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 2010 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.

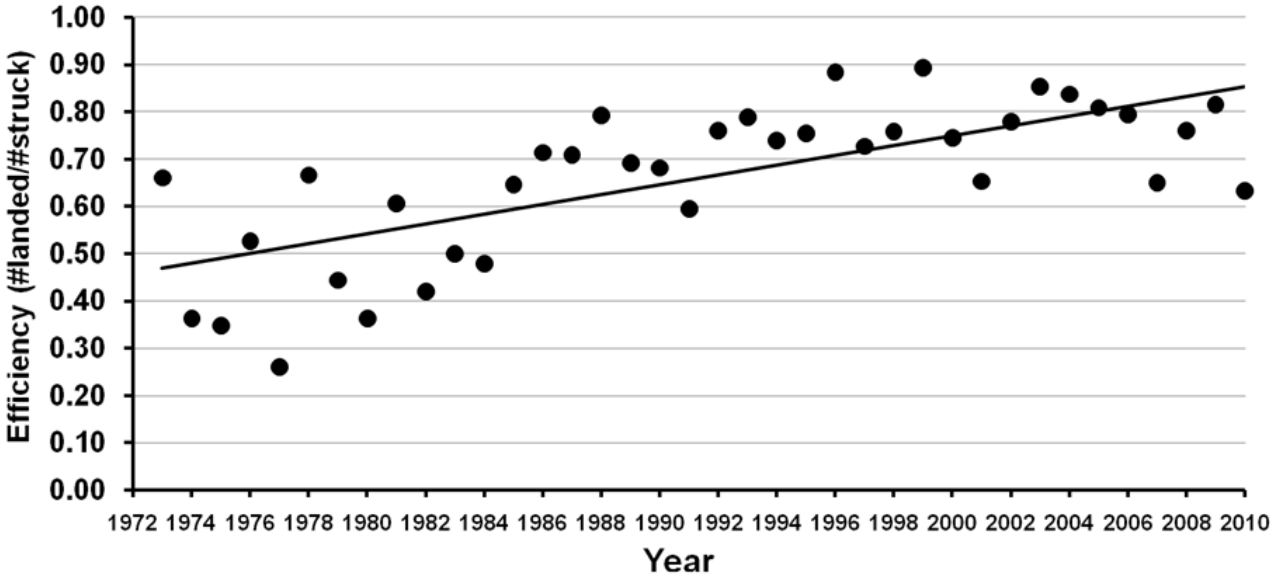
The Alaskan Bowhead Whale Subsistence Hunt

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.

Three of the villages 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.

Because of the treacherous conditions in which the bowhead whale subsistence hunt is undertaken, it is considered to be extremely dangerous, and fatal accidents are a fact of the hunt. During a hunt in Barrow within the past 10 years one of the most experienced harpooners in the Arctic was killed when his boat capsized while towing a whale; he was trapped under it. In April 2004, a prominent subsistence hunter from the village of Pt. Hope died of hypothermia when his boat capsized in the lead. Many accidents similar to these have occurred over the past three



decades.

Figure 1. Plot of hunting efficiency for the preiod 1973-2010. The fitted line is a simple linear regression.

Historical Efficiency in the Alaskan Bowhead Whale Subsistence Hunt

Historically, the efficiency 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. Hunting efficiency over the prior ten years (2000-2009) averaged 77 percent; standard deviation 7 percent (Figure 1).

As discussed below, the 2010 efficiency rate of 63% (52% in spring and 95% in autumn) was lower than in recent years. The 52% efficiency rate in the spring was anomalous in the context of recent history. Weather and ice conditions that contributed to this result are beyond the control of the hunters, as is the fact that four whales (one taken with a penthrite projectile) sank and could not be recovered. A number of equipment failures, especially harpoons and floats failing to remain attached to struck whales are within hunter control and these instances are under investigation by the AEWC's Weapons Improvement Committee.

THE 2010 BOWHEAD WHALE SUBSISTENCE HUNT (see SC/63/BRG2 for full discussion and associated research results)

Overview of Harvest Results

During 2010, 71 bowhead whales were struck during the Alaskan subsistence hunt. The total number of whales landed (n = 45) in 2010 was more than the average number of whales landed (per year) over the previous 10 years (2000-2009: mean = 39.0 whales, SD = 7.0).

Due to weather and climate, hunting conditions during spring 2010 were problematic throughout the northern and western Alaskan coast. Ice and weather conditions prevented hunters from Little Diomede, Wales, Kivalina, and Point Lay from striking a whale. A total of 27 bowheads were landed during the spring. Gambell and Savoonga, communities on Saint Lawrence Island in the Bering Sea, landed six and three whales, respectively, primarily during April and early May. Two of the bowheads struck by hunters from Gambell and Savoonga were later found, one in late May and the other in early June. Some edible muktuk (i.e., skin and the outer blubber) was recovered from both whales. Point Hope and Wainwright, on the coast of the Chukchi Sea, each landed two animals, mostly during May. Wainwright landed one whale in early June, which is not a typical harvest date. These two villages usually land whales in April or early May. In Barrow, 14 whales were landed during the spring from 1 to 15 May.

Eighteen whales were landed during the autumn migration by five villages (Barrow, Kaktovik, Nuiqsut, Savoonga, and Wainwright). Kaktovik hunters landed three whales between 10 and 20

September. The hunt in Kaktovik typically occurs the first week of September but high winds and seas precluded hunting prior to 10 September. Nuiqsut landed four whales during 29 August to 1 September. Hunting conditions were favorable for Nuiqsut in 2010 and the hunt was completed in four days. At Barrow, eight bowheads were landed between 7 and 11 October. Strong winds (> ~15 knots) and high seas prevented hunters from pursuing whales during the first week of October. Wainwright landed a whale in the autumn (7 October) for the first time since at least 1974 and likely the first in more than 50 years. Savoonga landed two whales in early December. Bowhead whale harvests during December and January at Savoonga and Gambell are a relatively recent occurrence, dating to about 1990. More whales are now available to those villages during the winter, possibly due to changing environmental conditions and/or because the bowhead population is increasing.

Of the 26 whales that were struck and lost in 2010, one had an excellent chance of survival, five had a fair chance of survival, 11 had a poor chance of survival, six died, and three whales had an unknown chance of survival. The estimates of survival are based on the Captain's assessment or scientists assessments based on the Captain's description of the circumstances of the struck and lost whale.

The overall efficiency of the hunt (# landed / # struck) in 2010 was 63 percent, which is lower than the average efficiency over the past 10 years (2000-2009: mean = 77%, SD = 7%). Beginning in the mid-1970s, the efficiency of the harvest increased steadily, in some years reaching a level near 90 percent. The current 13-year average is 77.3 percent (Table 1). The increase was due to many factors including enhanced communication (i.e., improved marine radio capabilities) among hunting crews, training of younger hunters, and improved weaponry. However, 2010 was an anomaly with a relatively low efficiency, because of struck and lost whales in the spring.

The success of the spring hunt is quite sensitive to environmental conditions, and thus is quite vulnerable to effects from climate change. In 2010, the overall efficiency of the spring hunt was 52%. At Barrow, the efficiency of the spring harvest tends to be lower than the autumn harvest due to ice and weather conditions as well as struck whales escaping under the shore-fast ice. These factors contributed to the lower efficiency in Barrow and Point Hope in the spring but there were also some equipment failures, such as harpoons with attached floats pulling out of whales. The AEWC Weapons Improvement Committee is investigating these instances to determine where improvements in the use of weapons is needed.

Additionally, four whales sank after they were killed and were not able to be retrieved. Typically bowheads float but for various reasons some do not. The significance of the fact that several whales sank is unclear, although it is not necessarily unusual for whales to sink.

The autumn hunts were successful and highly efficient (95%) in 2010. Eighteen whales were landed and one was lost. Autumn hunting typically occurs in more open water, thus sea ice has less influence on success. However, high wind speeds during the open water period in the

autumn can make hunting difficult or impossible. As climate change causes a greater and longer period of sea ice retreat, the increased fetch contributes to larger swells that can persist after strong winds have abated. However, the overall hunting period has increased in recent years due to sea ice retreat, possibly offsetting periods with poor hunting conditions. During fall 2010, high winds and seas delayed hunts at Kaktovik and Barrow by one to two weeks.

Use of the Penthrite Projectile in 2010

Eight whales were struck with penthrite projectiles during the 2010 Alaskan bowhead whale subsistence hunt in the villages of Barrow, Wainwright, and Nuiqsut. Five of these whales were landed, with instant or near-instant kills, including the whale taken in Nuiqsut. The hunters of Nuiqsut are anxious to continue use of the penthrite. One whale was lost under the ice and one whale sank after having been killed. One of the projectiles, used in Wainwright, did not explode and the whale was lost after having been struck.

This level of use is consistent with the levels of use in prior years. At this time, the AEWC is in the process of creating a program for the distribution of penthrite projectiles to the smaller villages. Projectiles have been sent to Nuiqsut, Kaktovik, Wainwright, Pt. Lay, and Gambell and Savoonga on St. Lawrence Island. Crews in these villages have been trained in the safe use of the new equipment. However, the high cost of travel and transportation in Alaska creates hurdles to broad and regular distribution, which the AEWC currently is working to overcome. Since the projectiles have to be flown by charter, shipment to St. Lawrence Island alone costs close to $30,000 US, not including the cost of travel for hunter training. The AEWC is working with the U.S. Coast Guard in an effort to use the annual transit of Coast Guard cutters as a means of distributing the new equipment.

Given the nature of the bowhead whale subsistence hunt, with the hunters virtually on top of the whale when it is struck, and the considerable power of the penthrite explosive, there is understandable concern about equipment failures and hunter safety, and thus reluctance among some of the hunters to adopt the new equipment. Therefore, in addition to a distribution plan, the AEWC is creating a system for tracking each piece of equipment as it is delivered to the hunters so that the fate of the equipment, on a piece-by-piece basis, can be followed. Since equipment failures, though relatively rare with the penthrite projectiles, are inevitable, it is necessary that the AEWC be able to trace equipment to production lots so that the frequency of failures can be tracked and cataloged by lot, along with information on any specific cause for failure that might be identified on site, such as the projectile tip striking bone. Dr. Oen is working with the AEWC to set up a “fault-tree” that can be used by the hunters as a guide for handling the equipment in the event a failure occurs.

Use of the Penthrite Projectile During the Spring 2011 Bowhead Whale Subsistence Hunt

Eleven whales were struck using the penthrite projectile during the spring 2011 bowhead whale subsistence hunt in the villages of Barrow, Savoonga, Gambell, and Pt. Lay. Reports on the projectiles and the struck whales are still being gathered. At this time it is known that at least three of the whales taken with penthrite, in Barrow, Savoonga, and Pt. Lay, were instant kills. Savoonga, Gambell, and Pt. Lay are using the equipment for the first time.

Future Use

The AEWC is in the process of working with the manufacturer on a new shipment of 200 projectiles, to replenish supplies in the villages where they have been used and for distribution to the remaining villages of Pt. Hope, Wales, Kivalina, and Little Diomede. Assuming travel funds for training can be identified, the AEWC will begin distribution and training in these villages during the fall of this year or the spring of 2012, depending on the shipment's delivery date, weather conditions, and the availability of the individuals responsible for training.

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.

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

[1 11] For a detailed description of the darting gun, see Ingling, 1995.

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.

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[222] 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. Since 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]

Use of the Penthrite Projectile in the Alaskan Bowhead Whale Subsistence Hunt (2003-2009)[4]

2003 Spring and Fall Bowhead Whale Subsistence Hunts in Barrow, Alaska

As discussed above, field trials of the penthrite projectile and modified darting gun barrel continued in Barrow through 2004. During the 2003 Alaskan bowhead hunt, five whales were taken with penthrite used as either a primary or secondary (second darting gun shot from crew other than the first strike crew) projectile, three in the spring and two in the fall. In all cases, the penthrite projectiles and modified darting gun barrels performed properly. Two of the whales taken with penthrite stopped moving almost immediately after being hit with the penthrite explosive (03B3, 03B4).

Due to delays in production and shipment of modified darting gun barrels, only a small number of Barrow crews were given penthrite projectiles for use during the 2004 spring and fall hunts. None of these crews had an opportunity to use the penthrite.

2005 Spring and Fall Bowhead Whale Subsistence Hunts in Barrow, Nuiqsut, and Kaktovik, Alaska

This was the first year of the Alaskan bowhead subsistence hunt after the AEWC WIP Committee and Dr. Øen determined that field trials could be concluded and the penthrite projectile and modified darting gun barrel could be distributed to villages outside of Barrow. As discussed below, training and certification workshops were held in Nuiqsut and Kaktovik prior to the fall hunt in those villages and captains certified in the use of the penthrite projectile were given a projectile and new darting gun barrel.

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[3] [33] 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.

[4] [44] For a discussion of prior years' results of the use of the penthrite projectile in the Alaskan bowhead whale subsistence hunt, see Alaska Eskimo Whaling Commission 1995, 2003, 2005.

During the 2005 spring hunt, two whales were taken in Barrow with the penthrite projectile and modified darting gun. One whale, shot near the base of the skull on the left side, appeared to die "instantaneously."

During the fall hunt, six whales were taken using penthrite, two in Barrow, one in Nuiqsut, and three in Kaktovik. A minor malfunction occurred when one of the penthrite projectiles was shot without removing the safety pin. Still, the projectile exploded safely, and the whale appeared to die quickly. One of the Kaktovik whales (05KK2), taken with a single penthrite projectile and struck approximately 1.5m behind the blowhole, appeared to die very quickly. According to the crew, upon being struck, the whale "shook, slapped its flipper, and died."

2006 Spring and Fall Bowhead Whale Subsistence Hunts in Barrow, Nuiqsut, Kaktovik, and Wainwright, Alaska

Hunting conditions during spring 2006 were very challenging. Ice and weather conditions prevented hunters from six villages (Savoonga, Gambell, Little Diomede, Wales, Kivalina, and Point Hope) from landing a whale. Only crews at Wainwright and Barrow successfully landed whales (5 total) during the spring migration. Wainwright crews took the first whale of the season on 10 May and another on 11 May. The hunters used penthrite on the second whale and reported a very short time-to-death. At Barrow, three whales were taken between 11 and 18 May. One of these was taken using penthrite, and the whaling captain reported that it died quickly.

During the fall hunt, of the 19 whales taken at Barrow, two were taken with the penthrite projectile and the modified darting gun, and were described as "instant kills." Four whales were taken in Nuiqsut; one of these was taken using penthrite and the modified darting gun. The whale was reported to have died very quickly In Kaktovik, three whales were landed, but none using penthrite and the modified darting gun.

2007 Spring and Fall Bowhead Whale Subsistence Hunts in Barrow, Alaska

Five whales were taken in Barrow using the penthrite projectile. Four were reported as instant or very rapid kills. The report on the fifth was unclear.

2008 Spring and Fall Bowhead Whale Subsistence Hunts in Barrow, Alaska

One whale was taken in Barrow using the penthrite projectile, and reported as an instant kill.

2009 Spring and Fall Bowhead Whale Subsistence Hunts in Barrow and Wainwright, Alaska

One whale was taken in Barrow, Alaska using a penthrite projectile, and reported as an instant kill. A second penthrite projectile was used in Barrow as a secondary strike. One whale was taken in Wainwright using a penthrite projectile, but it is not known whether the strike was primary or secondary.

HUNTER TRAINING AND CERTIFICATION

Hunter training is an ongoing priority of the AEWC and its captains. Several of the villages hold hunter training workshops as part of their meetings prior to each bowhead whale subsistence hunt. In addition, the AEWC holds a weapons workshop/hunter training session as part of its annual meeting. This workshop is always well-attended as it offers an opportunity for young hunters to receive instruction to upgrade their skills, as well as an opportunity for more experienced hunters from the different villages to share successful techniques.

In keeping with the AEWC's commitment to hunter safety, a key component of the AEWC's Weapons Improvement Program for the new projectile has been the preparation of a handbook on its function and proper use, along with a training video. The WIP Committee prepared theses items, working in cooperation with Dr. Øen. The handbook was published in February of 2004, and **the AEWC now requires that**, before they are entitled to receive penthrite projectiles or a new darting gun barrel, **all captains must be certified** in the use of the penthrite projectile and modified darting gun barrel through a training course based on the handbook and administered by the WIP Committee.

The Chairman of the AEWC and the Chairman of the WIP Committee have worked together providing training courses in Barrow.

2005-2006 Training/Certification Sessions
Harry Brower, Chairman of the AEWC, and Eugene Brower, Chairman of the AEWC's WIP Committee conducted training and certification sessions for captains and harpooners in the villages of Nuiqsut and Kaktovik in August 2005 . The Chairman of the WIP Committee, with the assistance of an AEWC staffer, conducted a training and certification session in the village of Wainwright in March 2006.

Training and certification are focused on the function and proper use of the penthrite projectile and the modified darting gun barrel. During each village session, the Chairmen cover how to prepare the penthrite projectile and how it works with the modified barrel.

As with all WIP training sessions, great emphasis is placed on the importance of striking the whale between the base of the neck and the diaphragm, since explosion in the thoracic cavity will lead to rapid insensibility and death. The sessions thus far have gone extremely well. Six captains in Nuiqsut, nine captains in Kaktovik, and eight captains in Wainwright all received their certification along with a penthrite projectile and modified barrel.

2007-2008 Training/Certification Sessions
With a new shipment of penthrite projectiles from Henrikson Mek. Verkstad received in February, 2008, the AEWC completed training and certification for the Villages of Pt. Lay, Wales and Little Diomede. The AEWC is seeking travel funds for training and certification in the remaining three villages – Pt. Hope, Savoonga, and Gambell.

HUNTING EFFICIENCY AND RECOVERY METHODS

The AEWC made a commitment to the IWC in 1978 to increase efficiency in the Alaskan bowhead whale subsistence hunt from an average of 50-percent to an average of 75-percent , and since that time has made improving the efficiency of this extraordinarily difficult and dangerous hunt one of its highest priorities. In recent years the average efficiency rate has been at least 75 percent and in some years has exceeded 80 percent. For the last 11 years (1996-2006) the average efficiency was 79.4% (STD= 0.08). However, efficiency in any given year is heavily affected by sea, ice, and weather conditions during the bowhead migration.

The majority of struck and lost whales occur during the spring hunt because hunting is especially difficult then. The spring hunt is conducted from the edge of the shore-fast ice as the whales migrate north through cracks, called leads, formed between shore-fast ice and the circulating ice pack. Depending on the current and the whale's momentum, ice movement can pull a struck whale under the ice, even if the whale is killed quickly. This happened at least twice during the spring 2006 hunt. When this occurs every attempt is made to recover the whale. Even "stinkers" may be salvaged for muktuk.

The AEWC uses a multi-faceted approach to improving the efficiency of the Alaskan bowhead hunt. In addition to the weapons improvement work, hunters have added "pingers" to some of the floats used in the hunt to increase the chances of recovering lost whales. When a whale is lost, local search and rescue operations will join the hunters in the attempt to locate and recover the whale. Finally, as noted, the AEWC has renewed focus on hunter training, including a return to more traditional methods of training young harpooners, such as target practice using ice/snow banks.

In general, while there can be significant year-to-year variability, the multi-year average represents a substantial improvement over historic rates. See table below.

Year of Hunt	# Landed	# Struck	Efficiency (%)
1996	38	43	88.4
1997	48	66	72.7
1998	41	54	75.9
1999	42	47	89.4
2000	35	47	74.5
2001	49	75	65.3
2002*	39	50	78
2003	35	41	85.4
2004	36	43	83.7
2005**	55	68	80.9

2006	31	39	79.5
2007	41	63	65
2008	31	41	75.6
2009	31	38	81.6
2010	45	71	63.4
13 Year Average of yearly % efficiencies			77.3

Table 1. Efficiency Rates for the Alaskan Bowhead Whale Subsistence Hunt in Recent Years

* Two whales abandoned due to weather, high seas.
** One whale abandoned due to weather, high seas and ice.

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ATTACHMENT I

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.

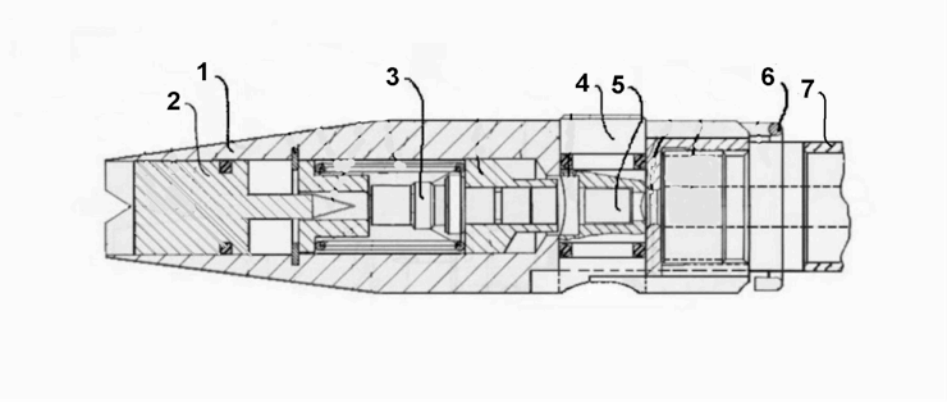
Manner of operation
When the darting gun has been fired, the projectile will plunge into and penetrate the tissues (muktuk and musculature) of the whale. When the front end of the head hits the target, the striking force at penetration will break a shear pin through the plunger allowing the plunger with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

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