NORTH ATLANTIC MARINE MAMMAL COMMISSION

REPORT OF

THE NAMMCO EXPERT GROUP MEETING TO ASSESS THE HUNTING METHODS FOR SMALL CETACEANS

Copenhagen, Denmark
15 – 17 November 2011

North Atlantic Marine Mammal Commission
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INTRODUCTION

Coastal people's right to hunt and utilise marine mammals has always been a firmly established principle in the North Atlantic Marine Mammal Commission – NAMMCO. However, embedded in this right is also the obligation for hunters and the competent authorities, to conduct the hunt in a sustainable way and in such a manner that it minimises animal suffering associated with the hunting and killing methods, and take into account hunters safety.

The Committee on Hunting Methods was formally 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. Advice given should be based on the best available scientific findings, technological developments and users' knowledge, and with due consideration to safety requirements / hunters safety and the efficient use of the resources.

The Committee on Hunting Methods has organised much of its work through the convening of international workshops. Valuable dialogues have been fostered by bringing together hunters, managers, technical experts and scientists to exchange ideas and viewpoints on hunting matters in an atmosphere of mutual respect and cooperation. The workshops have all generated recommendations at both general and specific levels. Over the years the Committee has also organised several Expert Group Meetings to address specific issues related to hunting of marine mammal (Appendix 3).

At its 19th annual meeting in September 2010 the NAMMCO Council tasked its Committee on Hunting Methods to organise an Expert Group to assess hunting methods for small whales.

Terms of reference for the Expert Group as provided by the NAMMCO Council were:

1. Review and assess current hunting and killing methods for small cetaceans
2. Review and assess information on recent and ongoing research on improvements and technical innovations in hunting methods and gear used for hunting of small cetaceans
3. Review and assess time to death (TTD) data on the killing of small cetaceans
4. Give recommendations with respect to possible improvements.

In setting up the Expert Group, the Committee on Hunting Methods identified a small group of qualified scientists and other persons with extended experience and knowledge of marine mammal hunting in general and in particular small cetaceans/or marine mammal specific biology, physiology, anatomy, pathology and statistics. All members of the Expert Group were invited in a personal capacity as experts in fields related to the issue of killing mammals. Also members of the Committee on Hunting Methods participated in the Expert Group. The Expert Group met under the chairmanship of Egil Ole Øen on 15 – 17 November 2011 in Copenhagen, Denmark.

The Expert Group was presented with data on hunting methods and killing of small cetaceans from Canada, Greenland, the Faroe Islands and Japan. The participating regions had been presented with a suggestion of what kind of data would be of interest for the Expert Group to assess prior to the meeting (Appendix 4).

At the beginning of the meeting the programme (Appendix 1) was presented and a small drafting committee (Bjørge, Geraci, Iwasaki, Levermann, Olsen, Williams and Øen) was

established with the responsibility to formulate conclusions and recommendations. Based on the discussions and deliberations of the meeting they formulated and presented draft recommendations on the last day. These recommendations were discussed in plenary together with extracts of the report where fundamental views, statement or opinions of the members of the Expert Group had been expressed, and adopted by consensus. The finalising of the full report was completed by correspondence in February 2012.

The present report summarises the discussions of the Expert Group and gives the conclusions and recommendations.

The Expert Group (Appendix 2):

Dr Egil Ole Øen: *Wildlife Management Service, Norway/Sweden, chair of Expert Group**
Dr Arne Bjørge, *Institute of Marine Research, Norway*
Head of Section Eigil Bjørvik, *Department of Fisheries, Hunting and Agriculture, Greenland**
Director Eyþór Björnsson, *Directorate of Fisheries, Iceland**
Hunter Jens Danielsen, *KNAPK (Fishermen and Hunters Organisation), Greenland*
Prof Pierre-Yves Daoust, *University of Prince Edward Island, Canada*
Prof Lars Folkow, *Department of Arctic and Marine Biology, University of Tromsø, Norway*
Prof Joseph Geraci, *USA*
Hunter Svend Heilmann, *KNAPK (Fishermen and Hunters Organisation), Greenland*
Hunter Charlie Inuarak, *Nunavut Tunngavik Inc., Canada*
Dr. Toshihide Iwasaki, *National Research Institute of Far Seas Fisheries, Japan*
Hunter Erneeraq Jeremiassen, *KNAPK (Fishermen and Hunters Organisation), Greenland*
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Head of Office Amalie Jessen, *Department of Fisheries, Hunting and Agriculture, Greenland*
Hunter Noah Kadlak, *Nunavut Tunngavik Inc., Canada*
Head of Section Nette Levermann, *Department of Fisheries, Hunting and Agriculture, Greenland**
Senior Veterinarian Jústines Olsen, *Veterinary Service, Faroe Islands**
Prof Lars Walløe, *Department of Physiology, University of Oslo, Norway*
Mr Glenn Williams, *Nunavut Tunngavik Inc., Canada*
Senior Advisor Hild Ynnesdal, *Norwegian Directorate of Fisheries**

The NAMMCO Secretariat was represented by General Secretary Dr Christina Lockyer and Deputy Secretary Ms Charlotte Winsnes. Winsnes acted as rapporteur.

*Member of the NAMMCO Committee on Hunting Methods

BACKGROUND

Hunting of small cetaceans takes place in many different regions of the world. A variety of weapons and methods are used often depending on several factors such as species hunted, size of the animal, hunting habitat and environmental conditions, cultural traditions, commercial availability of gear, national legislation, hunter's economy, personal experiences and preferences, and animal welfare considerations.

For animal welfare reasons it is important to achieve rapid insensibility to avoid unnecessary pain and reduce the risk of losing the animal. Thus the ideal weapon from an animal welfare point of view should render the animal instantly and irreversibly unconscious and insensible to pain, until death.

ANATOMICAL FEATURES INCLUDING BALLISTICS WITH RELEVANCE TO THE KILLING OF SMALL CETACEANS

A brief overview of anatomical features including ballistics with relevance to the killing of small cetaceans was given. It was emphasised that whales in general are difficult to approach and get close to in open water. With the exception of the drive hunts, the stunning and killing device must therefore be applied to the animal from some distance.

The fact that whales live in and dive under water and in the Arctic regions occasionally dive under the ice may make it difficult to observe the whale after the killing device has been launched. For the hunter it will therefore sometimes be difficult to judge if the whale is dead or not and how successful or rapid the killing attempt has been. In addition most of the species are in a negative state of buoyancy in water and will sink when they are dead.

Equipment used for whaling (whale crafts) are therefore often of a design with a multipurpose use. It should serve the purposes to stun/kill and secure the whale in order to retrieve it, in one and the same operation. To successfully achieve this effect it must inflict so much damage to organs vital for conscious life, that the whale is rendered unconscious and dies instantly or very fast.

An overview of the anatomical position of vital organs like the brain and the spinal cord in the neck, the circulatory system with the heart, main blood vessels in thorax, neck and spinal cord together with the lungs and its main vessels and main vessels in abdomen, was given. For the hunter the knowledge of exactly where these organs are situated in the whale's body and how they can be reached and wounded/damaged by different weapons is essential for a successful kill (Figs. 1 and 2).

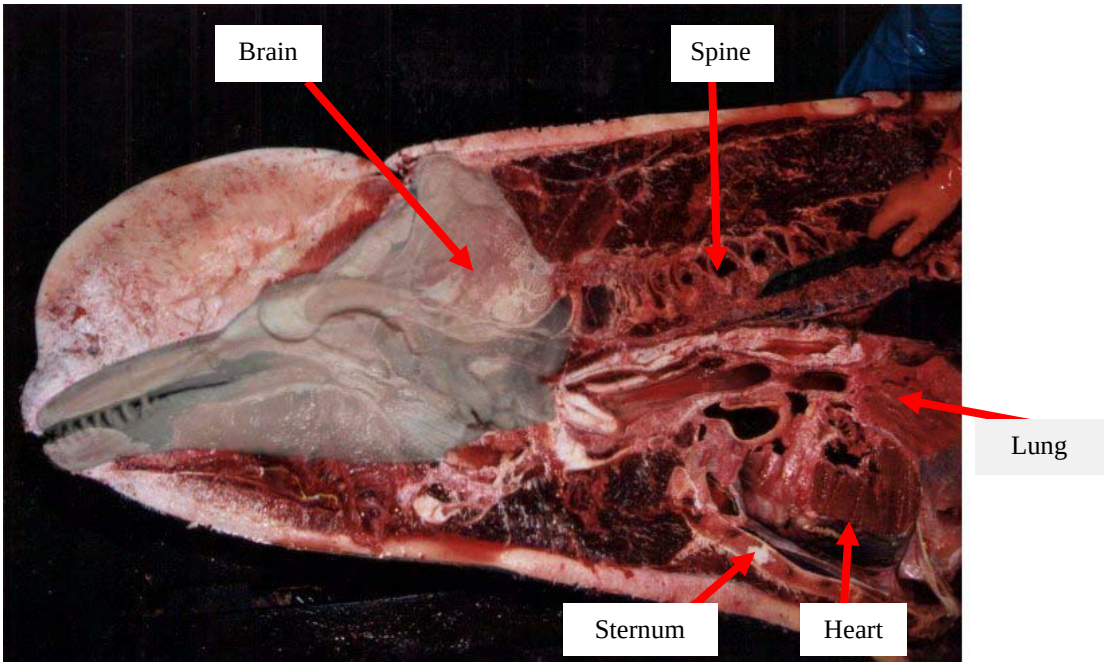

Fig. 1. Longitudinal section showing anatomical positions of vital organs in head, neck and thorax of pilot whale *(Globicephala melas)* . Photo: B. Hanusson, J. Olsen

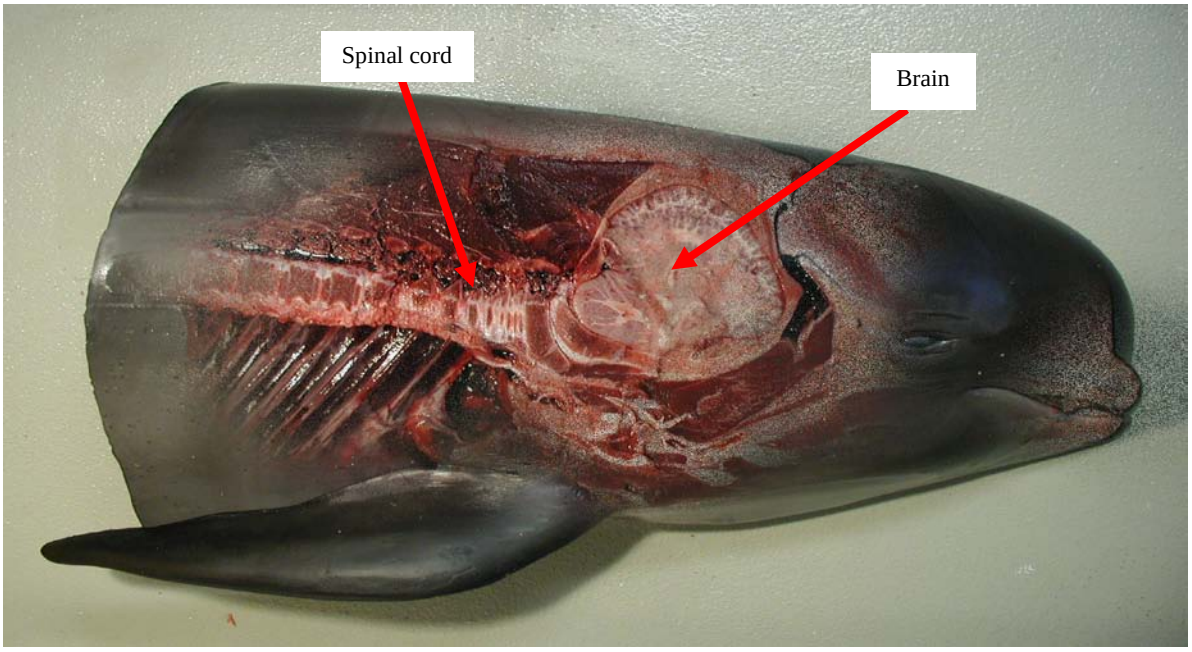

Fig. 2. Pilot whale head and torso. Longitudinal section showing location of brain and spinal cord in neck and thorax. Photo: B. Hanusson, J. Olsen

Hunting and killing weapons used for whales (alone or in combination) are

- Harpoons delivered by harpoon gun or by hand
- Explosive grenades delivered by harpoon gun or darting gun (only large cetaceans)
- Firearms – rifles and different types of ammunition
- Lances - spears
- Knives
- Nets

Factors that may influence the choice of weapons and hunting methods are

- Whale species
- Traditions
- Environmental conditions
- Availability of equipment and weapons
- Economy
- Others

The hunting methods and equipment used for the hunting of small cetaceans may vary considerably. The whales may be

- Harpooned and killed with lances or firearms from the ice edge or from small skiffs
- Shot with a firearm and harpooned/hooked afterwards
- In drive hunts the whales are herded ashore using boats and rendered unconscious and killed using knife and/or spinal lance.

CRITERIA OF DEATH – VOLUNTARY VERSUS REFLEX MOVEMENTS

A brief review of current criteria for insensibility and death in various mammals was given largely based on a review by Knudsen (2005). For humans, criteria exist for systemic death (irreversible cessation of cardio-respiratory function) and for brain death (irreversible cessation of all functions of the entire brain, brainstem included), according to the "Harvard criteria"[1] and the "NINDS criteria"[2]. For domestic animals in slaughterhouse practice, no official death criteria exist, but animals are classified as dead when cardio-respiratory function has ceased and/or the animal has been bled. Killing by bleeding is always preceded by stunning, which should cause immediate loss of consciousness which lasts until death. Stunning is typically achieved with electrical current, captive bolt or CO_2, each of which produces fairly distinctive responses in the animals. Such responses are used to assess stunning efficiency. In big game hunt, animals are mostly shot in the thorax without prior stunning and lose consciousness due to massive damages to heart/lung that compromise brain blood flow and oxygen supply. For large whales, the International Whaling Commission has defined specific death criteria: slackened lower jaw, no flipper movements, cessation of all movements with the animal rolling over (IWC, 1980). In whale hunts using penthrite grenades or rifle shot to the head/upper cervical spine, animals may be stunned as part of the killing process, while use of the harpoon or lance as a first weapon, or rifle shot to other body

[1] **Harvard criteria**
Criteria for brain death delineated by "Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death". They require the absence of all of the following: cerebral responsiveness, induced or spontaneous movement, spontaneous respiration, brainstem and deep tendon reflexes. The committee also recommended the presence of a flat electroencephalogram (EEG) and tests over a period of 24 h to reveal the persistence of the condition. In addition, the following must be present: body temperature ≥32º C, absence of CNS depressants (Anon., 1968. A definition of irreversible coma. Report of the ad hoc committee of the Harvard Medical School to examine the definition of brain death. Journal of the American Medical Association 205, 337–340.)

[2] **NINDS (National Institute of Neurological Disorders and Stroke, USA) criteria**
These criteria of cerebral death require: coma with cerebral unresponsitivity, apnoea, dilated fixed pupils, absent cephalic reflexes and electrocerebral silence which should be present for 30 min at least six hours after the onset of the state (Anon., 1977. An appraisal of the criteria of cerebral death – a summary of statement: a collaborative study. Journal of the American Medical Association 237, 982–986.)

regions, includes no stunning prior to killing. The methods specific to hunts for small cetaceans are detailed under separate headings in this report.

For all species, reflex movements that originate from spinal cord or brain stem circuits may be displayed for several minutes after loss of consciousness or even death. Reflex movements are sometimes violent and may also persist for particularly long durations in diving mammals due to their higher tolerance to hypoxia. Determination of the state of consciousness/sensibility can be difficult, since these movements may be mistaken for signs of animal awareness. Thus, a whale may have been killed during a hunt (as judged from post mortem examinations) without fulfilment of all the IWC death criteria. Due to the lack of conclusive insensibility/death signs for various hunting techniques, it may be concluded that, as a general rule, methods that rapidly cause either blast- or rifle induced severe traumatic brain injury or damages to the heart/major blood vessels and/or the lungs that compromise blood and oxygen delivery to the brain, are likely to lead to rapid and irreversible loss of consciousness and death. If doubt exists as to the state of the animal, the killing procedures employed should be repeated.

Comments and discussion
Several comments were given after the presentation.

Brain - blood supply
It was emphasised that the use of weapons that cause massive damages to the lungs, the heart and large central vessels, or to the main vessels supplying blood to the brain, leads to rapid loss of consciousness, and ultimately death, because of the high sensitivity to hypoxia that is characteristic of nervous tissue. Haemorrhages in the brain, and in particular in the base of the brain (brain stem) from explosives or by high energy rifle bullets, cause instant and irreversible loss of brain function and instant death.

Diving mammals typically display a higher tolerance to hypoxia than most non-diving species, which allows their tissues to remain functional under more severe hypoxic conditions than tissues of most non-diving species could tolerate. This also concerns their nervous tissue. However, in this context it is important to make a distinction between hypoxic conditions (low availability of oxygen, such as towards the end of a long breath-hold dive) and anoxic conditions (no oxygen available, such as if brain blood perfusion has been stopped), since, although diving mammal neural tissue has an anaerobic capacity that is somewhat higher than in most non-diving mammals, its normal function is completely dependent on aerobic metabolism as well as on a steady supply of glucoses. This means that diving mammals should be expected to lose consciousness almost as quickly as do other mammals, if the blood supply to their brain has been stopped.

The Expert Group concluded that even if the brain of marine mammals has a somewhat higher tolerance to hypoxia than the brain of terrestrial mammals, the corresponding increase in time to unconsciousness and subsequently death following cessation of blood flow to the brain is in the order of seconds.

The Expert Group further emphasised the fact that dolphins and whales that are in the process of dying and even those that have recently died may show strong reflex movements, in particular up-and-down thrashing of the flukes or tail that can last several minutes. The thrashing can be severe and is dangerous to anyone close enough to be struck by the tail. There are insufficient data on whether these reflex movements are influenced by the hunting

method. The Expert group, therefore, recommends the same precautions be taken regardless of the killing technique.

TIME TO DEATH – PRINCIPLES FOR COLLECTION AND PROCESSING OF DATA

Why do we want to record TTD?

Time to death (TTD) is internationally accepted as a measurement when discussing animal welfare issues in respect to killing of animals. TTD quantifies the time it takes for an animal to die and in doing so gives an indication of whether or not a killing method is acceptable from an animal welfare point of view. TTD may also be instrumental in discovering potential ways in which one may improve killing methods and recording of TTD may be a tool to monitor improvements and developments in killing methods over time.

How should TTD be recorded?

The best method to record TTD is to use a stopwatch and calculate the time from the first shot of the rifle or harpoon, until the animal is dead according to the accepted death criteria (mouth open, flippers slackened, all movements ceased). The next best method is to estimate TTD using an ordinary watch.

Ideally TTD should be measured or estimated by one person who has this as his or her main task during this phase of the hunt. At the same time or later, relevant other variables should be recorded ('explanatory variables'), e.g. distance to the animal, swimming angle in relation to the hunter and where the animal is hit, state of the sea and weather conditions. If the animal is still living after some time and a secondary (backup) weapon or killing method is used (e.g. harpoon first and then the rifle), the time used to change weapon/method should be recorded and subsequently used in the statistical treatment of the data.

Which and how many killings should be recorded?

The perfect and ultimate situation would be to record TTD for all animals killed. However it is scientifically sufficient to record TTD for a random (in the statistical sense) sample of the killings (or boats or hunters).

If random sampling is not possible, even non-random samples may provide valuable information, especially if 'explanatory variables' as mentioned earlier are recorded. In non-random sampling it is important to try to include all possible types of boats or hunters, and also to try to include the same boats or hunters (or similar boats and hunters) in the following years.

As a general rule a very small sample (~10 animals) is better than no sample at all. The results should be analysed with methods from "survival analysis" with "Cox regression" (and "logistic regression" for instantaneously dead animals).

Comments and discussion

The Expert Group emphasised that TTD data collection will benefit hunters in helping to make improvements to the hunt and to make the hunt more efficient. The Expert Group also agreed that time to death (TTD) is calculated from the moment the animal is first struck by an implement or projectile intended to secure or kill it, to the death of the animal. The Expert Group's position was that every effort should be made to achieve the shortest possible TTD,

and it was underlined that a small random sample is better and preferable to a larger non-random sample

BALLISTICS TESTING

Bullets are designed to have specific "terminal ballistic characteristics". Lead tipped, hollow point, or round nosed bullets have different characteristics. Rifle used for hunting have bullets from a diameter of .224" (5.56 mm) up to .458" (11.6 mm) and weights from 45 grains (2,9 gram) to 700 grains (45,4 gram). Each type of bullet has different sized casings. Such variations allow the best match between the many bullet designs and their intended terminal ballistic characteristics.

Death is caused by "circulatory disruption" or "neural disruption". Marine mammal hunting utilises neural disruption as the preferred method of killing, as the animals are taken in a marine environment while at the surface, to immobilise the animal and prevent sinking or losing the animal.

In 2006 in Nunavut six experienced narwhal, beluga and walrus hunters carried out a field test using .338 Winchester magnum and .375 H&H caliber rifles with solid and full metal jacket round nose bullets (FMJ RN). They reported (unpublished) significant penetration abilities and improved TTD when using this equipment. Controlled terminal ballistic tests done by the NAMMCO Committee on Hunting Methods in 2004 showed similar results (Appendix 3, doc 5).

Examples of different wound channels in the tissues were demonstrated. Cavity and channel wounds were shown as well as a wound channel from FMJ military ammunition (pointed nose) (Figs. 3 and 4). Depth of penetration of different bullet types and calibers were also presented.

Fig. 3. Cavity wound channel caused by an expanding bullet.

Fig. 4 . The labels 11(b) and the blue probe show a channel wound caused by a .338 Win, 250 grain RN Solid bullet in the head of a beluga *(Delphinapterus leucas)*.

Comments and discussion

The caliber, the type of jacket and the bullet tip affect the size and nature of the wounding. The bullet path made by a FMJ RN bullet is often channel-like with minor cavity-formation along the path (Fig. 4). This is contrary to soft point /expanding bullets which make large cavities in the tissues they pass (Fig. 3).

Military surplus ammunitions (FMJ with pointed nose) which often rotate (tumble) in soft tissue after entry, do not penetrate as well as the round nose solid or full metal jacket bullets that do not tumble in soft tissue. For larger whales like minke whales *(Balaenoptera acutorostrata)*, high caliber FMJ RN bullets are recommended.

In hunting marine mammals, neural disruption is desirable for efficient killing as opposed to terrestrial mammals where circulatory disruption is the norm The Expert Group agreed that for killing marine mammals, the preferred method of death is neural disruption. The most efficient wound type for neural disruption in most cetaceans is a channel wound which gives the greatest depth of penetration. Therefore the most suitable bullet types for cetaceans are; Solid round nose, FMJ RN, and Solid expanding. It also appears from the shooting trials on pilot whale (*Globicephala melas)* heads (Appendix 3, doc 5) that among the large calibers tested (.270, .308, .338, .375) in these trials the bullet type was more important than the caliber.

With respect to ammunition and weaponry, it was noted that also the skill of the hunter is very important when deciding on suitable caliber. Choice depends on the target site and the type of damage that is desired to kill the animal. It was also pointed out that high calibers give rise to greater impact and energy transformation that result in greater shock effect. However, the recoil caused by high caliber weapons might influence the accuracy of the shooting.

DESCRIPTION OF KILLING METHODS IN USE AND/OR UNDER DEVELOPMENT, SAMPLING AND REVIEW OF TTD DATA

DRIVE HUNTS

FAROE ISLANDS

The drive hunt in the Faroe Islands includes the following species: Long-finned pilot whale (*Globicephala melas)*, Bottlenose dolphin (*Tursiops truncatus)*, White-beaked dolphin (*Lagenorhyncus albirostris)* and White-sided dolphin (*Lagenorhynchus acutus).*

The Faroe Islands is divided into six districts with 23 authorised whaling bays. The most important criterion for a whaling bay is that the sea bed slopes gradually up to the shore line, and that the bay is spacious enough for the killing to take place. Whaling bays which do not fulfil these criterions are either abandoned or improved.

When a school of pilot whales is sighted (either from land, sea or air), the district administrator, the foremen or all have to decide into which whaling bay the school shall be driven. Once the decision on location is made, the boats form in a semi-circle behind the whales and stones are thrown into the water to make air bubbles, which help herd the whales in the desired direction. Upon approaching the whaling bay the boats are arranged by size, the smallest boats which can get closest to the beach, are in the front row, while the larger boats are kept behind. In this manner the school is beached or driven so close to the beach that people are able to wade out to the whales to secure them for the killing.

The actual killing method has changed very little throughout history. The whale is secured with a traditional iron whaling hook or a ball-pointed blowhole hook, after which the whale is cut across the back of the neck one hand's breadth behind the blowhole. The cut severs both the main blood supply to the brain as well as the spinal cord followed by severing the jugular veins and the carotid arteries. Once the cut is made, the whale lies completely paralyzed and unconscious[3]. The whaling knife – (in Faroese *grindaknívur)*, is used for the cutting. There are no specific formal requirements with respect to the whaling knife, but usually the length of the blade is between 16 cm and 19 cm (Fig. 5).

[3] International Whaling Commission: Document IWC/47/18. Report of the workshop on whale killing methods, Dublin 23-25 June 1995, p 25:
Blackmore stated that based on previous experiments on domestic stock and anatomical studies of arterial blood supply to the brain of pilot whales, the following conclusions could be logical:
1. severing the spinal cord itself will cause pain and will have no effect on loss of sensibility;
2. by severing the cord at this site, the rete of blood vessels supplying the brain will be severed, resulting in a total loss of cerebral circulation. This will result in permanent insensibility within approximately 5-10s.

Fig. 5. Traditional Faroese whaling knife, Photo H. Joensen

In 1995 the ball-pointed blunt hook was introduced as an alternative to the iron hook. It is inserted in either of the vestibular air sacs of the blowhole. The rationale behind the new hook was to minimise the possibilities of wounding the whale before the final cut and thus reducing the total killing time. In addition the hook makes it much easier to guide the whales towards the beach. Today both the iron hook and the ball-pointed hook are permitted for securing the whales. However it has been suggested to only permit the use of the ball-pointed hook with the stipulation that the iron hook may be used given permission from the district administrator or whaling foremen in circumstances where the ball-pointed hook cannot be used for instance when the water is too deep for the whalers to reach the animal in order to insert the ball-pointed hook.

Starting in 1998 trials have been carried out with a new spinal lance (Fig. 6) to replace the whaling knife. The spinal lance makes a much more directed and swift cut and trials have shown that TTD are reduced significantly.

The killing method with the spinal lance consists of first securing the whale with the ball pointed blowhole hook. When secured the spinal lance is positioned in the midline between the blowhole and the dorsal fin at one hand's breadth behind the blowhole and directed at an angle approximately 10 degrees backward. With a single thrust followed by sideways movements the spinal cord and the surrounding blood vessels are severed, directly followed by severing the jugulars and the carotids with a whaling knife so that the whale can be bled properly.

Fig. 6. The Faroese spinal lance, Photo: B. Hanusson

Systematic recordings of TTD have been carried out in the Faroe Islands, and the killing of the pilot whale has been divided in two phases. The first phase is the time from which the whale is secured with the iron hook or the newer blunt hook. The second phase is the actual severing of the spinal cord and the surrounding blood vessels. When estimating TTD using the iron hook both phases are included in the estimate, while only the second phase counts when the blunt hook is used, the assumption being that the hook does not wound the whale.

The average TTD estimate found when using the traditional whaling knife was 65.4 s (range 8.0 - 290 s), of which securing the whale on average took 29.3 s (range 0 - 132 s) while cutting the spine took 36.1 s (range 3,5 - 195 s). When using the blunt blowhole hook the average securing time was 20.1 s (range 6 - 211 s).

The average cutting time with the new spinal lance and the blunt blowhole hook was approximately 1-2 s. Consequently the total time from the insertion of the blowhole hook until the animal was dead was on average around 22 s.

Monitoring the killing time for the spinal lance by using a stop watch has been considered. However due to the very short TTD (1 – 2 s) quantification of the exact time is difficult, as the killing time using the spinal lance is the time from the start of the thrust of the lance until the spinal cord and the surrounding vessels are cut.

Comments and discussion
The Expert Group acknowledged that considerable progress had been made in improving the hunting methods in the Faroese pilot whale drive hunt with the introduction of the blunt hook and the spinal lance.

One of the explanations of the reduced securing and cutting times (TTD) is most probably that the hook is positioned in the blowhole and therefore does not interfere with the process of cutting the spinal cord and the main blood vessels to the brain. Also the blunt hook significantly decreases the time used to drag the whale onto the beach, because the whale moves in a straight line versus the side to side movements often observed when using the traditional gaff. Consequently, the total time used to secure and kill a whale is shorter using the blunt hook rather than the traditional hook.

Comments were made with respect to the presented statistics, and the underlying assumption that the blunt hook is not painful for the animal. The Expert Group could not accept this assumption as the blowhole like nostrils in terrestrial mammals probably are sensitive to stretching and strain. The general opinion of the Expert Group was that TTD should be recorded from the time the blunt hook is inserted into the blowhole, as is the case with the iron gaff until further investigations (i.e. gross post mortem and histological examination of affected tissues in the blowhole) have been undertaken and shown the opposite. TTD calculated from hooking to the time that the animal is dead still shows great improvements (65.4 s versus 22 s).

The traditional knife normally requires several cuts in order to sever the spinal cord and the blood vessels. With the spinal lance one stab is generally sufficient. The Expert Group therefore recognised the improvements made with the introduction of the spinal lance. A critical success factor is the angle with which the lance is thrust into the neck of the whale. However, the shape and wider tip of the latest version of the lance conforms with the anatomical shape of the skull of a pilot whale and ensures that the target area is hit.

The possibility of using captive bolts for stunning in the Faroese hunt was considered. However, captive bolts are primarily designed for stunning of ruminants and the bolt will be too short to effectively destroy the brain functions and stun a pilot whale. The Expert Group therefore concluded that this method would not be an option. This is supported by former trials in the Faroese hunt which have shown that the use of the captive bolt provokes very strong movements with violent trashing of the tail, making it dangerous for the hunter to approach the whale and cut its neck.

JAPAN

In the Japanese drive hunt of dolphins up until 1999 the hunters drove the dolphin schools to a small bay and closed the entrance of the bay with a net after which the hunters, standing in small boats, threw lances aiming at the neck region of the dolphins. The lances were approximately 3 m long. Using a wrist watch, it was observed that it took approximately 5 min from the first strike to a striped dolphin *(Stenella coeruleoalba)* until death (disappearance of any movements).

In 2000/2001, trials were undertaken on the beach with a spinal lance of similar design as the prototype tested in the Faroese Island drive hunt of pilot whales. The hunters applied the spinal cut to 9 Risso's *(Grampus griseus)*, 4 striped and 2 spotted *(Stenella attenuata*) dolphins and one southern form short-finned pilot whale *(Globicephala macrocephalus)*.

In the case of the Risso's dolphins, it was easy to drag and beach the dolphins with ropes attached to the tail. Hunters considered the lack/disappearance of movement/breath to indicate

that the animal was dead. The TTD of the Risso's dolphins ranged between 5 s and 40 s (n=9).

In the case of the striped dolphins, it was impossible to restrain the animals because they struggled before beaching or stranded on a rocky part of the beach (it should be done on sandy a beach). Therefore the hunters used the traditional lances to weaken the dolphins after which it was easy to cut the spine. Killing times after spinal cutting ranged between 5 s and 30 s (n=4). One whale was killed using the traditional method and TTD was recorded at approximately 5 min.

In the case of the spotted dolphins, the situation was similar to that of the striped dolphins. Spinal cut was applied for two spotted dolphins after having been hit by the lance. Killing time after spinal cut were 8 s and 10 s respectively (n=2).

In the case of a pilot whale, it was easy to simply apply a spinal cut. TTD was 25 s.

In 2008, the hunters covered the rocky part of the beach with a vinyl sheet (3 m in depth and 25 m in length) thus preventing access to this part, and drove the dolphins to the sandy beach. This attempt was successful as the dolphins in the net could be guided towards the beach without using lances and could be rapidly killed using a spinal cut.

Comments and discussion
The Expert Group welcomed the information on hunting methods from the Japanese dolphin hunt which clearly shows improvements over the recent years.

The Japanese spinal lance is different from the Faroese spinal lance with respect to length and design of the tip. The Japanese lance is thinner and more pointed than the current (latest version) Faroese lance which is wider and longer. The Expert Group underlined that this difference in shape may prolong the TTD as compared to the Faroese hunt and favoured a modification of the lance similar to the Faroese lance. The width and the double edged tip of the Faeroes lance especially ensure that the cut hits /destroys the targeted spinal cord and blood vessels to the brain with one stab.

The blood spill in the water from the exsanguinations has been used by anti-whaling groups to negatively focus on the killing of whales. In 2009, the hunters in Taiji made some attempts to prevent the blood from spilling into the sea to avoid such criticism. A modified knife with a small blade (almost similar to a shaft of 13 mm in diameters) was made to minimise the area of the wound and through that prevent the blood spill into water. Immediately after cutting the spine, the hunters inserted a wooden plug into the wound, after which the dolphins were taken to a offshore "dissection" boat for further processing.

The Expert Group discussed at length the purpose of inserting the plug into the wound of the whale to reduce the flow of blood into the sea. The Expert Group emphasised that the process of bleeding out animals is part of the killing process and that it is a widely accepted principle both from an animal welfare point of view and from the point of view of meat quality.

Whether this plugging procedure might actually prolong time to death was discussed. If the consequence is that this stops or hinders the blood draining from the brain, it might keep the brain active for a longer time period than necessary. Concerns were also raised that preventing the bleeding with the plug would reduce the quality of the meat.

HUNTING USING HARPOON OR FIREARMS OR COMBINATIONS OF HARPOON/FIREARMS

GREENLAND

Harbour porpoise *(Phocoena phocoena)*

The hunt takes place in ice-free, off-shore areas using rifles from small, open boats with powerful engines. There are often several boats participating in each hunt, but there will not be any appointed leader. This collective hunt requires extreme caution from the hunters, both in order to avoid ricochet and also in order to not disturb each other's hunts.

When the whales are spotted, the hunters will approach parallel to the animals. If the weather is sunny, they will position themselves so that they have the sun in their back. This makes it easier to spot the whales when they are diving. The aim is to deliver a broadside shot into the thorax region (Fig. 7), which will kill the whale rapidly by hitting the heart, lungs or vertebrae. Typical shot ranges vary from 5 – 30 m. After a successful shot, the hunter must rush to the animal and secure it with a long shafted (4-7 m) gaff hook, called *nissik* in Greenlandic, before it sinks. Head shots are avoided, because the whale will usually sink fast and easily be lost if not reached with the *nissik*.

The minimum caliber that the experienced hunters recommend is .222 with a full metal jacket bullet. Due to the fast swimming speed, and the relatively short shooting ranges, open sights are preferred. 12 or 16 gauge shotguns were used earlier, but are no longer preferred due to an increased TTD.

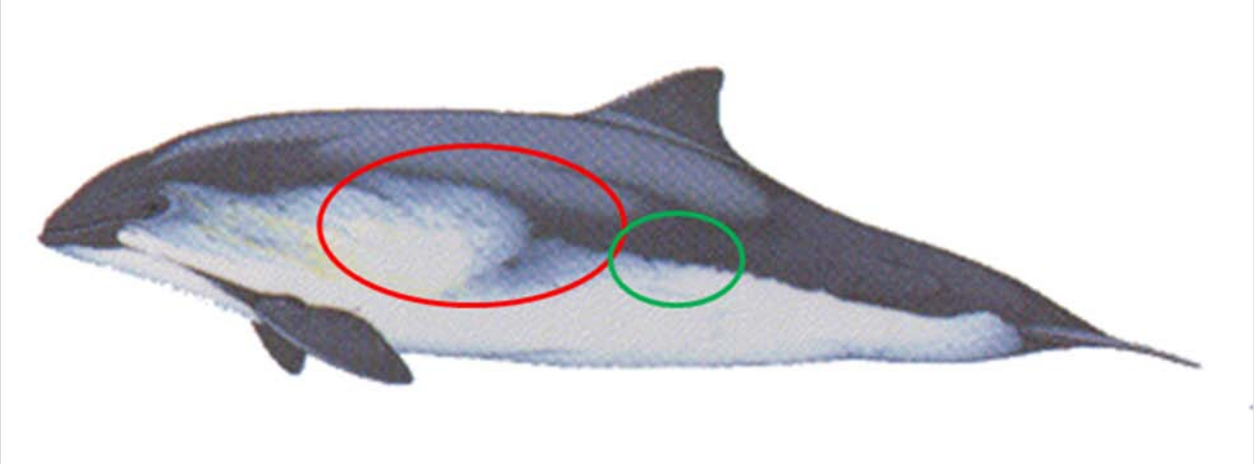

Fig. 7. The red ring indicates the hunters preferred rifle target area in harbour porpoise. A hit within the green ring, is not necessarily instantly lethal, but the animal will be immobilized and can easily be retrieved. Head shots are instantly lethal, but are avoided due to the high risk of losing the whale.

White-sided and white-beaked dolphins *(Lagenorhynchus acutus* and *L.albirostris)*

White-sided and white-beaked dolphins are relatively new species to be hunted by the Greenlandic hunters. Dolphin hunting is very similar to the harbour porpoise hunt with respect to hunting technique, target area and equipment. Due to the larger body-size, more powerful rifles are preferred. The hunters recommend a caliber .30-06 rifle with full metal jacket bullets as a minimum.

The hunters have experienced that head-shots may induce violent reflex movements, and this can be dangerous to the hunters and damage the boat - and result in a higher chance of struck and loss. Hence, the hunters will try to hit the thorax region (Fig. 8).

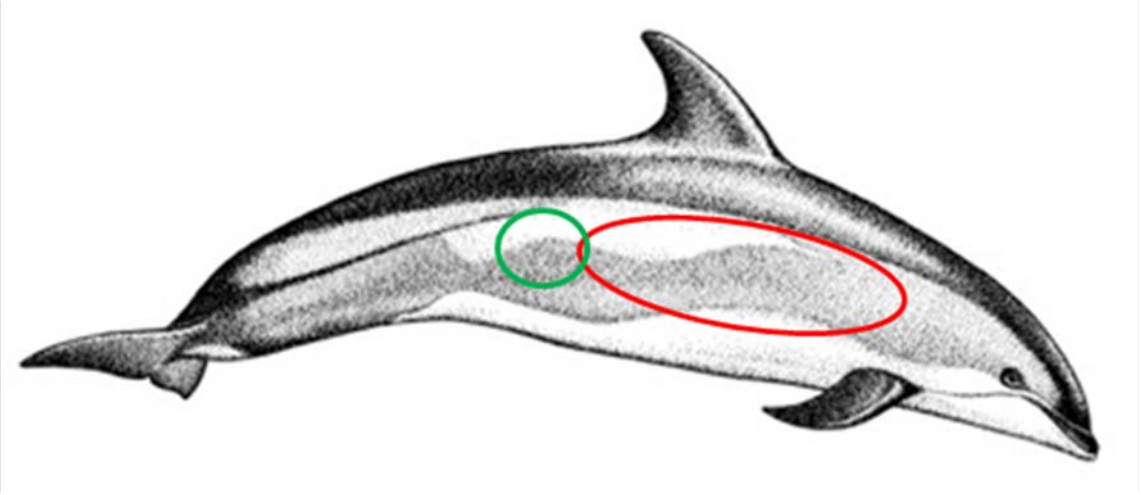

Fig. 8. The red ring indicates the hunters preferred rifle target area of white beaked and white sided dolphins. A hit within the green ring, is not necessarily instantly lethal, but the animal will be immobilized and can easily be retrieved. Head shots are instantly lethal, but are avoided due to the high risk of violent reflex movements in the whale.

Long-finned pilot whale *(Globicephala melas)*

The first catches of pilot whales in Greenland were reported in 1998. The pilot whale (Fig. 9) hunt is usually performed as a collective hunt, and remains very similar to the harbour porpoise and dolphin hunts. The strong schooling behaviour of pilot whales makes the hunt relatively easy, compared to the above mentioned species. When a school is discovered, the hunters only take the number of animals that they need. The hunters recommend a caliber .30-06 rifle with full metal jacket bullets as a minimum for pilot whales.

Fig. 9. The red ring indicates the hunters preferred rifle target area of a pilot whale.

Killer whale *(Orcinus orca)*
Only a few killer whales (Fig. 10) are taken in Greenland, and the hunt is usually performed as a collective hunt with small boats. Rifles, with a minimum caliber of .30-06 and full metal jacket bullets, are used as the primary weapon.

Fig. 10. The red ring indicates the hunters preferred rifle target area of a killer whale.

Comments and discussion on harbour porpoise, white-beaked, white-sided, long-finned pilot whale and killer whale hunting in Greenland
The Expert Group discussed the observation reported by hunters that if the bullet hits the head the animal nearly always sinks immediately, whereas if hit in the thorax area, it floats for a while. There might be different explanations for this observed reaction, although all are hypothetical. According to one explanation proposed by the Expert Group and based on the fast swimming pattern of porpoises, an animal shot in the head might carry its momentum downward into the water, and rapid compression of the body by water pressure could quickly reduce its buoyancy; trauma to the head could also cause some loss of air from the lungs. Conversely, a shot in the thorax might break the body's streamlined downward movement, particularly if the animal is not killed instantly or if its spinal cord is damaged.

The Expert Group noted that the collective hunt makes it important to know exactly where one's fellow hunters are and also to know how ammunition deflects on water.

The Expert Group was informed that the hunters' assessment of the struck and lost rate in the collective hunts was from 5% up to 10%. It was also noted that hunters observe animals with scars indicating that they have been struck by rifle shots earlier. If a harbour porpoise is lost the hunters will look for accumulation of birds as the occurrence of birds within five minutes sometimes indicates where the animal is located.

It was reported that in Canada the .223. is now replacing the .222. because of easy access to .223 ammunition. In Greenland one can get both ammunition types but the .223 is usually the

preferred ammunition. In the NAMMCO Workshop in 1999 it was reported that there were problems getting all recommended types of ammunition for small cetacean hunting in Greenland. However, Greenland responded that this was no longer a problem.

Narwhal and Beluga *(Monodon monoceros* and *Delphinapterus leucas)*
Traditionally and culturally the beluga and narwhal are key hunting species in Greenland. Both species are hunted in North Greenland and on the West coast whereas only narwhal is hunted on the East coast.

Narwhal (Fig. 11) and beluga (Fig. 12) are hunted by harpoon from qayaqs and with rifles from small boats (skiffs). In a few places in northern and eastern Greenland the whales are also captured with nets. All types of hunting require that the hunters have licenses and are governed by regulations. There are differences in surfacing behaviour between belugas and narwhals, the latter surfacing less frequently due to their longer dives. Sea transport has increased markedly off coastal Greenland, and the hunters believe that noise may disturb the whales and their movements.

Often Greenlandic hunters combine traditional hunting methods with the restrictions of contemporary regulations. For instance, the municipalities of Qaanaaq, Upernavik and Uummannaq have developed regulations stipulating that the hunters may only use qayaqs and harpoons, thereby limiting the number of animals taken. It is prohibited to hunt whales by surrounding, trapping or blocking them against land or the ice edge.

Rifle hunt from small motor boats
The hunt takes place in open water and ice cracks. The whale is first harpooned with floats attached and then shot with a rifle of caliber 30.06/.375. full metal jacket, pointed bullets. The number of participants varies depending on the ice situation – the more ice the fewer places to move. At the start of the hunt and as it proceeds new hunters may join, but as soon as a whale is wounded usually no new hunters will be allowed to join the hunt. .

The whale is targeted at an angle from the side (Fig. 13 and Fig. 14). The brain is the desired target, but the neck and heart are also regarded as good targets. The hunters may also aim for the vertebrae in the back to slow the animal and harpoon it in order to secure and kill it. The criteria of death are air bubbles rising to the surface, slackened flippers and jaw. If the whale is not hit in vital areas it dives and is killed on resurfacing. This may take up to 15 min. When the brain is hit there may be thrashing behaviour, making it risky for the hunter. TTD after hit in the brain and neck is usually instantaneous, and 1-2 minutes after hits in heart/lungs. When the animal is dead it is secured by binding a rope around the tail.

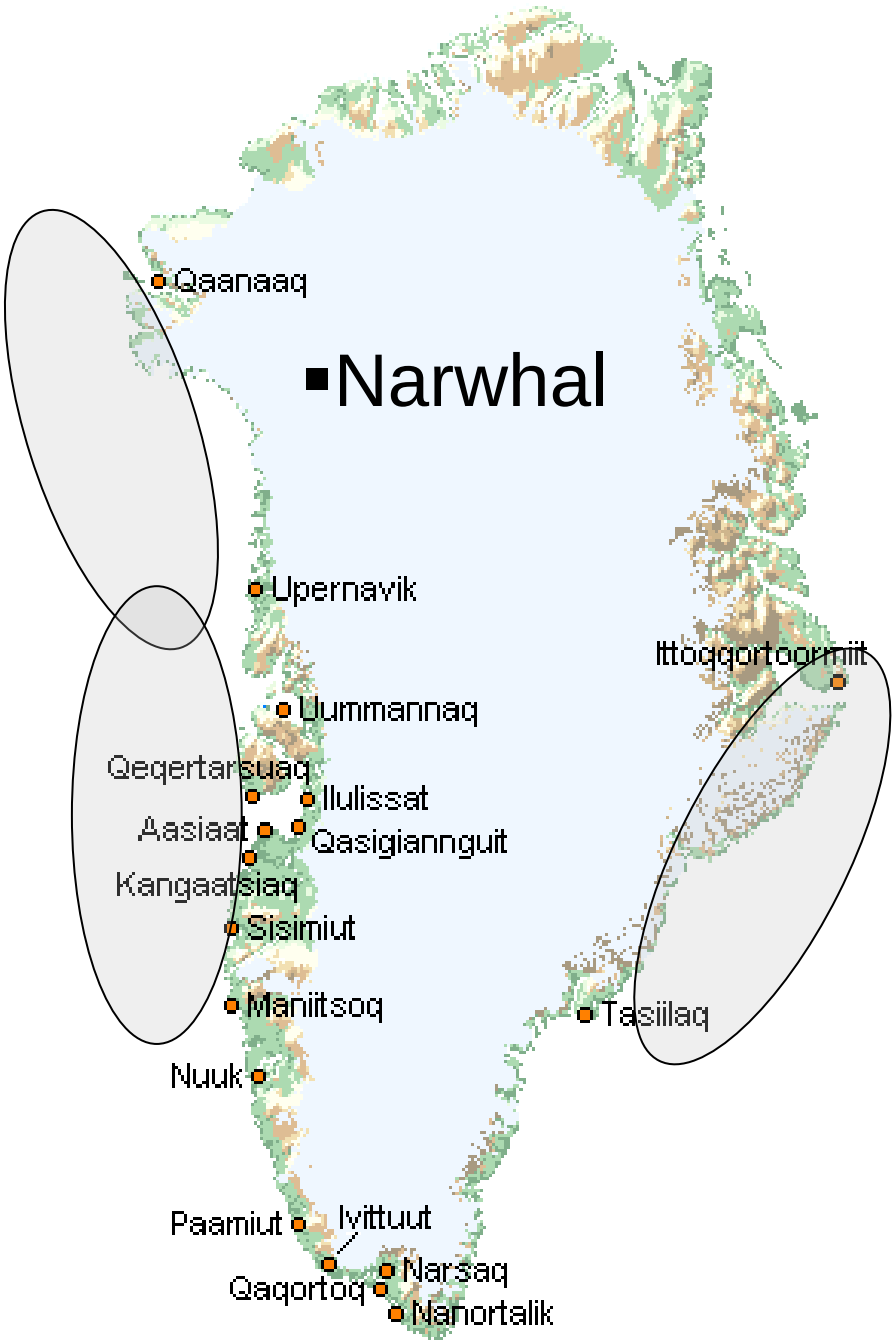

Fig. 11. Narwhal hunting areas in Greenland

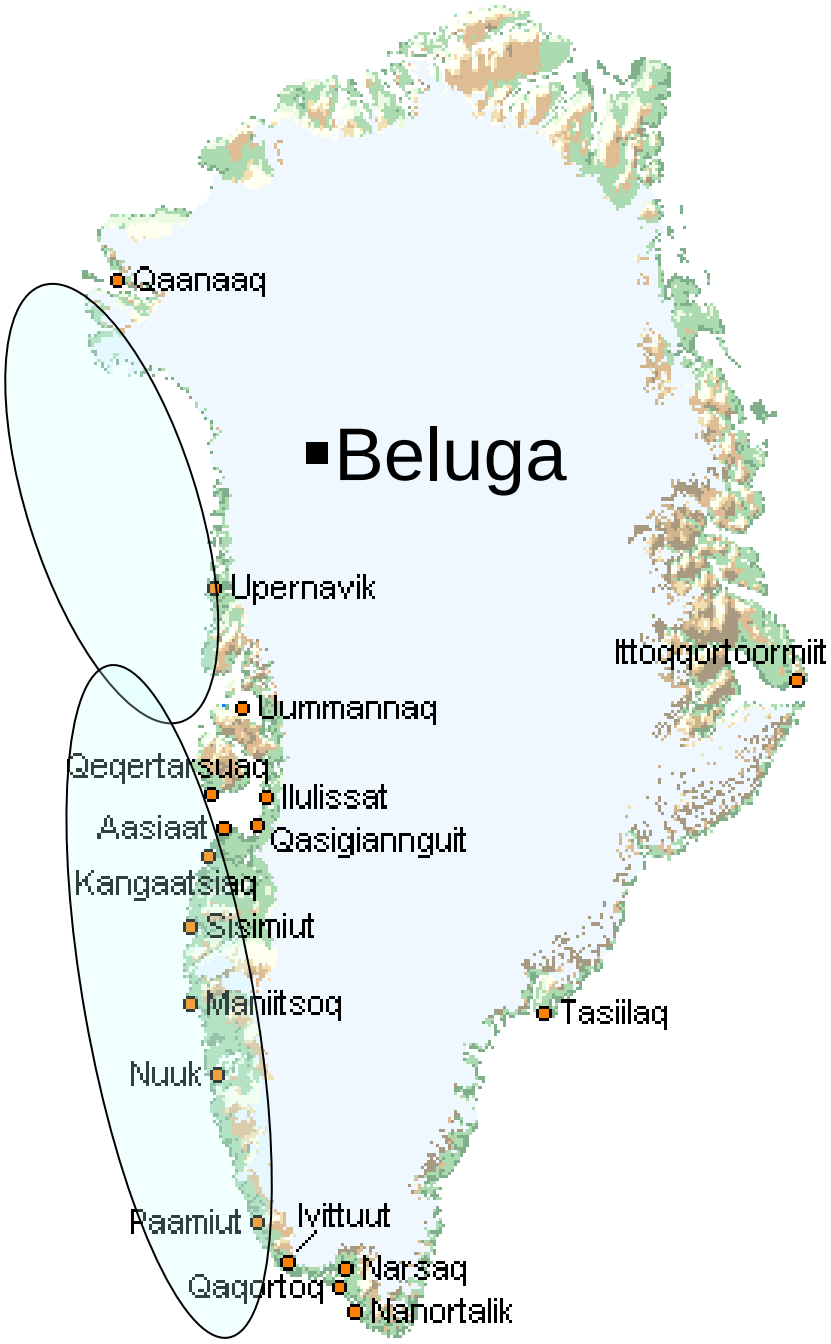

Fig. 12. Beluga hunting areas in Greenland

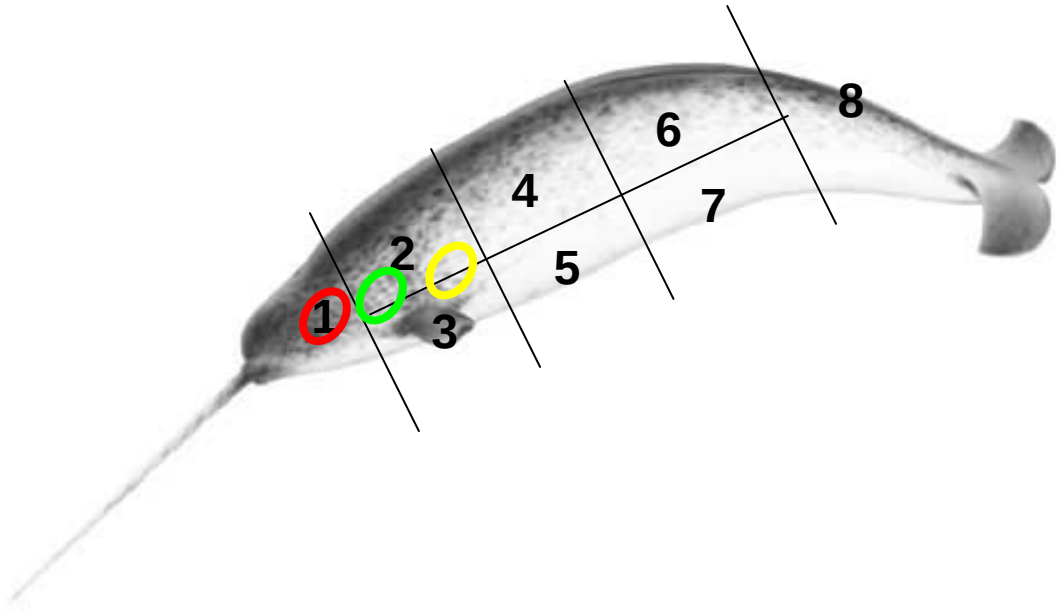

Fig. 13. Narwhal hunters preferred rifle target areas. Red circle indicates position of brain, green circle indicates position of neck and yellow circle indicates thorax and the upper abdominal area.

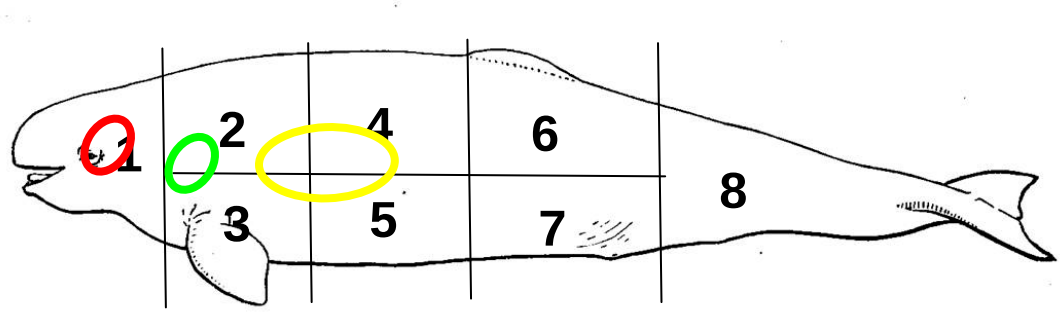

Fig. 14. Beluga hunters preferred rifle target areas. Red circle indicates position of brain, green circle indicates position of neck and yellow circle indicates thorax and the upper abdominal area.

The harpoon hunt from qayaqs

This type of hunt takes place from close to the ice edge in North Greenland when there is daylight from mid-May to mid-September. Typically for safety reasons two hunters will cooperate as it is potentially dangerous to go out in a qayaq alone. Silence and stealth are important in this hunt in order not to spook the animals. The hunters will observe the whale(s) from shore and very quietly embark the qayaqs The hunter uses a hand-held harpoon in a thrower to gain extra throwing distance. The harpoon shaft (Fig. 15) is made of wood and the harpoon point is made of stainless steel and tusk from walrus. Attached to the harpoon is a buoy of skin/cloth tied to a wooden frame on a line of 15-16 m.

The whale will first be secured with the harpoon and then shot using rifle caliber 30.06 or .375 with full metal jacket pointed ammunition when it re-surfaces. The target points/areas for the rifle shot are the brain, neck or heart. The total time from the first harpoon strike to the time that the whale is dead is usually 20-25 min. When it is dead the animal is hauled to a beach or ice edge for flensing and further processing.

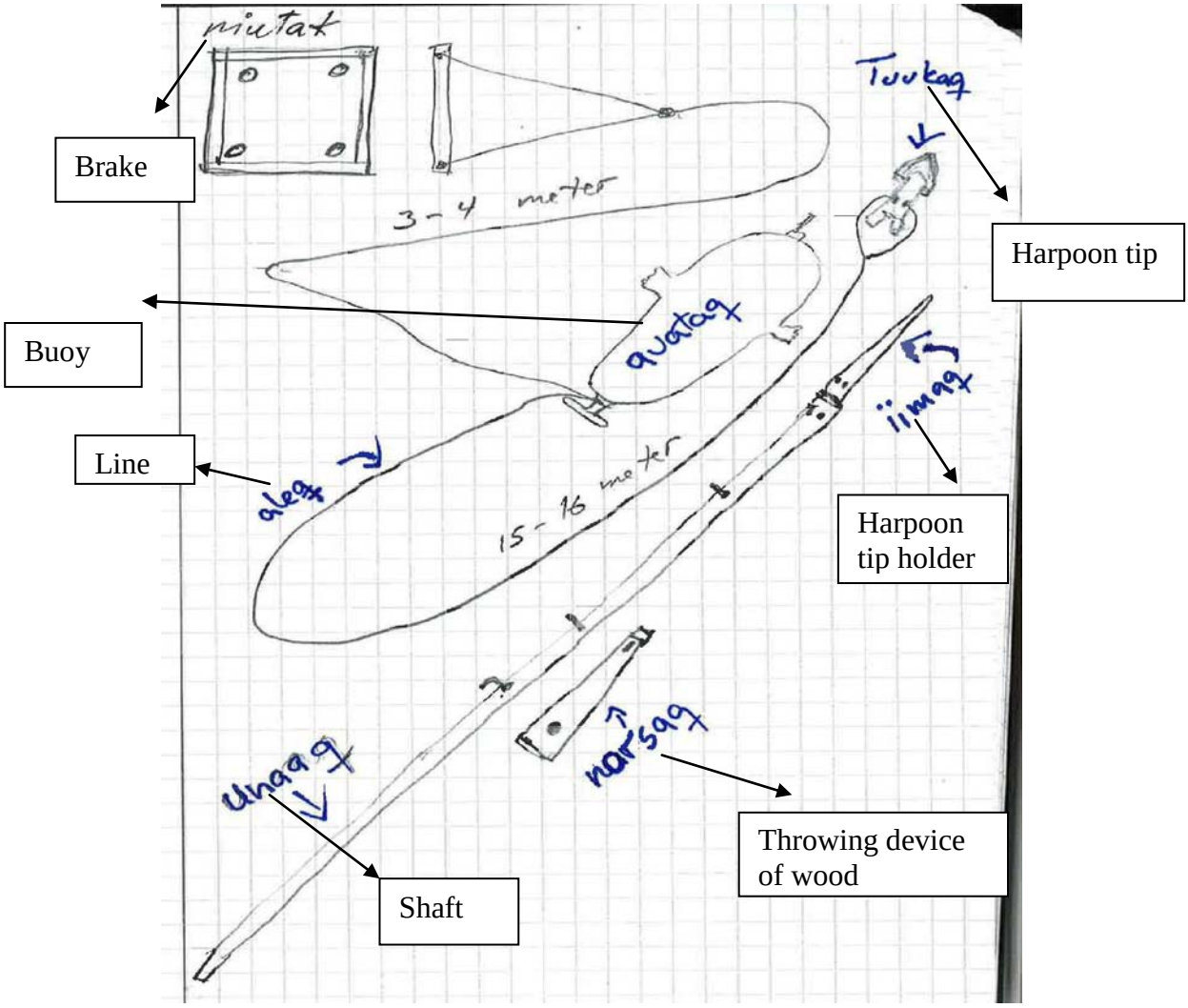

Fig. 15. Hunter's drawing of harpoon and equipment used for small cetacean hunting from qayaqs in Greenland

Net hunting
This traditional method targeting narwhal is used only by Municipality Executive Order in East and North Greenland during dark periods of the year when there is no daylight and during very ice-filled conditions under the sea-ice. Approximately 20 animals are taken on an annual basis.

The net is set in open water or under the sea-ice. The net is 10 meters high and 30 – 40 m long with a 380 mm mesh-size. The net is anchored to land or ice by a wire or chain and held upright by intervals of floats attached by an arm's length of rope to the headline. The base of the net is not secured but is weighted at intervals by hanging stones. Another netting method is free floating nets anchored underwater at one end. Stones are not used for weighting the foot line, but sink lines.

All nets are checked daily for captures, and live animals will be shot.

Improvements of small cetacean hunting gears
Technological improvements in Greenland have entailed the use of hand-held harpoons made of iron, the harpoon shafts as well as the spearing point. This makes the harpoon heavier which results in better penetration into the animal. In addition this harpoon can be used to pull

up whales that have sunk. In the anticipation of possible new species being hunted the hunters have started talking about how to exchange knowledge and know-how in order to ensure that appropriate killing methods are used, while also taking the safety of hunters into consideration.

Other improvements have consisted of a better supply of ammunition, new rifles, use of stronger ropes, better boats and GPS. The GPS is used for directing hunters to the area of the last successful hunting place and is also used for timing the diving behaviour of the whales in order to predict when or where to expect the next surfacing.

Comments and discussion on Narwhal and Beluga hunting in Greenland
The Expert Group welcomed the information on narwhal and beluga hunting in Greenland.

The Expert Group noted that the hunters' experience of violent thrashing of the tail after hits in the brain with rifle bullets was common both in Canada and Greenland. The preferred target areas (brain, neck and heart) were similar. But there was a difference in preference of the target areas between Nunavut and Greenlandic hunters. The Nunavut hunters preferred the neck to the brain, while the Greenlandic hunters often targeted the brain. This might be due to the fact that the Canadian hunt described was conducted from solid ice whereas the Greenlandic hunt was on the water from small boats.

The Expert Group was of the opinion that netting is likely to cause stress for the animals associated with the capture and the possible prolonged time to death. The Expert Group noted that netting is prohibited in Greenland with the exception of East Greenland and Qaanaaq in wintertime due to the lack of visibility in the dark period making it impossible to use firearms or other more effective methods of killing

The Expert Group noted Greenland's comment that most of the work on improving its hunting methods had been done in close collaboration with NAMMCO, weapon experts and veterinarians.

Time to Death Data
Some preliminary data on TTD using different hunting methods on beluga and narwhal were presented by Greenland. These data had been sampled by hunters according to the suggested data collection set up by the chair of the Expert Group and circulated prior to the hunting season (Appendix 4).

The Expert Group very much welcomed the presented material. However the data presented were too preliminary, although very promising, to be discussed or concluded upon during the meeting. The Expert Group encouraged Greenland to continue the data sampling and to further process the data already gathered for presentation to the NAMMCO Committee on Hunting Methods at a later stage.

The Expert Group also noted that the Greenlandic hunters saw the use of GPS as beneficial for the success of the hunt, and that they expressed an interest in more organized training for hunters.

CANADA

Narwhal and Beluga *(Monodon monoceros* and *Delphinapterus leucas)*
It was emphasized that the information presented was provided by Nunavut Tunngavik Inc. – an Inuit Organization, and not by the Canadian Government. The information relates to the areas of Pond Inlet, Coral Harbor, and Iqaluit in South Baffin, and describes two populations of narwhal – one wintering in Baffin Bay and another in Hudson Strait. The presentation on belugas described the summer aggregations around Somerset and in areas where freshwater outlets entered the sea. The largest group is in West Hudson Bay, which migrates to Hudson Strait in winter.

Narwhal
Three different types of hunt were presented:

1. Floe edge hunt.
   The floe edge hunt is conducted from May-June from the edge of fast sea ice near open water in Pond Inlet and Arctic Bay. Here the animals are shot from the fast ice. The animals are observed for some time before action is taken. Thereafter the animals are shot in the base of the neck area targeted from the side. The animal is retrieved with a thrown hook on a weighted line and secured to the ice. The carcass is then heaved up onto the ice by rope and tackle. It was noted that by aiming at the neck region, the animal relaxes, is immobilised and will roll to one side (trapping the air in the lungs), rather than going into spasm and thrashing. The shot is only taken when the narwhal takes a final, large breath just prior to diving beneath the ice. This also has the advantage that the animal is as close as possible to the hunter and the narwhal is struck and killed when the lungs are fully inflated thus assisting flotation of the carcass.
2. Crack ice hunt
   This hunt is carried out where cracks (leads) exist in the sea ice. As the sea ice deteriorates in the spring, cracks (leads) form giving narwhal access to new feeding areas with cracks (leads) that can be only 1.5 meters wide. The animals are again shot from the side in order to target the neck area. This hunting technique requires patience and often necessitates camping on the ice nearby for some days awaiting the narwhals' arrival. Rifles used are center-fire .338 Winchester Magnum, or .375 H&H Magnum. The original choice was the .303 British issued because it was generally available to the militia (Arctic Rangers) along with full metal jacket ammunition. These are no longer available. Guns are used with open sights but the ammunition used is generally dictated by what is available and this is generally now soft-point round nose bullets.
3. Open water hunt,
   The open water hunt is conducted from boats. This method is most generally used today because of changing ice conditions. Again the target area is the neck region and the animal is shot after it has been driven by the hunters towards the shore and shallow water.

In the spring, with its constant daylight, the hunters need to ensure they are not overly tired and have adequate rest during the hunt

Target area of the body
Narwhals will stay at the surface breathing and resting for long periods. In preparation for a dive, the narwhal will swim towards the ice edge and as it takes the last large breath before diving it will expose the vital area at the base of the skull. The hunter must be ready for this

moment and shoot from the side. If the animal is alarmed or disturbed, a shot must not be taken as it may dive deeply and for a long while.

Anatomical markers are used such as the blowhole and the back of the skull to target the right shooting area in the neck region. Hits in this region damage the spine in the cervical area and shatter the base of the skull resulting in neural trauma. If the animal is shot in the lungs, it will swim rapidly away and may be lost.

The choice of gun is related to a hunter's preference and different guns may be preferred for different hunts and quarries. Generally, the strongest gun the hunter has is selected for narwhal.

The hunter will check the eye of the narwhal and if the eye is closed or if the heart is beating while the whale is hauled in the animal is not considered to be dead. Another shot will be taken – again in the neck and not the head. A shot to the head frequently results in thrashing which may be dangerous to the hunter (especially in a boat), or it may dive for up to 30 min and it may be lost. Although thrashing does not always occur when the head is shot, targeting the neck avoids this problem.

Beluga
A report was presented for the area of Coral Harbor, on Southampton Island, where the belugas are present from August – September, and later migrate south for the winter. There are four settlements in this area on the mainland where beluga hunting takes place using boats. The animal is generally chased / driven towards the beach where the water is shallower and the carcass can be seen even if it sinks.

Historically a handmade wooden harpoon was used in the hunt together with an attached line and float, thrown from the boat. Now a steel rod has replaced the harpoon shaft (weighing about 4.5 kg) which is more efficient as the extra weight permits deeper penetration and it may reach to the heart when this is aimed at the right angle from the side in the heart and lung region. The harpoon is a cold-rolled steel rod (5/8" in diameter) fashioned to a length that correlates with the height of the hunter. The handle has a rope binding (for a hand grip) at one end, while the harpoon head has a line that links it to the handle and shaft, and a long line for securing the animal. The majority of belugas (>50%) are killed using only one harpoon strike.

The animal dives after being struck and it may take 2-5 min before the animal is dead. If the strike is efficient, no further action is required. However, if necessary, the animal can be shot in the neck. This usually results in no flurrying or thrashing. When opened up, the chest and organs will be full of blood.

Comments and discussion on Narwhal and Beluga hunting in Canada
The Expert Group welcomed the information on narwhal and beluga hunting in Canada.
Commenting on the TTD it was noted that when hitting the heart the animal will die fast and when hitting the lungs it might take up to some minutes. The Expert Group noted that data on TTD would be desirable.

In a Workshop held by NAMMCO in 2001 (Appendix 3) it had been reported that many animals bear bullet scars from previous hunting encounters. The Expert Group noted that the hunter's impression now was that this was observed less frequently than previously, and that this was perhaps because of more efficient and appropriate weaponry.

The Expert Group noted that in spring, snow and ice melt contributes to lowering the salinity at the sea surface. For this reason whales are less buoyant and more likely to sink at this time.

With respect to equipment it was reported that in the narwhal hunt a 3-pronged hook was preferred to a 4-prong hook was preferred to a 4-prong in securing the line to the ice and that a .338 rifle with expanding bullets worked well in this hunt. It was also noted that expanding bullets do not penetrate into water as well as round nosed solid bullets do.

The Expert Group recognised that the hand held harpoon is a primary weapon and is recognised as an important/essential tool to secure the animal in some forms of marine mammal hunts. The aspects of the hunter's safety and the retrieval of the animal have therefore to be balanced against the animal welfare issue.

TRAINING OF HUNTERS, MONITORING AND COLLECTION OF DATA

Hunters training

In the Faroe Islands the Pilot Whalers Association holds annual meetings to discuss experiences from the last season and potential new and better killing methods. In Greenland there was an expressed wish for more training of inexperienced hunters. However, a school for educating hunters and fishermen started in 2009 in Uummannaq where the teaching is divided between theory and practical exercises.

The Expert Group noted that in general for all types of hunts presented and discussed in this meeting training of hunters is not mandatory. Hunting knowledge is thus passed on from generation to generation and between hunters through direct observation and participation in the hunt. The Expert Group emphasised that the incentives to train new and younger hunters and also to improve killing methods are to improve and ensure hunter safety, to minimize animal suffering and to increase the efficiency of the hunt.

Monitoring and collection of data

Monitoring and systematic reporting of the hunt takes place in the Faroe Islands through the district administrators report to the Ministry of Fisheries. In the Faroe Islands each drive hunt reports data such as when and where the hunt occurred, total killing time for the school, number of whales, size and sex, number of participating boats, number of hunters on shore and in boat and any breaches of the regulations governing the hunt.

In Greenland the hunt is monitored by the local authorities and by fisheries and hunting inspectors or wildlife officers. The Ministry of Fisheries and Hunting gathers information and follows the development of the hunt through a self reporting catch system. There is one executive order (latest revision March 2011) that directly affects the taking of narwhal and beluga by controlling the hunt, the reporting and selling of edible products. Licences and hunting certificates are required for the killing of narwhal and beluga. The product of a catch cannot be sold before the municipal authorities have registered the hunt and stamped the licence. The catch report was designed to collect information on date and position of capture, hunting method and gear, sex and age, and for the 2011 hunt also on the number of rifle shots fired, the times the harpoon was used and the time to death.

In Japan and Canada (Nunavut) no formal control or monitoring mechanisms exist, and there is no formal collection of data. In Nunavut the hunt is self-reported by the hunters.

GENERAL COMMENTS AND RECOMMENDATIONS

General comments
NAMMCO's focus is on ensuring that hunters make every effort to reduce unnecessary suffering by hunted animals, by minimizing killing times to the extent feasible. We recognize that this goal must be balanced by considerations of the safety of the hunter, and the risk of losing the animal.

The Expert Group acknowledges the significant advances that have been made in achieving the goals of hunting efficiency thus reducing TTD and S&L, and that this is largely due to the growing cooperation and trust among managers, scientists and especially the hunters nationally and internationally. In this context the group is impressed by the adaptability of the hunters and their willingness to effect changes.

It is inherently difficult to compare hunting efficiencies from one method or country to another. The Expert Group recognises that technology and methodology differ from species to species, region to region, and country to country. The goal is not to unify methods and techniques but to ensure that, by open dialogue that transfers information, each hunt is conducted within the circumstances that define its methodology in a manner that maximizes hunter safety, and reduces TTD and S&L, while achieving the intended goal.

Specific comments and recommendations
The Expert Group expressed its appreciation and congratulated the hunting communities with the progress made to improve the animal welfare aspects of the drive hunts for small cetaceans.

Drive hunt - Faroe Islands
The Expert Group noted that the introduction of the spinal lance has entailed significant improvements in the TTD for the Faroese pilot whale hunt. The Expert Group also noted the extensive advances that had been made in the development of the lance.

The Expert Group recommends:
- An illustrated manual is developed to document the technique, gear and bays certified for drive hunts. A manual could add credibility to the science behind the improvements, facilitate uniform practice among bays and also assist in exporting the knowledge to other hunting communities.
- The spinal lance has proven efficient in reducing the TTD and reducing the number of cuts, and therefore the standardized lance should be made mandatory for use in the Faroese drive hunt.
- Adopting this lance as a standard should not preclude further improvements of the lance.
- Any damages from the use of the newly designed blunt tipped hook should be further explored.
- TTD should be measured from the first use of the blunt hook.

Drive hunt - Japan
The Expert Group noted that a spinal lance has been introduced in the Taiji drive hunt and is expected to have improved the efficiency of the hunt in relation to TTD. The Expert Group recommends that this effect be documented with an appropriate sample size for the involved species.

The Expert Group noted the difference between the Faroese and Japanese spinal lance and blowhole hook and recommends Japan to adapt the design of the Faroese spinal lance and perhaps the blowhole hook.

Finally the Expert Group recommends a study to document the effects of plugging the bleeding wound on the efficacy of killing and the quality of the meat product.

Hunting of pilot whales, dolphins and porpoises - Greenland
The Expert Group recommends that regulations on equipment and hunting methods are developed for harbour porpoises, white-sided and white-beaked dolphins, pilot whales and killer whales and that efficiency, struck and lost rate and TTD are documented for the involved species. It is recommended that data are gathered in a standardized manner making comparison between hunts and development over time possible.

Hunting of beluga and narwhal - Greenland
The Expert Group appreciates Greenland's effort to improve the data collection on struck and lost and to initiate data collection on TTD. It is recommended that data are gathered in a standardized manner making comparison between hunts and development over time possible.

Netting - Greenland
The Expert Group noted that netting of beluga and narwhal is prohibited in most areas in Greenland, but is allowed in East Greenland and one location in North West Greenland. This method is used when there is no other available option. The Expert Group noted that netting is likely to cause stress for the animals associated with the capture and the prolonged time to death and recommends that every attempt should be made to develop alternative catching methods.

Hunting of beluga and narwhal - Canada
The Expert Group noted the information on hunting provided by the Inuit hunters of Nunavut. The Expert Group encourages management agencies to engage with NAMMCO in its commitment to

- Continue to improve standards of hunting methods;
- Training of hunters;
- Assuring the funding of programmes to document TTD.

It is recommended that data on TTD and struck and lost are gathered in a standardized manner making comparison between hunts and development over time possible.

Hunter training
The Expert Group 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.

The Expert Group recommends the development of a training manual for hunters, to include such topics as hunters' safety, anatomy of the relevant species with emphasis on target sites likely to minimise TTD and S/L, required equipment, such as weapons, ammunition and secondary equipment, approaches to efficient utilisation of carcasses, and other topics to be identified. The Expert Group recommends a small working group be identified to explore the feasibility of developing such a manual, fully identify its components and develop a plan of human and other resources needed to produce it.

STRUCK AND LOST IN SMALL CETACEAN HUNTING

The issue of struck and lost (S&L) was not on the agenda for the meeting but was raised at the beginning of the meeting. It was agreed to discuss the issue if time permitted. However due to lack of time the Expert Group recommended that Greenland and Canada in cooperation discuss the issue. The following statement was submitted for inclusion in this report from Greenland and Canada:

- It was noted that Canada did not present new or recent information on rates of struck and loss of small cetaceans.
- It was noted that Greenland reports a loss rate of 0 on a reported catch of 179 narwhals and 86 belugas.
- Canada and Greenland delegates agree that an exchange of information and experience on the collection of struck and loss rates in the harvesting of marine mammals would be beneficial to both the resource harvesters and the management decision process.

Appendix 1

PROGRAMME

TUESDAY 15 NOVEMBER

0900 – 1045 INTRODUCTORY SESSION – agenda items 1, 2, 3, and 4
1. INTRODUCTION – Terms of reference, review of documents, meeting procedure
2. ANATOMICAL FEATURES INCLUDING BALLISTICS WITH RELEVANCE TO THE KILLING OF SMALL CETACEANS
3. CRITERIA OF DEATH - VOLUNTARY VERSUS REFLEX MOVEMENTS
4. TIME TO DEATH – PRINCIPLES FOR COLLECTION AND PROCESSING OF DATA

1045 – 1100 Coffee break
1100 – 1700 MAIN SESSION - agenda item 5
1300 – 1345 Lunch
1515 – 1530 Coffee break

5. DESCRIPTION OF KILLING METHODS IN USE AND/OR UNDER DEVELOPMENT, SAMPLING AND REVIEW OF TTD DATA
   - 5.1 Drive Hunt - Pilot whales, Dolphins and Harbour porpoise
     - 5.1.1 Faroe Islands
     - 5.1.2 Japan
     - Review of TTD
     - Assessment and comparison of methods and efficacy
     - Recommendations

WEDNESDAY 16 NOVEMBER

0900 – 1700 MAIN SESSION - agenda item 5 continued
5. DESCRIPTION OF KILLING METHODS IN USE AND/OR UNDER DEVELOPMENT, SAMPLING AND REVIEW OF TTD DATA
   - 5.2 Hunting using harpoon or firearms or combinations of harpoon/firearms
     - 5.2.1 Pilot whales, Dolphins and Harbour porpoise
       - 5.2.1.1 Greenland
       - 5.2.1.2 Canada
     - Review of TTD
     - Assessment and comparison of methods and efficacy
     - Recommendations

     - 5.2.2 Beluga and Narwhale
       - 5.2.2.1 Greenland
       - 5.2.2.2 Canada
     - Review of TTD
     - Assessment and comparison of methods and efficacy
     - Recommendations

THURSDAY 17 NOVEMBER

0900 – 1700 MAIN SESSION AND CLOSING OF MEETING
6. CONCLUSIONS AND RECOMMENDATIONS
7. OTHER MATTERS
8. ADOPTION OF REPORT

Appendix 2

List of Participants

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Appendix 3

List of Documents and references

NAMMCO/EG/Doc 1	Programme
NAMMCO/EG/Doc 2	List of Documents
NAMMCO/EG/Doc 3	List of Participants
NAMMCO/EG/Doc 4	Terms of Reference
NAMMCO/EG/Doc 5	Olsen and Øen: Shooting trials on heads of dead pilot whales – guidelines to test the efficiency of rifle ammunition used for hunting and euthanasia of small whales (2004)
NAMMCO/EG/Doc 6	Olsen: Killing methods and equipment in the Faroese pilot whale hunt.
NAMMCO/EG/Doc 7	Olsen: Information from the Faroe Islands to the NAMMCO Expert Group meeting on small whale killing, Copenhagen Nov. 15th to Nov. 17th
NAMMCO/EG/Doc 8	Toshihide Iwasaki: Brief report on improvement of slaughtering method in dolphin drive fisheries in Taiji, Japan during the years between 2000 and 2010
NAMMCO/EG/Doc 9	Roberge and Dunn: Assessment of the subsistence harvest and biology of narwhal (*monodo monoceros L.)* from Admiralty Inlet, Baffin Island N.T.W. 1983 and 1986-89.
NAMMCO/EG/Doc 10	Øen: Data collection in preparation for the Expert Group meeting on assessing hunting and whale killing data for small cetaceans 15 - 17 November 2011

References and additional documents:

Anon. (1968) A definition of irreversible coma. Report of the ad hoc committee of the Harvard Medical School to examine the definition of brain death. Journal of the American Medical Association 205: 337–340

Anon. (1977) An appraisal of the criteria of cerebral death – a summary of statement: a collaborative study. Journal of the American Medical Association 237: 982–986

IWC (1995) International Whaling Commission. Report of the workshop on whale killing methods. Report of the International Whaling Commission IWC/47/18: 25

IWC (1980) International Whaling Commission. Report of the Workshop on Humane Killing Techniques for Whales. Report of the International Whaling Commission IWC/30/15

Knudsen SK (2005) A review of the criteria used to assess insensibility and death in hunted whales compared to other species. The Veterinary Journal 169: 42-59

NAMMCO (1999) Report from the NAMMCO Workshop on hunting methods. NAMMCO Annual Report 1999 265: 61-82

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NAMMCO (2006) NAMMCO Conference on User Knowledge and Scientific Knowledge in Management Decision-Making. Reykjavik, Iceland 2003.

NAMMCO (2006) Report of the NAMMCO Workshop to address the problems of "struck and lost" in seal, walrus and whale hunting. NAMMCO Annual Report 2006 – Volume 1 277: 69-144

NAMMCO (2010) Report from the NAMMCO Expert Group meeting on assessment of large whale killing data. Copenhagen, Denmark, 2010.

Appendix 4

Data collection in preparation for the Expert Group meeting on assessing hunting and whale killing data for small cetaceans 15 - 17 November 2011

Background: To facilitate that the expert group on small cetaceans will have the essential and necessary data to do an assessment of the killing methods it is suggested that the listed data may be collected in the coming season.

It is a prerequisite that the hunters are informed that all information they give will be treated with confidentiality.

NB! A practical method is to define death as the moment the mouth is slackened or open, the flippers are slackened/lie along the sides and/or all movements have ceased.

For any given species the following data would be of interest:

1. Weapons, ammunition and equipment/gear used or combinations of weapons/gears for the different species or in the different hunts
2. Number of animals that are struck with harpoons/rifle shots/combination of harpoon and rifle shots/gaffed (pilot whales) and retrieved
3. Number of animals that are struck with harpoons/rifle shots/combination of harpoon and rifle shots/gaffed (pilot whales) and lost 1) dead or 2) alive
4. If whales were lost, the most probable reasons for losses
5. If harpooned and shot ; Where the animal was hit with harpoon and rifle shot(s) (Please, mark as exactly as possible on a figure)
6. How many shots and/or harpoons were used before the animal died
7. If available measured Time to Death (TTD) (**using watch**): Time measured from the first harpoon/shot/gaff to the animal is perceived as dead
8. In the absence of measured TTD (point 7) report estimated TTD, (**without using watch**): Estimated time from the first struck of harpoon /shot/gaff to the animal is perceived as dead

In addition the following information would be acknowledged:

- Is training of hunters mandatory?

  If YES what kind of training and how is it transmitted/given to the hunters
- If there are control mechanisms, to describe these
- How are data reported