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NORWEGIAN MINKE WHALE HUNT 2011 AND 2012

The Norwegian minke whale hunt 2011 and 2012

Studies on killing efficiency in the hunt
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Background and brief summary of results

Time to death (TTD), Survival time (ST) and Instantaneous death rate (IDR) are terms known to describe how fast hunted whales die and has been used as a tool to measure and quantify the killing efficiency and state of art of killing methods and practices in the Norwegian whaling operations since the beginning of 1980ies (Øen EO, 1995a). Sampling and analysis of TTD data in a standardised manner give possibilities for direct comparisons of killing efficiency between different hunts and also the hunting methods and hunting gears used in the hunts. It has successfully been used in Norway to measure the impact of new developments in the minke whale hunt, modifications of hunting gears, new hunting practices, obligatory training of hunters etc.

The NAMMCO Expert Group Meeting in 2010 to assess TTD data and results from whale hunts (NAMMCO 2010) recommended new sampling of TTD data from the Norwegian minke whale hunt (*Balaenoptera acutorostrata*) where the last data sampling had been carried out in 2000-2003. The Group recommended that TTD data should be collected and analysed with covariates (animal size, shooting distance and angle of harpoon cannon shot, hit region and detonation area) like it had been done from 1981-2002 (Øen EO, 1995, 2003, 2006) in order to check the current status of the hunt.

To follow up these recommendations the Directorate of Fisheries in Norway engaged the author of this report to organize sampling and processing of data and to organise the analysis of the new data in compliance with the NAMMCO recommendations. The data sampling took place during the two hunting seasons of 2011 and 2012. The statistical analyse of the data was carried out by Professor Lars Walløe.

TTD data were collected for 271 minke whales caught by 14 vessels, 180 whales in 2011 and 91 in 2012. The number of instantaneous dead whales of the 271 whales was 222 (82 %). The average TTD of all whales was 1min. The median TTD for the 49 whales not registered instantly dead was 6 min. No whales were lost alive.

Current Norwegian whaling practice

<u>Weapons and equipment</u>

Norwegian fishermen are hunting minke whales from small (50 feet) or medium sized (60-120 feet) fishing boats that are rigged for whaling in the spring and summer season. The weapons are 50 mm and 60 mm harpoon guns (Fig. 1) and back-up rifles calibres .375 and .458 using full metal jacket, round nosed bullets. The harpoon is equipped with a penthrite grenade (Whale grenade-99) developed in Norway in 1997-1999 (Øen EO, 2003, 2006) (Fig. 1). The grenade is loaded with 30g pressed penthrite as explosive. A triggering device, a twin hook connected to the

firing pin in the grenade with a strong synthetic cord, triggers the detonation when the harpoon has travelled about 65-70 cm inside the whale body (Fig. 2). The harpoon line, the fore-runner, made of synthetic materials runs through a spring system to a winch used to haul the whale in to the boat immediately after it has been shot.

The hunt

The vessels usually search for whales in slow speed (4-6 knots/h). Minke whales are often coming up to the vessel and are often shot from a relative short range (< 30m). No sonar or similar instruments are used during the hunt as such instruments are regarded to scare off the whales.

It is recommended to fire the grenade at the whale from a side position (45°-135° - relative to the animal's long axis) and aim at the thorax (chest). A minke whale, which is hit deadly as it rises to the surface to blow normally rolls on to its back, and floats for a short time before sinking. If it is deadly hit at diving, it usually passively pulls out some line before it sinks. If the whale does not loose consciousness and die rapidly, it might in some cases regain consciousness, straighten its position in the water and starts swimming after some time. Therefore, if the whale does not turn over on its back or stops pulling out the line, it shall be hauled to the boat as fast as possible to be re-shot with rifle. Many hunters pull the whale in immediately after it is shot and fire a bullet into the whale's brain as matter of routines. The rifle is usually fired at close range and when the whale's head is over water. The shot is directed to the brain.

When the whale is lying at the boat side, a wire or rope is put around its tail before it is hauled on to the boat across the deck through an open gate in the gunwale and butchered (flensed) on deck. The meat and blubber is put on grates on the deck and cooled before being stored on ice in the hull until it is brought to on land processing plants.

Training of gunners and monitoring of the hunt

From 1984 on all gunners and licence holders have been obliged to attend obligatory training courses arranged by the Directorate of Fisheries where the main topics have been animal welfare, safety for hunters, grenade function and safe and arming systems, maintenance of weapons, correct handling of weapons, vital aiming points at the whales and shooting directions etc. In addition each gunner is required to pass an annual obligatory shooting test with the rifle and harpoon gun. Prior to the hunt the boats and hunting gears are controlled and approved for hunting by governmental inspectors from the Norwegian Directorate of Fisheries and the Norwegian Food Safety Authority. From 2006 on the hunt is monitored at-sea by an electronic trip recorder, "Blue Box" (Øen EO, 2005), and in random checks at sea and in harbours by authorised personnel from the Norwegian Directorate of Fisheries.

In 2014 all skippers received the "NAMMCO Instruction manual for the maintenance and use of weaponry and equipment deployed in hunting of baleen whales in NAMMCO member countries" (NAMMCO, 2014).

Research programs in Norway to improve killing efficiency in whaling 1981-2005

From 1981 to 2005 several research programs and studies to assess and improve the hunting and killing methods for minke whales have been conducted in Norway.

1981- 86

*Research program I***:** Project manager EO Øen.

Development of improved killing methods in the Norwegian minke whaling, improvements of weapons and hunting methods and training of hunters.

This study was a five years research program, which aimed first of all to find alternatives to the "cold" harpoon (harpoon without explosives) that was used in the hunt. The scope of the program included collection of TTD data of "cold" harpoon hunt, the possible use of high velocity projectiles, high pressure gases, drugs and electric harpoons. Also the use of explosives and alternative design of harpoons had to be explored. And finally testing and adaptation of new weapons and equipment and the training of hunters had to be carried out before approval of new hunting methods. After several studies and field trials the work resulted in the development and implementation of a new harpoon grenade (Raufoss) with 22 g of penthrite fuse as explosive (Øen EO. 1995a, 1995b, 1995c).

1992- 96.
*Research program II***:** Project manager EO Øen.
Further developments of alternative hunting gears and hunting methods in Norwegian minke whaling

This study that started as a part of a Norwegian scientific whaling program that lasted until 1994, was extended to 1996. The studies included development of methods for *in situ* fixation of whale brains and histological examination of brain tissues, ballistics studies and further trials with harpoons, examination of rifle bullets and calibres for back-up rifles, harpoon gun sights and marksmanship contra shooting ranges, improvements of catching routines etc. These studies were fundamental and resulted in implementation of new regulations in the hunt.

1996- 2004
*Research program III***:** Project manager EO Øen.
Further developments of explosives and weapons in Norwegian minke whaling: Development and fields testing of a new and improved harpoon grenade for minke whales (Whale grenade-99).

In the 1990ies it was discovered a high rate of malfunction of the Raufoss harpoon grenade. It was first repaired. Later misfires were so frequent that it became an ethical problem together with a safety problem for the hunters. Other problems of safety nature occurred on the grenade, malfunctions that the manufacturer would not guarantee could be prevented in future productions. It was therefore decided to develop a new, safer and more reliable penthrite grenade for Norwegian minke whaling. The author of this report designed a new penthrite grenade and a project for development was set up. The project was partly funded by the Norwegian Research Council and carried out in cooperation with the Norwegian defence industry. The new grenade was tested in field trials for three seasons before governmental approval and prescribed obligatory in the Norwegian hunt from year 2000 on under the name of Whale-Grenade-99.

1998-2004
*Research program IV***:** Project manager SK Knudsen and EO Øen
Assessment of insensibility and death in hunted minke whales; study of trauma and its consequences caused by the currently used weapons in the Norwegian minke whale hunt

The major aims of the study were to investigate: (1) pathological lesions caused by penthrite grenade detonation in minke whales, with special emphasis on the central nervous system

(CNS); (2) reassure that the rifle ammunitions used in the Norwegian hunt were capable of penetrating the skull of minke whales and cause sufficient damage to the CNS to account for an instantaneous loss of sensibility; and (3) to find if the "IWC criteria" (IWC, 1980) were valid to determine time to death (TTD) in whales.

The results obtained from this study of minke whale brains fixed *in situ*, proved the fast deadly effect of penthrite grenades detonating in the whale body. It further confirmed that whales may show agonal reflex movements after they loose consciousness, an issue that had been under discussion for years in IWC. It also confirmed what Norway had claimed in IWC that the "IWC-criteria" were not fully adequate to determine exactly when a whale loose consciousness or die and when TTD are solely determined on the basis of these criteria, which in practice is immobility, a significant proportion of animals will be recorded as being sensible or alive when they most likely are unconscious or dead. It confirmed that if the IWC criteria are used in conjunction with a post mortem examination the estimated TTD will be closer to the real TTD for a majority of the whales. The method can be used to compare different hunting techniques and methods provided that competent personnel collect the data and the same protocol are used for the data collection and analysing. But, if the pathological examination does not include investigations of the brain, it is likely that the TTD of some animals still will be overestimated.

2001- 2005: Automated monitoring of minke whaling. Project manager: EO Øen
Development of automated electronic monitoring system to monitor the Norwegian minke whale hunt.

The traditional methods for monitoring the Norwegian minke whale hunt included logbook inspection and at-sea inspectors on every vessel. The system was useful in monitoring hunting regulations, but imposed unintentionally side effects on the execution of the hunt. Inspection time was limited to seven weeks and prevented the hunters from traditional opportunistic "fair weather" hunt and forced them to start the season when the inspectors were available. For the smallest vessels one of the crew had to stay at port to make room for the inspector during the season (Fig. 3).

An electronic tamper-proof automated computing system to independently monitor the whaling activities was developed and tested for several seasons before approved by Norwegian authorities. The system eased some of the unnecessary and unintended restrictions and be superior to the traditional monitoring system in many ways brought the hunt back to its traditional opportunistic "good weather" hunt and still secured that the harvest fit within long-term resource conservation targets and sustainable goals. It takes little space, it does not sleep, eat, and does not socialize with anyone. To day this system is obligatory on every whaling vessel and has for ten years proved to be a reliable and useful instrument for hunters and authorities.

SAMPLING OF TTD DATA AND RESULTS FROM THE 2011 AND 2012 SEASONS

Data sampling
The data sampling the two season was carried out by fisheries inspectors who were trained in data sampling in a two days course prior to the hunting seasons. The inspectors were not veterinarians or biologists like in earlier sampling seasons. Therefore, the instruction manual for data sampling and the data-sampling scheme were somewhat completed with information from the hunt. It was emphasised on the importance to get detailed information where the detonation took place and the gross damages of organs caused by the grenade detonation. In addition to TTD, the behaviour of the whale after being shot, data on whale length, estimated

range of shooting, the angle between the shot direction and the whale's long axis, the impact point on the whale, the detonation site, necropsy finds, grenade function and re-shootings should be recorded. The time from a strike to the animal's death was recorded by using stop-watch. Shooting range and angle of the shot relative to the animal's long axis were estimated without instrumental aid.

Criteria of death

To decide TTD the "IWC criteria" were used (see above) (IWC/47/18; Knudsen SK, 2005).

Results

TTD data were collected for 271 minke whales caught by 14 vessels, 180 whales in 2011 and 91 in 2012. The whales were killed with 50 and 60 mm harpoon guns and Whale Grenade-99 with 30 g of pressed penthrite as explosive. Rifles calibre .375 and .458 with full metal jacketed, round nosed bullets were used as back-up weapons.

The results of the survival plot for the 271 minke whales are shown in Fig. 4. Instantaneous death was recorded for 222 whales (82 %) with an average TTD of 1min. The median TTD for the 49 whales not registered instantly dead was 6min. One whale that had only been wounded was reshot and died after 20-25 minutes. No whales were lost alive.

In Norway it is recommended to shoot the whales from a side position (45°-135° - relative to the animal's long axis) aiming at the chest. The shooting position/angel is registered for 254 (94%) of the 271 whales. Of these 62% were shot from the recommended side position (45°-135° - relative to the animal's long axis), 22% in a narrower angel from behind (135°-180° - relative to the animal's long axis), 16% were shot from the front or from behind (Fig. 5).

About 92% of the whales shot from the recommended side position (45°-135°) were registered instantly dead while only 70% of whales shot in the narrower angel either from front or behind positions (0°- 45° and 135°-180°) died instantly. The results for the other 16% of whales shot from the front (0°) or from behind (180°) where about 63% (Fig.6)

The shooting distance varied from 20 to 60 meter. Whales shot from the shortest distance died some faster than whales shot from the longer distances. However, the differences were very small and not statistically significant.

No misfire of grenades due to technical errors was reported during the two seasons.

Discussion and conclusions

Instantaneous death was recorded for 82% of the 271 whales with an average TTD of 1min. This is the highest IDR and the lowest average TTD ever recorded in the Norwegian minke whale hunt. In 1983 when cold harpoon was used the IDR and average TTD registered were 17% and 11min, respectively (Øen 1995c). When the first penthrite grenade was implemented in the hunt the recorded IDR and TTD values were 45% and 6.5 min, respectively (Øen 1995b) and when the new penthrite grenade, Whale Grenade-99, was implemented in the hunt, the recorded IDR reached 80% and the average TTD value was reduced to 2 min (Øen EO, 2003, 2006).

Detonation in the thoracic cavity, detonation near the spinal column in he thoracic part of the body and at the neck and brain results in 100% instant death (Øen 2003, 2006). The detonation of penthrite causes massive bleedings, damages and injuries to vital organs like heart, lungs, major blood vessels and central nervous system (CNS). Studies of minke whale brains from

whales killed with penthrite grenades (Knudsen and Øen, 2003) show that the detonation in thorax and neighbouring regions like the rostral part of abdomen creates fatal haemorrhages (bleedings) as far away from the detonation site as in the spinal column and the basis and cortex of the brain. This effect is in all probability caused by the extremely high, undulating pressure/shock waves that spread out through the body and to the brain through natural openings like the spinal column, large vessels and brain nerves openings in the skull.

The angle of the shot relative to the animal's long axis has a significant influence on TTD and IDR. Grenades that are directed at the thorax from the recommended side position of about 45°-135° relative to the animals long axis resulted in 92% instant kills while shots directed in narrower angels from front or from behind resulted in only 70%, instant kills. The results for shots directed parallel to the body were as expected, lower (63%).

The results from this study are concurrent with earlier studies (Øen 1995a, 1995b; Knudsen and Øen 2003; Øen 2006). Shots from a narrow angel to the body of a moving target will significantly increase the risk of hits and detonation outside vital areas. The risk of stray shots and wounding without killing the animal is considerable. This type of shooting seems to be the main reason for the longer survival times. It is well known also from hunting of terrestrial large games that firing the first rifle shot from the front with some exceptions should be avoided. Firing from back should never be permitted except for the felling of wounded animals (Øen 1995a).

To day malfunction or misfire of the Norwegian penthrite grenade is very unusual much due to continuous modification of components that have showed weaknesses and a close surveillance and quality control of the production. However, if the harpoon does not penetrate deep enough (65-70 cm) to trigger the detonation the grenade will not be set off. The high quality of the grenade together with the introduction and use of the NAMMCO handbook "NAMMCO Instruction manual for the maintenance and use of weaponry and equipment deployed in hunting of baleen whales in NAMMCO member countries" should make a potential for further improvements of IDR and TTD if all gunners show a bit more patience and wait until the animal is in the recommended side position before the gun is fired.

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Fig. 1. 50 mm Kongsberg harpoon gun with harpoon and Whale Grenade- 99.
Photo: Björgvin Gudmundsson

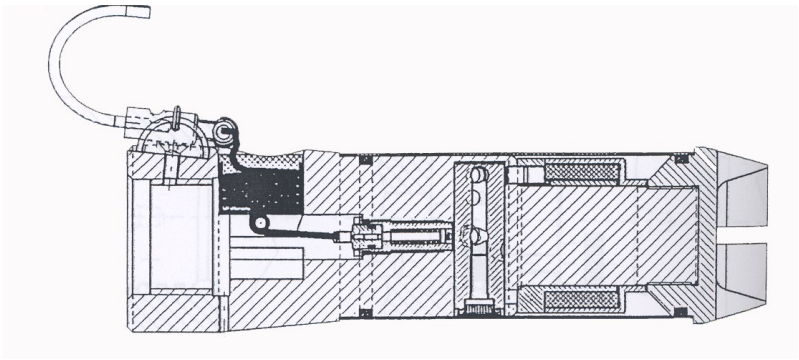

Fig. 2. Whale Grenade-99 (longitudinal section view). Safety and arming mechanism in secured position.

Fig. 3. The Blue Box (Control Box).
The Automated Electronic Monitoring System for the minke whale hunt in Norway.

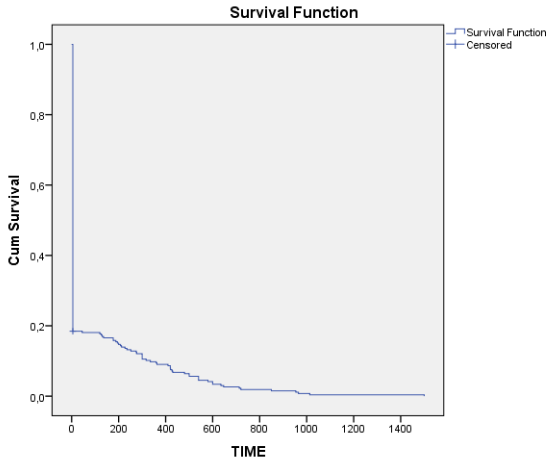

Fig. 4. Survival plot for the 271 minke whales hunted in 2012 and 2013.
Time in seconds.

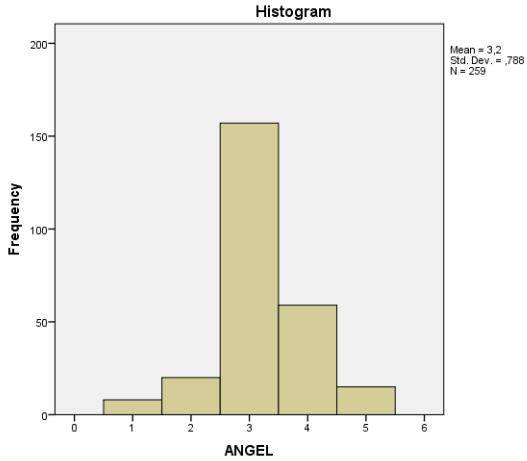

Fig. 5. Shooting angel/boat position relative to the animal's long axis:

1: In front 0°, 2: Position 0°- 45°, 3: Position 45° - 135°, 4: Position 135°-180°, 5: From behind 180°

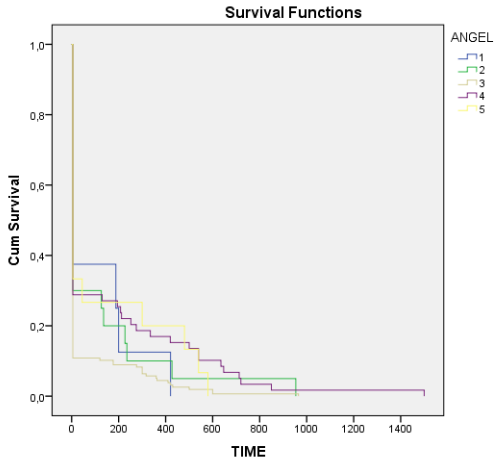

Fig. 6. Survival plot for shooting angels relative to the animal’ s long axis. Time in seconds.

1: In front 0°, 2: Position 0°- 45°, 3: Position 45° - 135°, 4: Position 135°-180°, 5: From behind 180°