - Nunavut**

Weather conditions are a very important factor in affecting struck and lost. One can now easily get weather forecast by radio, etc. Wind is no good for hunting, and calm water is best. The turbidity of water also affects the ability to track and recover a sinking whale.

**Ways to reduce struck and lost**

**User knowledge, scientific and management collaboration**

**Greenland** - quotas now mean that the catch is very small in comparison to earlier times. Therefore hunters must be careful not lose animals. In practice therefore, struck and lost is not really a problem. There should be involvement of hunters with the planning of hunting quotas and in the areas of operation. User knowledge should be used in management in conjunction with science. The Hunters Association (KNAPK) together with the Greenland Institute of Natural Resources (GINR) are formalising cooperation and how they can work together. Managers sit in between scientists and hunters, nearly always resulting in a compromise on quotas. The question is exactly how to improve cooperation.

In Greenland there is monitoring information from biologists and aerial surveys to count animals. The problem is how to get complementary information from users in a systematic quantifiable way. It was recommended to develop ways to get systematic information from
hunters. With large whales there is a system in place but less so for small whales. The users (hunters) should be involved in decision-making processes concerning the hunt.

**Canada** - in Nunavut, hunters have formal meetings with local government officials where they talk about all aspects of hunting - equipment, safety, training, etc. and also how to reduce struck and lost. These meetings establish local hunting rules and regulations, the required equipment, etc. Such types of meetings could be a role model for other countries and regions. User knowledge should be taught everywhere not just isolated to Greenland, and other indigenous communities. There was discussion on recommending teaching traditional knowledge in high schools. It is important in such communities to disseminate knowledge and respect for hunting and the hunted animal.

**Technical recommendations** – regardless of the equipment used one must know how to shoot and handle this equipment expertly.

*Nunavut* - 1) The need for training has been identified as a priority by Inuit – it is recommended that training be community-based and species specific; currently the only training is firearms safety which is generic all over Canada and must meet certain standards. Local experienced hunters who are familiar with local environment should be employed to train hunting methods and ethics. 2) Equipment – In harvesting walrus and small cetaceans, the bullet penetration required to reach vital organs and cause nervous disruption demands special ammunition. Ammunition designed to create cavity wounds is used for the harvesting of terrestrial animals but is not as effective for larger marine mammals as ammunition that is designed to create channel wounds. Suitable ammunition for the harvesting of marine mammals is not readily available from local merchants. As ammunition is classified as a dangerous goods it cannot be transported by air or mail; this means that hunters cannot readily obtain suitable ammunition for harvesting walrus and small cetaceans. In hunting communities, suitable ammunition designed for marine mammals should be made more readily available.

**General discussion** - However, even using more efficient equipment still does not necessarily diminish struck and lost. It may just lead to sinking and loss. A combination of suitable equipment and training is needed in the use of rifles and appropriate ammunition. A recent NAMMCO project in terminal ballistics testing was done in the Faroe Islands on pilot whale heads, that has been very valuable in determining the effectiveness of different bullet types and sizes for the killing of small cetaceans. Also valuable is user knowledge on ammunition performance.

Another aspect of ammunition use is the potential loss of hearing in both gunner and crew with the use of high velocity rifles. The question is how to minimise this problem and disseminate technical information for user safety.

Military surplus ammunition – full metal jacket spear headed bullets - tends to cause an increase in superficial wounding in marine mammals when not penetrating the required target, through ricochet. The challenge is for observers to assess whether such a wounded animal lost will survive or die.

With steady quota reduction, hunters in Greenland are trying to adapt and reduce struck and lost by modification of hunting gear. One example is in Nunavut where one can use new thinner strong synthetic line on the harpoon rather than traditional skin rope. It is important to develop new technology for reducing struck and lost. One possibility is to develop something that could improve the range of strike.
Japan – two types of hunt exist for small whales – 1) the drive fishery similar to the Faroes and 2) the hand harpoon. At one time the rifle was used and then the harpoon. However, gun regulations and restrictions resulted in the eventual relinquishment of the rifle use. Now, only the hand harpoon with line and buoy are employed. This has actually reduced struck and lost, because of the short line that secured the whale.

In Japan, there is an air gun that could be adapted for the deploying of a harpoon in the hunt, based on the biopsy gun design. For example, fire rescue teams use a system to fire projectiles to break windows in fires. However, this is not yet generally available.

Norway - An air-driven gun made of corrosion free materials has been developed by Øen (Norway) to deploy radio and satellite transmitters on whales from helicopter. In shooting trials with the gun the projectiles weighing 350g hit accurately and inside the target (a circle of 10 cm in diameter) at 15 m shooting range. This gun might probably easily be modified to deploy a small sized harpoon with a line attached.

How to monitor struck and lost

Greenland

Hunting inspectors and a self-reporting system exist for large whales, and could possibly work for small whales. The Greenlandic reporting about struck and lost is rather limited and species-dependent according to whether or not the species is quota-restricted. A form of one page, requesting date, place, time, struck and lost, catch, etc. could work. Presently, forms are returned to the municipal authority. What is currently lacking is a good way to get feedback from the hunters.

Canada

In Nunavut, every hunting season a request is sent out to each community for information on hunting losses and takes. In Canada generally, reporting is not mandatory on struck and lost. In Quebec/Nunavik there is no obligation to report struck and lost. If struck and lost is reported, then this is deducted from the quota, which is no incentive for reporting. In Nunavut, however, reported struck and lost are NOT deducted from the quota.

It was suggested that the problem of struck and lost is really only critical where a population is harvested close to unsustainable levels. Thus there are different situations where and when it is important to monitor struck and lost.

Generally, it was regarded as an urgent matter as to how to get feedback from hunters on struck and lost. Currently there is inadequate information and all parties (hunters, administrators, managers, biologists) have to get together to find a way forward on this matter of recording and reporting stuck and lost. One route could be to establish local sub-committees to work out an acceptable and appropriate monitoring system in hunting areas.

RECOMMENDATIONS

Hunter training:
- Training is paramount – it should be community based and species specific. Local experienced hunters who are familiar with local environment should be employed to train.
- Traditional knowledge should be taught in high schools.
- Ways have to be found to counteract the negative effects of diminishing quotas and hunting restrictions on the acquisition of hunter skills in future generations.
Techniques and equipment
• Using more efficient equipment still does not necessarily diminish struck and lost. Thus a combination of suitable equipment and training is needed in the use of rifles and appropriate ammunition.
• Methods of improving access to long-range forecasting of weather conditions need to be found as weather is a very important factor in affecting struck and lost.
• Develop a weapon that could improve the range of strike, e.g., an air gun that could be modified to incorporate firing of a harpoon head. This could improve the firing / strike range and the securing of the whale.
• In hunting communities, suitable ammunition designed for marine mammals should be made more readily available.
• Use of high velocity rifles can result in hearing loss and steps should be taken to minimise this problem and disseminate technical information for user safety.

Regulatory measures
• The users (hunters) should be involved in decision-making processes concerning the hunt such as the planning of hunting quotas and in the areas of operation. User knowledge should be used in management in conjunction with science.
• Establishing formal meetings with local government officials on all aspects of hunting - equipment, safety, training, etc. where reduction of struck and lost can also be discussed. These meetings could establish local hunting rules and regulations, the required equipment, etc. that would help to mitigate struck and lost.

Monitoring
• All parties (hunters, administrators, managers, biologists) have to get together to find a way forward on the matter of recording and reporting stuck and lost. One route could be to establish local sub-committees to work out an acceptable and appropriate monitoring system in hunting areas.

REFERENCES

WORKING GROUP ON WALRUS

The Working Group was chaired by Harry Brower (Alaska) and Daniel Pike (NAMMCO Secretariat) acted as rapporteur. The Working Group began with a presentation by Gennady Inankeuyas from Association of Traditional Marine Mammal Hunters of Chukotka on Walrus Hunting in Chukotka.

WALRUS HUNTING IN CHUKOTKA

All coastal villages in Chukotka hunt walrus, and walrus hunting is carried out during all seasons of the year. In recent years there has been a catch of between 1,000 and 1,500 annually.

Types of hunting
Three basic types of walrus hunting are carried out in Chukotka.

Ice Haulout
Walrus are hunted when they haul out on the ice during the spring and early summer. They are shot either from a boat or from a neighbouring ice floe.

Open Water
The open water hunt is conducted in the summer and early fall. Walrus are hunted from small boats. They are harpooned before shooting if possible, but it is often necessary to injure the walrus first with a non-lethal body shot, so that it can be approached close enough to harpoon. Once the animal is secured with a harpoon and float, it is shot lethally.

Land Haulout
Walrus utilize land haulouts once the drift ice departs in the late summer and fall. When hunting walrus on land haulouts great care is taken not to disturb the animals unduly, as this could cause the animals to stampede and abandon the haulout. Therefore the walrus are usually killed by a hunter on foot using a hand lance. If the haulout is accessible from the water, the walrus may be approached quietly with the engines off, then harpooned and killed with a lance.

Struck and Lost
Community based monitoring of walrus hunts suggests that loss rates range between 4 and 20%. Losses are generally very low in land and ice haulout hunts, and somewhat higher in open water hunts. Struck and lost occurs for many reason including poor quality or poorly maintained equipment, poor weather conditions and hunter error. The experience, skill and judgment of the hunter are the most important factors determining the incidence of struck and lost.

Reducing Struck and Lost
Proper training of hunters is most important in reducing struck and lost. It is also important that hunters receive feedback from the hunt monitoring programme so that they know how much struck and lost is occurring. Hunters should be well prepared and have well made and well maintained equipment, as equipment breakage often leads to lost animals. Finally, it is very important that hunters keep careful track of the weather and be prepared to abandon hunting if the weather deteriorates.

Monitoring
In Chukotka monitoring is done at the local level. A person in each village is designated to keep track of the number of walrus landed and to obtain information on struck and lost. They
do this by observing some hunts and by interviewing hunters when they return to the village. In addition they record the age (cubs, 1-year old, young, adult, not-identified) and sex of walrus that are taken, and take samples including teeth for ageing and tissue samples for genetic analyses.

WORKING GROUP DELIBERATIONS FOLLOWING THE PRESENTATION

Descriptions of hunting methods
Generally, four types of walrus hunting are carried out, and these are similar in all areas. The type of hunting depends mainly on the habitat and season of the hunt.
1. Pack ice, from a boat or another ice floe;
2. Open water;
3. Breathing hole;
4. Land haulout (Chukotka only).
All these methods are described in detail in the Report of the Workshop on Hunting Methods for Seals and Walruses (NAMMCO 2005) and will not be covered here.

Regional descriptions

Alaska
Most walrus hunting in Alaska is done in the pack ice, by single small boats or small groups of boats. Walrus are usually shot first on the ice, then harpooned if necessary. The most common rifles in use are the .270, 7 mm, 30-0-6 and 375 magnum. It is most important to immobilize the animal with the first shot so that it cannot enter the water. Generally the base of the neck has been found to be the most effective target area for doing this.

Canada (Nunavut and Nunavik)
In Nunavut and Nunavik, only a few communities have easy access to walrus. Hunters from some communities must travel long distances to access areas with walrus, and consequently may mount only one or two walrus hunting expeditions per year, during which they may take several animals. In the main walrus hunting communities of Igloolik and Hall Beach, most hunting is done in the pack ice during the spring and early summer. Walrus are generally shot on the ice, then harpooned if necessary. In other areas walrus may be hunted in open water during the summer, in which case every effort is made to secure the walrus before it is killed. Smaller numbers of animals are taken at the floe edge and at breathing holes during the winter. In Nunavut there is also a highly regulated, non-native sport hunt for walrus. To date there has been no struck and lost in this hunt, in which approximately 100 animals have been taken over 10 years.

West Greenland
In West Greenland walrus are generally found in the pack ice many miles offshore. Walrus hunting is limited by law to vessels under 20 tonnes displacement. Walrus are generally shot on the ice, and then harpooned if necessary. However new legislation requires that walrus be harpooned before the killing shot is made. Hunters who spoke in the Working Group were opposed to this because they felt it was not feasible to approach walrus close enough to harpoon them in most cases. Also, in cases where the walrus could be harpooned, it was thought likely that the harpoon line would be broken in the ice.

Northwest Greenland
In this area, walrus are often hunted at their breathing holes in new ice during the fall and winter. The walrus is harpooned when it comes up the hole to breathe. The walrus then dives, but is restrained with the harpoon line. When the walrus surfaces again, it is shot in the head at close range. Struck and lost was reported to be rare for this type of hunting.
Factors contributing to struck and lost
Few actual estimates of struck and lost in walrus hunting were available to the Working Group. However, based on experience, it was generally agreed that struck and lost was very low for breathing hole and land haulout hunts, medium for ice floe hunts, and highest for open water hunts.

Lack of experience or knowledge of proper techniques
Hunting is an activity for which a variety of skills are required, and there are some techniques that relate specifically to reducing the incidence of struck and lost. For example, in ice floe hunts, animals in the centre of the group should be targeted first, so that they are not pushed into the water by others. Also, in open water hunts, it is sometimes advisable to shoot the animal non-lethally so that it can be secured before killing (see Recommendations). There are many such techniques that are often specific for a particular area or set of conditions. It was considered therefore that hunter training and experience was the most important factor in determining the incidence of struck and lost.

Lack of proper equipment
It is obvious that a lack of proper equipment, suitably adapted to local conditions, can contribute to struck and lost. Equipment presently in use for walrus hunting by region was described in the Report of the Workshop on Hunting Methods for Seals and Walruses (NAMMCO 2005) and will not be covered here. It was also suggested that new equipment could be developed or adapted that would be effective in reducing struck and lost in walrus hunting. An example would be a small harpoon gun or harpoon cannon.

Poor maintenance of equipment
Equipment failure, including breakage of harpoons and lines, jamming of rifles and engine failure, was noted as a common cause of struck and lost. Hunting equipment should therefore be well maintained and carefully inspected before every use. This is also a factor that can affect the safety of hunters.

Weather/Environmental conditions
Delegates noted that weather conditions can affect the success of the hunt in several ways. Poor weather can lead to less accurate shooting and therefore to heightened struck and lost. In addition, changing weather conditions can sometimes necessitate the abandonment of a hunt before the animal is properly secured, and can even force hunters to abandon animals that have been landed. Hunters should therefore have access to and use the best available weather forecasts, and should not initiate hunting if the weather conditions are not favourable. Again this issue also affects hunter safety.

Monitoring
The Workshop noted the general lack of recent and detailed data on rates of struck and lost in most areas. At present the only area with an operational monitoring programme that includes estimation of struck and lost is the Chukotka region. In addition the limited sports hunt in Canada is closely monitored. Recently the reporting of struck and lost has become mandatory in Greenland, but no data are yet available. This means that at present, old and perhaps unreliable data are being used in management in most areas. This can have a direct effect on hunters, particularly in areas where walrus hunts are controlled through quotas.

It was noted that hunt monitoring at the level of detail that will enable estimation of struck and lost requires careful planning and design, and is best achieved through the active cooperation of hunters, researchers and managers. This requires that hunters “buy in” to the programme by participating honestly and consistently. Therefore the need for estimates of
struck and lost must be explained properly to hunters, something that has not been done in the past.

Monitoring can be particularly difficult and expensive in areas where hunts are conducted over an extended period of time by individuals or small groups, and over a large area. Under these conditions it is not feasible to observe a many hunts, and self-reporting systems are difficult to maintain. One idea brought forward was to recruit an appropriate number of “index” hunters, who would be trained to report their hunting activities in sufficient detail to estimate struck and lost. The estimates from the index hunters would then be expanded to cover the entire hunt. A similar process is used to monitor by-catch in many areas.

RECOMMENDATIONS

Hunter training
- Walrus hunters should be properly trained and their training should be appropriate for the local environment. Such training can occur through traditional methods, formal schooling and other media such as video and the internet. It was specifically emphasized that inexperienced hunters should accompany experienced hunters on hunts.

Hunting techniques
- When hunting walrus on ice floes, the hunter should approach as closely as possible before shooting. The hunter should shoot animals in the centre of the group first so that killed animals won’t be pushed into the water by the others.
- In open water hunts, it is best to harpoon before shooting, but this is not always feasible. It may be necessary to shoot the walrus in the body and lungs to disable it so that it can be harpooned, and then shoot it lethally. This will reduce the incidence of struck and lost and the chance of the walrus attacking the hunter.
- Hunters should obtain the best available forecasts before setting out, only initiate hunting if the weather conditions are right, and abandon hunting if the weather deteriorates.

Hunting equipment
- Hunting equipment is often specific to particular regions and seasons, and is adapted to local conditions. Local authorities should compile descriptions of equipment suitable for each area and make these available to hunters and teachers.
- Hunters should ensure that proper equipment is available and well maintained.
- Technological innovation could reduce the incidence of struck and lost in some hunts. A harpoon gun that would be effective at a range of 10-15 m would be particularly effective in walrus hunting.

Monitoring
- The importance of monitoring must be explained to hunters so that they can “buy in” to a monitoring programme.
- A monitoring system should provide feedback to hunters so that they can improve their hunting techniques.
- Community-based monitoring, based on a combination of hunt observation and post-hunt interviews, has been effective in Chukotka and could be adapted to other areas.
- A system based on “index hunters” may be effective in some areas.

REFERENCE

GENERAL OVERALL RECOMMENDATIONS

A Drafting Group composed of Glenn Williams, Simione Keenianak, Fernando Ugarte, Harry Brower, Justines Olsen, Egil Øen and the NAMMCO Secretariat developed a set of draft recommendations based on the presentations and the discussions at the Workshop. These draft recommendations were then presented to the workshop participants and discussed one by one, revised if necessary, and adopted by consensus.

The final set of recommendations is:

Minimize animal suffering
The Workshop recommended that the hunters should make every effort to reduce unnecessary suffering by hunted animals, by minimizing killing times to the extent that is feasible. However, this must be balanced by consideration of the safety of the hunter, and the risk of losing the animal.

Monitoring
The Workshop noted that the present information on struck and lost is outdated or inadequate for several species and areas, and that accurate estimation of struck and lost is important for effective management and essential to improve hunting practices.

The Workshop recommended that new monitoring programmes that are appropriate for local conditions should be developed that could produce accurate information that will be accepted by hunters and managers. Such monitoring programmes should be developed in full cooperation between hunters, managers and researchers.

Proper training of hunters
The Workshop recommended that hunters should be trained in both the theoretical and practical aspects of hunting, and that training materials and programmes should be appropriate to local conditions.

Hunting equipment
The Workshop recommended that hunters should always carry weapons and equipment appropriate to the target species and local hunting conditions, and that the equipment should be properly maintained and renewed when necessary.

Cooperative management
The Workshop recommended that the hunters should be involved in the marine mammal management process, including the development of regulations pertaining to hunting.

The Workshop furthermore recommended that the design, development and testing of new weapons and hunting equipment should be done in cooperation with hunters.

Sharing of technology and knowledge
The Workshop recommended that there should be open exchange and sharing of information about new weapons, equipment and hunting techniques, and that this should be done on both the national and international levels.

These recommendations are for implementation by management authorities, hunters and researchers.
WORKSHOP CLOSURE

The Chairman thanked the technical staff and all participants for making the meeting a success. The Report from the workshop will be sent out to all attendants and presented to the Council of NAMMCO at their next meeting in March 2007. The Report will also be published in the NAMMCO Annual Report for 2006.
NAMMCO Workshop to address problems of "struck and lost" in seal, walrus and whale hunting

Appendix 1

PROGRAMME

Chair: Egil Ole Øen, Norwegian School of Veterinary Science
Co-chair: Glenn Williams, Nunavut Tunngavik Inc. (NTI)
Rapporteur: NAMMCO Secretariat

TUESDAY 14 NOVEMBER

0830: Registration
0900-0905 Welcome: Christina Lockyer, NAMMCO Secretariat
0905-0920 Introductory remarks: Egil O. Øen, Chair of the Workshop
0920-1010 Keynote addresses:
What is it? Why is it a problem? What can we do about it? Daniel Pike, NAMMCO Secretariat
Struck and lost from a hunter's perspective: Kale Mølgaard, The Association of Hunters and Fishermen in Greenland (KNAPK)
1010-1050 Factors that may influence struck and lost
Hunting equipment and methods: Egil Ole Øen
Anatomy and physiology of relevance to struck and lost: Siri K. Knudsen, Norwegian School of Veterinary Science
1050-1110 Coffee break
1110-1140 Monitoring of struck and lost: Stefan Romberg, Fisheries and Oceans Canada
1140-1200 Struck and lost in the Harp seal hunt in Greenland: a questionnaire survey: Fernando Ugarte, Ministry of Fisheries, Hunting and Agriculture, Greenland Home Rule
1200-1220 A study on struck and lost in the Faroese Islands whale drive hunt
Justines Olsen, Veterinary Service, Faroes Islands
1220-1240 Status of struck and lost in Japanese Research Whaling
Hajime Ishikawa, Institute of Cetacean Research
1240-1300 Introduction to Working Group Session
1300-1400 Lunch
1400-1800 Working Groups, two running in parallel
1530-1600 Coffee break
WG 1) Seals:
Chair: Simeonie Keenainak, NTI
Rapporteur: Daniel Pike
Presentation: Ole Petersen, KNAPK
WG 2) Large whales:
Chair: Fernando Ugarte
Rapporteur: Christina Lockyer / Fernando Ugarte
Presentation: Eugene Brower and/or Harry Brower, Alaska

Common Agenda for all Working Groups:
- Description of various hunting techniques
- Factors contributing to S/L
- Ways to reduce struck and lost
- How to monitor struck and lost

1800 Reception hosted by the Faroes and the Greenland Representations on 4th floor.
WEDNESDAY 15 NOVEMBER

0900-1300 Working Groups, remaining two running in parallel

WG 3) Small whales:
Chair: Justines Olsen
Rapporteur: Chrisitna Lockyer
Presentation: Simeonie Keenainak

WG 4) Walrus:
Chair: Eugene Brower and/or Harry Brower, Alaska
Rapporteur: Daniel Pike
Presentation: Gennady Inankeuyas, The Association of Traditional Marine Mammal Hunters of Chukotka (ATMMHC)

1030-1100 Coffee break
1300-1430 Lunch

1430-1630 Working Groups continue if necessary. Preparation of Working Group reports.

The Drafting Committee\(^3\) will work in the afternoon to prepare recommendations. We anticipate two types of recommendations:
1) General recommendations for all hunting types discussed
2) Specific recommendations for the various types of hunt

THURSDAY 16 NOVEMBER

0900-1100 Working Group presentations and discussion
1100-1145 Coffee and drafting group meeting
1145-1245 Drafting Committee presents suggestion for recommendations
1300-1345 Lunch
Drafting Committee revises recommendation according to the discussion in the plenary

1345-1445.1 Discussion, final recommendations and conclusions
1445-1500 Closing by Egil O. Øen, Chair of Workshop

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\(^3\) Drafting Committee:
Chair: Glenn Williams
The four WG chairs and rapporteurs
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NAMMCO Workshop to address problems of “struck and lost” in seal, walrus and whale hunting

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