REPORT ON WEAPONS, TECHNIQUES, AND OBSERVATIONS IN THE ALASKAN BOWHEAD WHALE SUBSISTENCE HUNT

Prepared by the Alaska Eskimo Whaling Commission

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OVERVIEW OF THE 2011 ALASKAN BOWHEAD WHALE SUBSISTENCE HUNT AND USE OF THE PENTHRITE PROJECTILE

INTRODUCTION

The Alaska Eskimo Whaling Commission (AEWC)

The AEWC is a not-for-profit entity composed of the eleven coastal subsistence whaling communities in the Alaskan Arctic – ranging from the Villages of Gambell and Savoonga on St. Lawrence Island in the Bering Sea and the Village of Little Diomede on Little Diomede Island, to the Village of Kaktovik on Barter Island in the Beaufort Sea near the Canadian border. The culture and the social structure of these SiberianYupik and Inupiat Native communities are built around the annual subsistence harvest of the Bering-Chukchi-Beaufort Seas stock of bowhead whales. In this paper, any reference to "bowhead whales" is to this stock.

The Alaskan Bowhead Whale Subsistence Hunt

The Alaskan Eskimo subsistence hunt of bowhead whales is conducted pursuant to the regulations of the IWC Schedule; U.S. law; and the AEWC Management Plan, approved by the U.S. Government. The hunt takes place from small boats using hand-held weapons. The use of small boats and hand-held weapons requires hunting crews to approach the whale at very close range, positioning themselves to be virtually on top of the whale when it is struck.

Nine of the eleven subsistence whaling villages typically hunt in the spring as bowheads migrate north and east from the Bering Sea to the Canadian Beaufort Sea through the spring ice leads along the Chukchi Sea coast. This hunt is conducted from the edge of the shore-fast ice using wood-framed boats made by hand with walrus (St. Lawrence) or bearded seal skin and thread fashioned from caribou sinew. Because whales must be taken in an ice-covered ocean, some of the struck whales inevitably slip under the ice, where they may be lost. The rapid advance of climate change in the Arctic also is having a dramatic impact on this hunt, as thinning sea ice increases the difficulty of reaching the edge of the shore-fast ice and creates an unstable and dangerous platform for conducting the hunt in the spring lead system. The thinner, less stable ice has greatly increased the danger in this already treacherous hunt and has increased the difficulty of landing whales that must be pulled onto an ever-thinner ice edge, which is subject to shifting and cracking under the weight of the whales. With the ice changes, the bowhead whale subsistence hunt at St. Lawrence Island, historically a spring hunting location, has shifted to winter months, with a number of whales now taken between November and March. Similarly the villages along the Chukchi Sea coast are looking increasingly to the fall open water season to take bowheads. In 2010, the village of Wainwright, for the first time in memory took a bowhead whale in the fall, and again took a fall whale in 2011.

Three of the villages, Kaktovik, Nuiqsut, and Barrow, typically hunt in the fall as the bowheads that summer in the Canadian Beaufort migrate west along the Beaufort Sea coast of Alaska and then south through the Chukchi Sea and into their wintering grounds in the northern Bering Sea. This hunt is conducted from small skiffs with outboard motors in ice-choked waters and under conditions that often include high winds and rough seas.

Efficiency in the Alaskan Bowhead Whale Subsistence Hunt

Historically, the efficiency (# landed / # struck) in the bowhead whale subsistence hunt averaged approximately 50 percent. In 1978, the AEWC committed to the IWC that it would increase that efficiency to an average of 75 percent. In recent years, the average efficiency rate in the bowhead whale subsistence hunt has been at least 75 percent and in some years, well above 80 percent. The efficiency of 75% for 2011 was similar to the past 10 years (2001-2010: mean of efficiency = 76%; SD = 0.08%).

Animal Welfare in the Alaskan Bowhead Whale Subsistence Hunt

The IWC has adopted a set of criteria for determining time to death in whales (see IWC/30/15) based on observed behavioral criteria, especially cessation of movement, slack jaw, and slack flippers. These behavioral criteria can be very difficult to observe in the bowhead whale hunt, since the whale is struck while sounding, meaning the body is below the water surface. In addition, the whale's momentum can carry it into a dive that might keep it below the surface for some time, or the dive might take it under the ice. Given these conditions, no reasonable means exist to estimate time to death in this hunt, except in instances where the whale remains on the surface or floats quickly after being struck, or on the occasion when the whale turns on its back after being struck. These instances will be recorded as instantaneous or near-instantaneous kills.

Therefore, rather than focus its welfare improvement efforts on criteria that cannot accurately and consistently be observed, the AEWC focuses its welfare program on proper weapon placement and the weapons upgrades discussed in this paper. During the 2003 IWC Workshop on Whale Killing Methods and Associated Welfare Issues, it was reported that research conducted on minke whales demonstrated that, with appropriate charge and placement, penthrite is capable of causing "severe and fatal neurotrauma . . . in which the cardinal symptoms are immediate loss of consciousness without any lucid interval and very high mortality rate (Annual Report of the IWC 2003, Annex E, p. 95, reporting on presentation of Knudsen, et al., 2003). During the most recent IWC Workshop on Whale Killing Methods and Associated Welfare Issues, held in 2006, the Workshop participants adopted a number of recommendations aimed at improving animal welfare and hunter safety. Recommendations specific to Aboriginal Subsistence Whaling or that can be adapted to the bowhead whale subsistence hunt are:

- Recommend the best possible type and calibre weapon is used in aboriginal subsistence whaling and continue weapon technology improvement for use in aboriginal subsistence whaling with particular focus on calibre of weaponry. Encourage the development of the

aboriginal subsistence whaling caucus to further the exchange of information and best practice. (Workshop recommendation 2.)
- Recommend continued efforts to improve accuracy of placement of primary and back-up shorts, to continue improvements towards achieving instantaneous death. (Workshop recommendation 3.)
- When using explosive devices, for welfare reasons whales should whenever possible be shot from the side at the thorax or neck and all animals should if possible be hauled in as fast as possible to control if the animal needs to be re-shot. (Workshop recommendation 6.)
- As a precaution, the hunters should be recommended to re-shoot as a routine any animals that move or in other ways show any signs of life. (Workshop recommendation 8.)[1]
- Recognize the importance of hunter training for the improvement of hunters' safety, animal welfare and minimizing struck and lost rates. (Workshop recommendation 9.)
- Recognize the importance of maintaining weapons and hunting gear. (Workshop recommendation 10.)

The AEWC has been an active participant in the meetings of the IWC Working Group on Whale Killing Methods and Associated Welfare Issues since its inception in 1983 and in the IWC Workshops on Whale Killing Methods and Associated Welfare Issues since 1980. As a result, and as reflected in this report, the AEWC's Weapons Improvement Program (WIP) and related work are geared toward meeting the goals of the IWC regarding whale killing methods and welfare (humane killing and hunter safety) issues, as represented by the recommendations set forth above.

The AEWC's WIP is focused on 4 principal aspects of improved hunting and welfare techniques:
1. Introduction of a penthrite explosive projectile into the bowhead whale subsistence hunt.
2. Ongoing hunter training in the use of the new equipment.
3. Ongoing hunter training in shot-placement and accuracy.
4. Ongoing upgrades to traditional hunting equipment to improve the performance of the penthrite projectile and to enhance hunter safety, animal welfare, and hunting efficiency.

While the AEWC is in the process of completing implementation of the use of the penthrite projectile in all villages, efforts with this program are yielding positive results. During the 2011 bowhead whale subsistence hunt, six of 38 whales were taken with penthrite alone, and an additional 12 whales were taken with penthrite and black powder. A total of 12 whales were reported to have died instantly with an additional 14 whales reported as having died near-instantaneously.

To date in the 2012 spring bowhead whale subsistence hunt, the village of Savoonga took all six of its whales using penthrite. All were reported as very quick kills and no whales were lost. Pt.

[1] It is standard practice in the bowhead whale subsistence hunt to deliver a follow-up shot from the shoulder gun, armed with a black powder projectile, immediately following the darting gun shot.

Hope reported a similar experience, with all five of its whales taken using penthrite and no whales lost. According to the Pt. Hope Village Whaling Captains' Association President:

"It seems the Penthrite Projectiles have worked very nicely in Point Hope. Point Hope is one village where the struck and lost has been a problem for years. This year during their first use of the projectile, they did not lose a whale. A short success story with the use of the projectile in Point Hope. I am very pleased."

-- Herbert Kinneeveauk

THE 2011 BOWHEAD WHALE SUBSISTENCE HUNT (see SC/64/BRG2 for full discussion and associated research results)

Overview of Harvest Results

In 2011, 51 bowhead whales were struck during the Alaskan subsistence hunt, with 38 whales landed.

Spring Hunting Conditions

Hunting conditions during spring 2011 were again problematic throughout the northern and western Alaskan coast. Ice and weather conditions prevented hunters from Little Diomede, Wales, and Kivalina from striking a whale. A total of 20 bowheads were landed during the spring.

Gambell and Savoonga, communities on Saint Lawrence Island in the Bering Sea, landed four and two whales, respectively, during April. Sea ice was typically less extensive and relatively thin near Saint Lawrence Island during spring 2011. Shorefast ice was noticeably absent in several locations and the ice available for hauling up and flensing whales was weak/thin – or non-existent. Additionally, based on the timing, numbers, and locations of whales observed during spring 2011, there were several local seasonal migratory paths whereby many northbound whales bypassed Southwest Cape and passed closer nearshore at the northwestern end of the island. This resulted in fewer whales being available to Savoonga hunters who hunt at Southwest Cape in the spring.

Point Hope and Wainwright, on the coast of the Chukchi Sea, each landed three animals between 22 April and 24 May. Point Lay landed a whale in mid-May. In Barrow, seven whales were landed during the spring from 26 April to 22 May. The hunting and flensing conditions were some of the worst seen in years. The landfast ice at Barrow was very rough and broken due to a major west wind storm on 17 February 2011. Wind speeds peaked at over 70 kmh. The storm crushed up the landfast ice ~ 1km shoreward of the lead edge. It created a long agiukpuk (ice wall) several meters high from Point Barrow to at least 50 km SW of Barrow. Trail-building to access the leads was long and tedious.

Mr. Johnny Aiken, Executive Director of the AEWC, described the ice as follows:

"The shorefast ice is in terrible condition this year; there's only one place to [hunt for a] whale. Jumble ice along the edge is pervasive along the coast and limits the areas where people can whale. One of the worst years for landfast ice in decades."

-- Johnny Aiken

Autumn Hunting Conditions

Eighteen whales were landed by four villages during the autumn migration (Barrow, Kaktovik, Nuiqsut, and Wainwright). Kaktovik hunters landed three whales between 5 and 12 September. Hunting conditions were favorable for Nuiqsut where they completed their hunt by landing three whales from 3 to 5 September. At Barrow, 11 bowheads were landed, two on 8 October and the other nine between 24 and 30 October. There were few whales near Barrow in early to mid October, which is very unusual. Hunters were out searching for animals in mid-October but few bowheads were observed. More whales arrived near Barrow on 24 October. The migration across the Beaufort Sea appeared to be very late in 2011 for unknown reasons. Wainwright landed a whale in the autumn (28 October) for only the second time since at least 1974 (Suydam and George, 2004). They also landed a whale in autumn 2010.

Struck and Lost and Hunting Efficiency

Of the 13 whales that were struck and lost in 2011, two had a fair chance of survival, eight had a poor chance of survival, and three died. The estimates of survival are primarily based on the Captain's assessment, or scientists' assessment based on the Captain's description of the circumstances of the struck and lost whale. This suggests the total hunting mortality for 2011 was 49 whales; i.e., 38 landed plus 11 whales that likely died.

Overall efficiency of the hunt (#landed/#struck) in 2011 improved to 75% compared to 2010, returning to the long-term average efficiency over the past 10 years (2001-2010: mean = 76%; SD = 7.8%). However, the efficiency can vary substantially from year to year, primarily due to environmental conditions. For example, 2010 had a relatively low efficiency of 63% for a variety of reasons (see Suydam et al., 2011).

The success of the spring hunt is quite sensitive to variable environmental conditions (George et al., 2003). Therefore, efficiency varies between seasons and among years. The efficiency of the spring harvest is on average lower than the autumn harvest due to more demanding ice and weather conditions as well as struck whales escaping under the ice. In 2010, the overall efficiency of the spring hunt was quite low at 52%. However, in 2011, the efficiency of the spring hunt improved to 69% despite the difficult ice conditions. In Barrow there was a modest number of whales landed -- seven -- during the spring. The principle reason for the modest spring hunt at Barrow was unfavorable shore-fast ice conditions, as described above. Difficult

sea ice may have contributed to the relatively low efficiency in many of the spring hunting villages, as well

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The autumn hunts were successful and efficient (82%) in 2011. Eighteen whales were landed and four were lost. Autumn hunts typically occur in more open water, thus sea ice is less of an influence on success. However, high wind speeds during the open water period in the autumn can make hunting opportunities extremely difficult (George et al., 2003). As climate change causes a greater and longer period of retreat of sea ice, the increased fetch contributes to larger swells that even persist after strong winds have abated. The overall hunting period has increased in recent years due to sea ice retreat, which possibly offsets inclement weather resulting in poor hunting conditions.

Use of the Penthrite Projectile in 2011

Six whales were taken with penthrite projectiles alone during the 2011 Alaskan bowhead whale subsistence hunt. An additional 12 whales were taken using both black powder and penthrite.

In all, 26 whales were reported as instant or near-instant kills, including all but three of those taken using penthrite and six whales taken with black powder.

Ongoing Hunter Training in the Use of the New Equipment

Currently all but three of the AEWC's villages have received training in the use of the new equipment. The AEWC hopes to be able to complete training in the villages of Wales, Kivalina, and Diomede this year. In addition, a number of the captains in Gambell have yet to complete their training. Hopefully funds will be available for this in the coming year.

Ongoing Hunter Training in Shot Placement and Accuracy

The AEWC continues its practice of holding training seminars during its annual meetings in Barrow. During the February 2011 annual meeting, several presentations and discussions were focused on methods of improving hunter safety, animal welfare, and hunting efficiency through weapons upgrades, proper care and handling, and shot placement. George Noongwook, AEWC Chairman from Savoonga, gave a talk on traditional hunting practices in his village. Eugene Brower, Chairman of the AEWC's WIP Committee, and Dr. Øen gave a talk on proper use and handling of the new equipment. Billy Adams, harpooner with his brother Jake Adams' crew from Barrow, joined Mr. Brower and Dr. Øen for a demonstration of harpoon technique and proper shot placement.

Ongoing Upgrades To Traditional Hunting Equipment To Improve the Performance of the Penthrite Projectile and To Enhance Hunter Safety, Animal Welfare, and Hunting Efficiency

Upgrade to the Darting Gun Barrel: During development and testing of the penthrite projectile, it was necessary to upgrade the traditional darting gun by fitting a new barrel to the gun. The new barrel is designed to accommodate the size and shape of the penthrite projectile.

Standardized Pusher Shell: As the use of the penthrite projectile has expanded, hunters have noticed issues with the function of the projectile under conditions of the hunt. Upon review of several incidents and inspection of some of the failed equipment during 2011, Dr. Egil Øen determined that the principal cause of failure in the new equipment is the "pusher shell" used to launch the projectile from the darting hunt. Currently pusher shells are hand-packed by each individual captain, which results in variability in the quality of the powder used and size of the charge. Water seeping into the barrel of the darting gun and wetting the powder is a problem as well.

Early in the design of the AEWC's Weapons Improvement Program, Dr. Øen advised that, once the development and testing of the penthrite projectile were completed, the AEWC should contract for the development of a standardized pusher shell to fit the darting gun. With the completion of the design and testing of the penthrite projectile and the recent equipment failures, the AEWC WIP Committee has decided to turn its attention to the development of a standardized pusher shell for the darting gun. To do this, the AEWC has contracted with Jon Holmgren of Fairbanks, Alaska. Working with Dr. Øen, Mr. Holmgren and the AEWC hope later this year to have a prototype of a standard pusher shell, which will fit the new barrel and provide an adequate charge to launch the penthrite projectile.

Other Equipment Upgrades: Some of the AEWC's captains own darting guns that were originally manufactured in the 19th century. This older equipment is not easily modified to fit the new darting gun barrel needed for use of the penthrite projectile. New darting guns cost approximately $1,000 apiece. Therefore, replacing this older equipment is not simple for subsistence hunters, who may earn only a few thousand dollars a year in cash income. The AEWC is investigating funding opportunities to help its captains with older guns upgrade their equipment.

Future Manufacture of the Penthrite Projectile: Currently the AEWC imports its penthrite projectiles from a machinist in Norway, who also manufactures the penthrite projectile for Norwegian hunters. In an effort to save transportation costs, the AEWC is investigating the possibility of having projectiles manufactured domestically. To this end, the AEWC is talking with Jon Holmgren of Fairbanks, and seeking authorization from the U.S. Department of Homeland Security.

REFERENCES

Alaska Eskimo Whaling Commission, 1995, "*Hunting Efficiency and Recovery Methods Developed and Employed by Native Alaskans in the Subsistence Hunt of the Bowhead Whale*," submitted to the International Whaling Commission, IWC Workshop on Whale Killing Methods as paper IWC/47/WK15, May 1995.

Alaska Eskimo Whaling Commission, 2003, "*Report on Alaska Eskimo Whaling Commission Progress Concerning Improvement of Whale Killing Methods*", submitted to the International Whaling Commission, IWC Workshop on Whale Killing Methods and Associated Welfare Issues as paper IWC/55/WK1, June 2003.

Bockstoce, John R., 1986, Whales, Ice, and Men: The History of Whaling in the Western Arctic, University of Washington Press, Seattle, Washington.

George, J. C., S. Braund, H. Brower, Jr. C. Nicolson, and T. M. O'Hara. 2003. Some observations on the influence of environmental conditions on the success of hunting bowhead whales off Barrow, Alaska. In: Indigenous ways to the Present: Native whaling in the Western Arctic. Studies in whaling No. 6. Canadian Circumpolar Institute (CCI) Press, Alberta Canada. 432 pp.

International Whaling Commission, Chairman's Report, 1993, Appendix 1 of Chairman's report of the forty-fourth Annual Meeting of the International Whaling Commission (1992). Report of the International Whaling Commission 43: 38-39.

International Whaling Commission, 2003, Report of the Workshop on Whale Killing Methods and Associated Welfare Issues, IWC/55/Rep 5, 7-9 June, Berlin, Germany.

International Whaling Commission, 1999, Report of the Workshop on Whale Killing Methods, IWC/51/12, 17-19 May, Grenada.

Ingling, A., 1995. *Determination of the muzzle velocity of the black powder and the penthrite projectiles fired from a bench-mounted darting gun of the type used by Alaskan Eskimo in the subsistence hunt of the bowhead whale, as influenced by the propellant charge and other factors*, submitted to the International Whaling Commission, Workshop on Whale Killing Methods as paper IWC/47/WK16, May 1995. (Also submitted in an expanded version of 45 pages as a report in 1997 to the Department of Wildlife Management, North Slope Borough, Box 69, Barrow, AK 99723, from the Virginia-Maryland Regional College of Veterinary Medicine, University of Maryland, College Park, MD 20742.)

Knudsen, S.K.. and Øen, E.O. 2003, Neurosci. Research (Available online at www.sciencedirect.com), IWC/55/WK16.

Montague, J.J. Introduction. In: J.J. Burns, J.J. Montague, C.J. Cowles Eds. *The Bowhead Whale. Special Publication Number 2* The Society for Marine Mammalogy. Lawrence, KS Allen Press, Inc. 1993: 1-17

Øen, E., 1995, *A New Penthrite Projectile Compared to the Traditional Black Powder Projectile: Effectiveness in the Alaskan Eskimos' Hunt for Bowhead Whales.* In: Øen, Egil Ole, *Killing Methods for Minke and Bowhead Whales.* (1995), Arctic. 48(2), 177-185. Submitted as paper IWC/47/WK8 to the IWC Workshop on Whale Killing Methods, Dublin, Ireland, 1995.

O'Hara, T., T. Albert, E. Øen, L. M. Philo, J.C. George, A. Ingling, *The Role of Eskimo Hunters, Veterinarians, and Other Biologists in Improving the Humane Aspects of the Subsistence Harvest of Bowhead Whales*, Journal of the American Veterinary Medical Association. In Press.

Sharpnack, D.D., Johnson, A.J., and Phillips, Y. *The pathology of primary blast injury*. In: R. Zatchuk, D. Jenkins, R. Bellamy, and C. Quick Eds. Textbook of Military Medicine: Warfare, Weaponry, and the Casualty. Published by Office of Surgeon general at TMM Publications. Center for Excellence in Military Medical Research and Education. Walter Reed Army Medical Center, Washington DC. US Government Printing Officer. 1990; 271-294.

Suydam, R.S., J.C. George, B. Person, C. Hanns, R. Stimmelmayr, L. Pierce and G. Sheffield. *Subsistence harvest of bowhead whales (Baleana mysticetus) by Alaskan Eskimos during 2011.* SC/64/BRG2.

Suydam, R.S. and J.C. George, 2004 Subsistence harvest of bowhead whales (Balaena mysticetus) by Alaskan Eskimos, 1974 to 2003. Paper SC/56/BRG12 presented to the Scientific Committee of the International Whaling Commission.

Suydam, R.S., J.C. George, B. Person, C. Hanns, and G. Sheffield. 2011. Subsistence harvest of bowhead whales (Balaena mysticetus) by Alaskan Eskimos during 2010. Paper SC/63/BRG2 presented to the Scientific Committee of the International Whaling Commission.

ATTACHMENT 1

WEAPONS USED IN THE ALASKAN BOWHEAD WHALE SUBSISTENCE HUNT AND HISTORY OF THE AEWC'S WEAPONS IMPROVEMENT PROGRAM

Primary Weapon

The primary weapon used in the Alaskan Eskimo bowhead whale subsistence hunt is a hand-held darting gun, armed with an explosive projectile and a harpoon that attaches a line and float to the whale to assist in recovery.[1]

Brief History of the Darting Gun

A black powder-loaded projectile has been used for approximately 150 years as the explosive projectile loaded into the traditional hand-held darting gun and shoulder gun: Inupiat and Siberian Yupik people of the northern and western coasts of Alaska have hunted bowhead whales for thousands of years. Early hunting equipment consisted of hand-held spears with points made of stone or bone. In 1847 and 1848, the North Pacific commercial exploitation of whales began in the Okhotsk and Bering Seas and ended for the Bering, Chukchi, Beaufort Seas (BCBS) stock of bowhead whales around 1914 (Montague, 1993). By the end of Yankee commercial whaling activities (1849 to 1914) 18,650 whales were estimated to have been killed (Bockstoce, 1986), dramatically decreasing the BCBS population. This industry severely depleted the BCBS stock, as well as other marine mammal stocks, especially walrus and gray whales. This caused serious starvation-related declines in the indigenous human population of coastal Alaska. The human populations also suffered further severe declines due to the introduction of disease through contact with the Europeans.

Contact with Yankee whalers caused the Native people to change their hunting techniques as they incorporated new technologies in the form of the darting gun, the shoulder gun, and the black powder exploding projectile (the black powder projectile). These tools are still used in combination with traditional Eskimo whaling methods (shorefast ice-based operations) and equipment, (bearded seal, *Erignathus barbatus,* skin boat or umiaq), and some modern equipment (i.e. small outboard boats in the fall).

While far more successful and humane than hand-held spears with stone or bone heads, the black powder projectile is limited and dangerous to use in that it is loaded with an old low-power explosive (black powder), has a fusing system that can be unreliable, and ignition of the fuse occurs in the barrel of the gun (Ingling, 1995). Until recently, no alternatives to the black powder projectile were available to Alaskan Eskimo subsistence hunters.

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[1] For a detailed description of the darting gun, see Ingling, 1995.

However, since 1987, the AEWC through its Weapons Improvement Program Committee (WIP Committee) has worked closely with Dr. Egil Ole Øen and Henriksen Mek. Verksted of Norway on the design, testing, and manufacture of a penthrite-loaded projectile for use in the hand-held darting gun. In the course of developing the penthrite projectile, the AEWC and Dr. Øen also found it necessary to modify the design of the darting gun barrel to accommodate the dimensions of the new projectile. The work undertaken in the course of developing the penthrite projectile has been the subject of numerous reports to this Working Group and to the IWC Workshop on Whale Killing Methods. A detailed summary of the work on the darting gun barrel is provided in Alaska Eskimo Whaling Commission, 2005.

Secondary Weapon

The secondary weapon used in this hunt is a smooth bore, seven gauge shoulder gun used to shoot a finned projectile loaded with black powder. Under traditional practices and the rules of the AEWC Management Plan, the shoulder gun cannot be fired until after a line and float have been attached to the whale. Therefore, the shoulder gun is fired following delivery of the darting gun, usually immediately after to help ensure a quick kill.

Overview of AEWC Weapons Improvement Program for the Hand-Held Darting Gun

Development of the Penthrite Projectile

Since 1977, the AEWC has pursued technical research and development designed to improve the safety and efficiency of the weapons used in the Alaskan Eskimo subsistence hunt of the bowhead whale. The most important guiding principle of the AEWC's Weapons Improvement Program is the need to ensure human safety. With the introduction of penthrite, caution is imperative due to its extraordinary explosive power and thus the potential for extreme danger in this hunt, where the crews are only feet from the whale when the darting gun is fired. Thus the penthrite projectile is equipped with a fuse head that serves as a "safe and arming mechanism" (SAM). The SAM is designed to ensure that the projectile detonates only after entering the whale to a safe depth. Redundant safety measures are included to prevent detonation if the projectile is dropped. For added safety, the projectile body and fuse head are delivered separately and are not joined until the crew is prepared to begin hunting.

Work on the development of the penthrite-loaded projectile for the hand-held darting gun began in late 1987 and was largely concluded by 1998.[2] During this period, bench trials of the penthrite projectile were conducted at Henriksen Mek. Verksted, with accompanying field trials in Barrow, Alaska. The penthrite projectile was not used in the bowhead subsistence hunt during 1993, 1994 or 1996, due to the need for modifications based on experience in field trials in each of the previous years.

[2] For a more detailed review of early modifications to the penthrite projectile, see Appendix A to Alaska Eskimo Whaling Commission, 1995

The Barrow field trials included post-mortem examinations, by North Slope Borough Department of Wildlife Management biologists and veterinarians, of whales landed using penthrite. After 1998, field trials revealed the need for further modifications to the projectile, in particular reinforcement of the connector between the fuse head and the tubular body, as well as reinforcement of the tip of the fuse head. This work was carried out in 2000 and 2001.

Modification of the Darting Gun Barrel

The Barrow field trials also revealed the need for modifications to the historic design of the darting gun barrel to accommodate the size and shape of the new projectile. Beginning in 2001, the WIP Committee and Dr. Øen have concentrated their work on modifications to the darting gun, itself, to adapt the weapon to the penthrite projectile, and on the education and training of hunters in the use of the penthrite projectile. Field trials of the penthrite projectile continued in Barrow through 2004 in support of this work.[3]

Design and Implementation of Standardized Pusher Shell for Darting Gun System

Expanded use of the penthrite projectile has revealed the need for development of a standardized pusher shell for the darting gun system. This is consistent with recommendations made by Dr. Øen early in the set-up of the AEWC's Weapons Improvement Program. The work is in its early stages and currently is being undertaken by Jon Holmgren of Fairbanks, Alaska, in consultation with Dr. Øen and the AEWC's WIP Committee.

[3] For a detailed overview of the AEWC Weapons Improvement Program for development of the penthrite projectile used in the hand-held darting gun, and modifications to the darting gun, see Alaska Eskimo Whaling Commission, 2005.

ATTACHMENT 2

OVERVIEW OF PENTHRITE PROJECTILE DESIGNED FOR THE ALASKAN BOWHEAD WHALE SUBSISTENCE HUNT

This overview was adapted from an explanation of the penthrite projectile and its development for use in the Alaskan bowhead whale subsistence hunt, prepared by Dr. Egil Øen.

The explosive

Penthrite (Pentaerytritol Tetranitrate or PETN) belongs to the so-called secondary explosives customary used for demolition purposes etc. It is regarded to be non-toxic and does not affect the usefulness or taste of whale meat because it does not dissolve in water and upon detonation it breaks down into natural gases and water. Also, penthrite is thermally the most stable and least reactive of its category of explosives. Curiously enough in recent years, it has also been used for medical treatment in the therapy of angina in humans and animal data suggest that it also might have antiatherosclerotic effects.

A Norwegian study of harvests and post mortem of more than 5000 minke whales shows that penthrite is very efficient in causing the (minke) whale to become unconscious almost instantly and causes quick death by producing "pulses" of shock and pressure waves that travel at supersonic speed in all directions, causing severe damage to vital organs. Injuries and bleeding are often found in the brain, heart, lungs and other vital organs. Therefore, if used correctly, and properly aimed, penthrite projectiles or grenades are both safer and more effective and kill the animals faster than grenades with conventional explosives. It is more powerful and a hunter may take aim at a broader area of the whale's body to achieve a rapid death in comparison to the traditional black powder grenade. Even so, hunters can expect the most rapid death only when the grenade explodes in or near the chest, spine, neck, and skull which are the most vulnerable regions. In the Norwegian hunt of minke whales an 80% rate of instantaneous kills is achieved compared to 17% in the beginning of the 1980s.

The projectile

The penthrite projectile for the darting gun is composed of two major parts:

A head (Fig. 1) comprising the firing mechanism with pyrotechnical devices, arming devices, and a number of safety devices. The sequence of operation contributes to a high degree of safety as the operation of the various devices in the projectile head must occur in the pre-determined sequence to fire the main charge in the bomb at penetration into the whale.

The bomb is a shaft or tubular body (Fig. 2) which is attached to the rear end of the head before the darting gun is loaded.

At transport these parts are held separately.

Manner of operation

When the darting gun has been fired, the projectile will plunge into and penetrate the tissues (muktuk and musculature) of the whale. When the front end of the head hits the target, the striking force at penetration will break a shear pin through the plunger allowing the plunger with

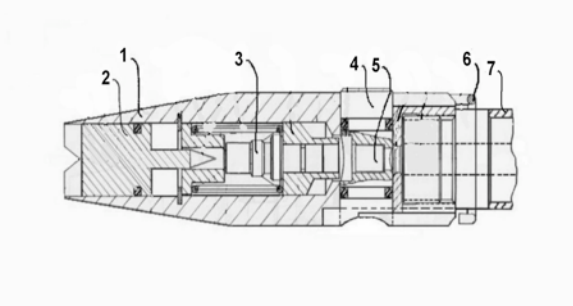
the striker pin to be forced backwards against a stopper device and the time delay fuse. The striker will ignite (activate) the time delay fuse after penetrating to the predetermined depth.
Having been activated by the striker pin, the time delay fuse starts burning and continues burning for approximately 4.5 seconds.

Upon further penetration of the head, the "stirrup" will be hit by the surface of the whale, disrupting another shear-pin and moved to a position flush with the shaft. At this movement of the stirrup, a detonator is moved in a position where it can be ignited by the delay fuse. At the rotation movement the detonator is aligned and in close contact with the burning time delay fuse at one end and the penthrite charge in the shaft at the other end. In this aligned position, the detonator is ready to set off the penthrite charge once it has been triggered by the time delay fuse after 4.5 seconds.

If the detonator housing is rotated accidentally before the time delay fuse has been ignited, the time delay fuse will move immediately into the detonator housing and be safely away and out of reach from the striker pin. Accordingly, the striker pin cannot ignite the time delay fuse and no detonation can occur accidentally.

Diagram of penthrite projectile for Bowhead whale

Fig. 1. Fuse head assembly



1. Housing of Fuse Head Assembly
2. Ignition plunger with striker pin
3. Time Delay Fuse
4. Detonator housing
5. Detonator
6. Stirrup in activated (armed) position
7. Body Assembly

Fig. 2. Penthrite projectile: Fuse Assembly and Body Assembly