

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

Prepared by the Alaska Eskimo Whaling Commission

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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 Diomed on Little Diomed 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 Siberian Yupik 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 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.

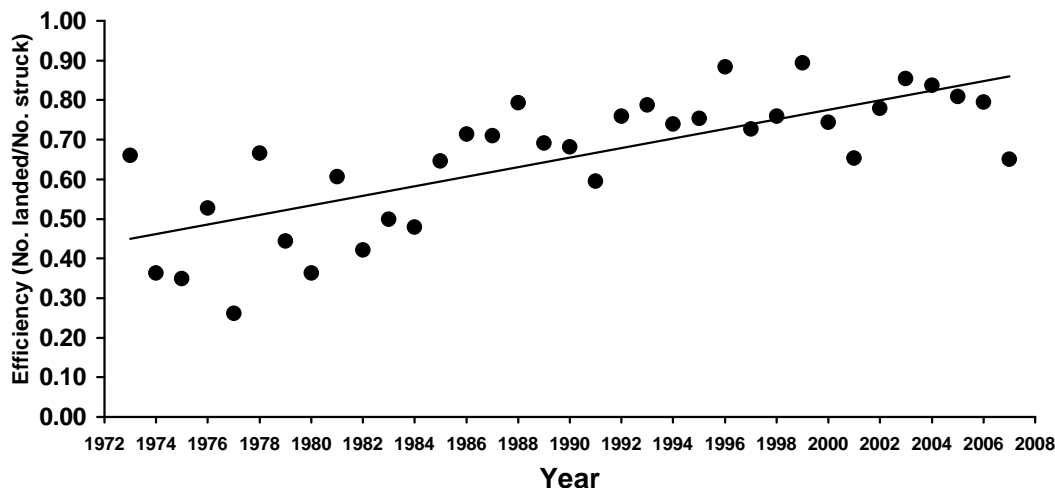
Nine of the eleven subsistence whaling villages hunt in the spring as bowheads migrate north and east from the Bering Sea to the Canadian Beaufort Sea through the spring ice leads. This hunt is conducted from the edge of the shore-fast ice using wood-framed boats made by hand with walrus (St. Lawrence) 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.

Three of the villages hunt in the fall as the bowheads that summer in the Canadian Beaufort migrate west and south through the Alaskan Beaufort Sea and into the Chukchi 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 recent hunt in Barrow, 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 March of 2007, a prominent subsistence hunter from the village of Pt. Hope was killed when sea ice moved in and crushed him while he was opening a trail on the land-fast ice, in preparation for the spring bowhead whale hunt. Added to this is the fact that the effects of climate change have been evident in the Arctic for a number of years, with the rapid shrinking and thinning of the arctic sea ice making the spring bowhead whale subsistence hunt even more treacherous.

Efficiency in the Bowhead 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 subsistence hunt has been at least 75 percent and in some years well above 80 percent.



WEAPONS USED IN THE ALASKAN BOWHEAD WHALE SUBSISTENCE HUNT

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 (Bockstoe, 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 AEWI, 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 AEWI 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 AEWI 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 AEWI Weapons Improvement Program for the Hand-Held Darting Gun

Development of the Penthrite Projectile

Since 1977, the AEWI 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 AEWI'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 "safety and arming mechanism" (SAM). The SAM is designed to ensure that the projectile detonates only after entering the whale's body to a

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

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 shipped and 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, based on recommendations of the IWC and discussions between the AEWG and Dr. Egil Øen, with initial bench test and field trials 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.

Overview of Weapons Improvement Program Work, 2000 – 2008

2000: The darting gun barrel was modified to fit the dimensions of the new penthrite projectile. This work included bench trials in Norway and a review of the use of the new barrel in the 1999 bowhead whale subsistence hunt in Barrow. In February 2000, Dr. Øen, in consultation with the WIP Committee, completed a training manual entitled “The Penthrite Projectile for the Darting Gun Used by the Alaskan Eskimos in the Hunt of Bowhead Whale, a Brief Description of Design and Function.” This training manual is for use in weapons workshops conducted by the AEWG and in hunter training sessions held by the AEWG or AEWG Commissioners in the villages outside of Barrow prior to distribution of the penthrite grenades in these villages.

2001: During the 2001 AEWG Mini-Convention, Dr. Øen conducted a lecture on the use of the penthrite grenade and the modifications being made to the darting gun barrel.

2002: A second modified darting gun barrel, the brass “Triple B” or “Super Barrel” was designed to address problems arising with the first modified barrel. Materials to be used in the manufacture of the barrel were subjected to metallurgical tests and quality control bench trials to ensure that the materials are fully reliable for use with the Proto 2 modified darting gun barrel design. In addition, Dr. Øen consulted with the WIP Committee on proposals for a modification to the design of the tip of the SAM and for a redesign of the tubular body of the penthrite grenade where it is attached to the connector used to join the SAM to the tubular body of the grenade. The modification to the tip of the SAM was for purposes of reinforcing the construction and reducing the likelihood that the metal cutouts will bend upon impact with bone. The redesign of the tubular body at the connection joint was for purposes of reinforcing that joint, which had shown signs of weakness in field trials. Included with these modifications was a change of the penthrite charge from penthrite fuses to pressed penthrite. The modifications were incorporated into the 2002 batch of penthrite grenades, following qualification tests and bench trials.

2003: After receiving comments from the AEWG at its third quarterly meeting in 2003, Dr. Øen and the WIP Committee completed the Training Manual for use of the penthrite projectile and modified darting gun barrel in the Alaskan bowhead whale subsistence hunt. The manual describes and demonstrates correct and effective use of the new equipment.

2004: Based on field trials in Barrow, the WIP and Dr. Øen decided that further modifications of the “Triple B” or “Super Barrel” would be needed. Dr. Øen prepared specifications and the AEWG located an American manufacturer (Addendum III to the WIP Scope of Work). While the redesign was successful, the manufacture resulted in a barrel with a diameter too narrow to accommodate the penthrite grenade. Therefore, the AEWG engaged Dr. Øen to identify alternate tubes for the penthrite projectile, with a smaller diameter to accommodate the new barrels. Dr. Øen identified the new tubes and in consultation with Johnnie Mathiassen at Henriksen mek. Verksted confirmed the design drawings for the penthrite projectile using the new, narrower tubes. Finally, Dr. Øen designed and implemented a test program for fabric acceptance control of the new projectile tubes, using a small batch of penthrite projectiles manufactured by Henriksen mek. Verksted.

In addition to the above, during 2004 it became necessary for Henriksen mek. Verksted to locate new suppliers for certain components of the grenade head (SAM). Dr. Øen conducted quality control and safety tests on all technological components purchased from the new suppliers. The new, narrower tubes were used in the 2004 batch of projectiles ordered by the AEWG, based on quality control tests of the redesigned projectiles, including

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

qualification of a modified tip and reinforced connector for the SAM. All quality control tests were overseen by Dr. Øen.

Dr. Øen and Eugene Brower, the Chairman of the WIP Committee, conducted a Weapons Workshop/Hunter Training Session during the AEWI Mini-Convention in February 2004, continuing the training of AEWI Commissioners and senior hunters from each village in the use of the penthrate grenade and the darting gun with the modified barrel.

The WIP Committee consulted with Dr. Øen on the development of a village training program for each village and a quality control program for evaluating: (1) the readiness of the hunters in each village to use the penthrate projectile, (2) the results of initial use of the penthrate projectile with the modified darting gun barrel in each village, and (3) a written process for tracking the use of penthrate projectiles in each village and for providing ongoing evaluation of the results obtained with the penthrate projectile and the modified darting gun barrel.

2007: Dr. Øen and the Chairman of the WIP Committee conducted a Weapons Workshop during the AEWI Mini-Convention in February 2007, continuing the training of AEWI Commissioners and senior hunters from each village in the use of the penthrate grenade and the darting gun with the modified barrel.

2008: At the February 2008 Mini Convention meetings in Barrow Dr. Øen gave a lecture reviewing the history and the development work of the current penthrate grenade now implemented in Alaska Eskimo's subsistence hunt for bowhead whales, for the AEWI Commissioners, senior hunters from each village, representatives of Association of Traditional Marine Mammal Hunters of Chukotka, Russian Federation, representatives from NOAA administration, members of the AEWI staff, Barrow scientists and people from the villages. He explained that the main reason for the relatively long time it had taken to finish the development and to implement the penthrate grenade in the bowhead whale hunt was the small number of whales that were taken each year with the penthrate grenades. It was necessary to collect enough data and information on function and reliability of the grenade and in particular the built-in arming and safety devices before the equipment could be approved and recommended to be used by the hunters. A cautious, step by step, approach had therefore been chosen. The new grenade also had to be adapted to the traditional darting gun, which is a very old fashioned low-tech weapon.

In his lecture Dr. Øen also explained the rapid fatal effect on the whale from an intra body detonation of penthrate and the importance of hitting the whale in the most vital and vulnerable body area. The function of the built-in safety and arming devices was explained in some detail and the hunters were reminded of the importance of training and maintenance of the hunting gear to maintain proper function. Data sampled earlier from hunts with the penthrate grenade prototypes and the traditional black powder grenade showed that both time to death for the whales and the number of grenades used for each whale was significantly reduced using the penthrate grenade. Also losses of struck whales were reduced. The conclusion was that the current penthrate grenade not only was much safer for the hunters but also more effective compared with the traditional black powder grenade.

Use of the Penthrate Projectile in the Alaskan Bowhead Whale Subsistence Hunt (2003-2006)⁴

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

As discussed above, field trials of the penthrate projectile and modified darting gun barrel continued in Barrow through 2004. During the 2003 Alaskan bowhead hunt, five whales were taken with penthrate 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 penthrate projectiles and modified darting gun barrels performed properly. Two of the whales taken with penthrate stopped moving almost immediately after being hit with the penthrate explosive (03B3, 03B4).

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

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

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 AEWG WIP Committee and Dr. Øen determined that field trials could be concluded and the penthrate 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 penthrate projectile were given a projectile and new darting gun barrel.

During the 2005 spring hunt, two whales were taken in Barrow with the penthrate 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 penthrate, two in Barrow, one in Nuiqsut, and three in Kaktovik. A minor malfunction occurred when one of the penthrate 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 penthrate 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 Diomed, 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 penthrate 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 penthrate, 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 penthrate projectile and the modified darting gun, and were described as “instant kills.” Four whales were taken in Nuiqsut; one of these was taken using penthrate and the modified darting gun. The whale was reported to have died very quickly. In Kaktovik, three whales were landed, but none using penthrate and the modified darting gun.

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

As with other recent years, the 2007 spring bowhead whale subsistence hunt suffered from challenging sea ice and weather conditions. These conditions especially affected hunters at Point Hope and Barrow during spring. Of the 63 whales struck during the 2007 hunt, six were taken in Barrow using the new hunting equipment. Three of these whales were reported as instant kills. One whale in Nuiqsut was taken with a penthrate grenade.

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

Of the 50 whales struck during the 2008 bowhead whale subsistence hunt, three were taken with the new equipment, two in Barrow and one in Wainwright. One of the Barrow whales was reported as an instant kill.

HUNTER TRAINING AND CERTIFICATION

Hunter training is an ongoing priority of the AEWG 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 AEWG 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 AEWG’s commitment to hunter safety, a key component of the AEWG’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 these items, working in cooperation with Dr. Øen. The handbook was published in February of 2004, and **the AEWG now requires that**, before they are entitled to receive penthrate projectiles or a new darting gun barrel, **all captains must be certified** in the use of the penthrate projectile and modified darting gun barrel through a training course based on the handbook and administered by the WIP Committee.

The Chairman of the AEWG 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 AEW, and Eugene Brower, Chairman of the AEW'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 AEW 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 penthrate projectile and the modified darting gun barrel. During each village session, the Chairmen cover how to prepare the penthrate 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 penthrate projectile and modified barrel.

2007-2008 Training/Certification Sessions

The AEW received a new shipment of penthrate projectiles from Henrikson Mek. Verkstad in February, 2007, and completed training for the Village of Pt. Lay. The AEW has received a travel grant that will be used to fund training for Wales and Little Diomed in the coming months. The remaining three villages – Pt. Hope, Savoonga, and Gambell – will receive their training as funding becomes available.

HUNTING EFFICIENCY AND RECOVERY METHODS

The AEW 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 AEW 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 AEW 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 overleaf.

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

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	38	50	76
13 Year Average of yearly % efficiencies			78

* Two whales abandoned due to weather, high seas.

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

In 2007, 63 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 41 animals landed. Total harvest for 2007 was similar to recent years. The average number of whales landed in the 10 previous years was 41.1 ($SD = 7.5$).

The efficiency (# landed / # struck) of the hunt was 65%, which is lower than the average during 1997-2007 (mean = 77.3%, $SD = 7.7\%$). Challenging sea ice, weather conditions, equipment malfunctions, and struck whales diving under the short-fast ice contributed to a lower efficiency in 2007 compared to the previous 10 years. These conditions especially affected hunters at Point Hope and Barrow during spring. The spring hunting efficiency was 61% compared to 76% for the autumn.

In 2008, 50 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 38 animals landed. Total landed for 2008 was similar to the average over the past 10 years (1998-2007: mean = 40.4; $SD = 7.1$). The efficiency (# landed / # struck) of the hunt was 76%, which is higher than the average during 1998-2007 (mean = 65%, $SD = 8\%$). The efficiency of the spring hunt was 60% compared to an autumn efficiency of 92%.

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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 (Pentaerythritol 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.

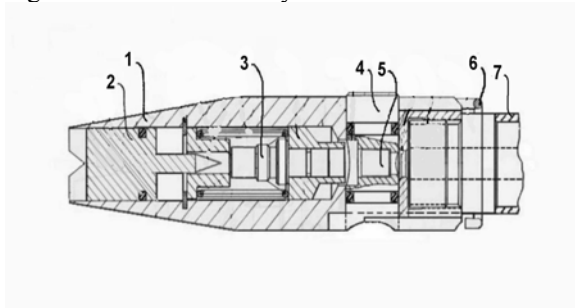
Having been activated by the striker pin, the time delay fuse starts burning and continues burning for approximately 4.5 seconds.

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.

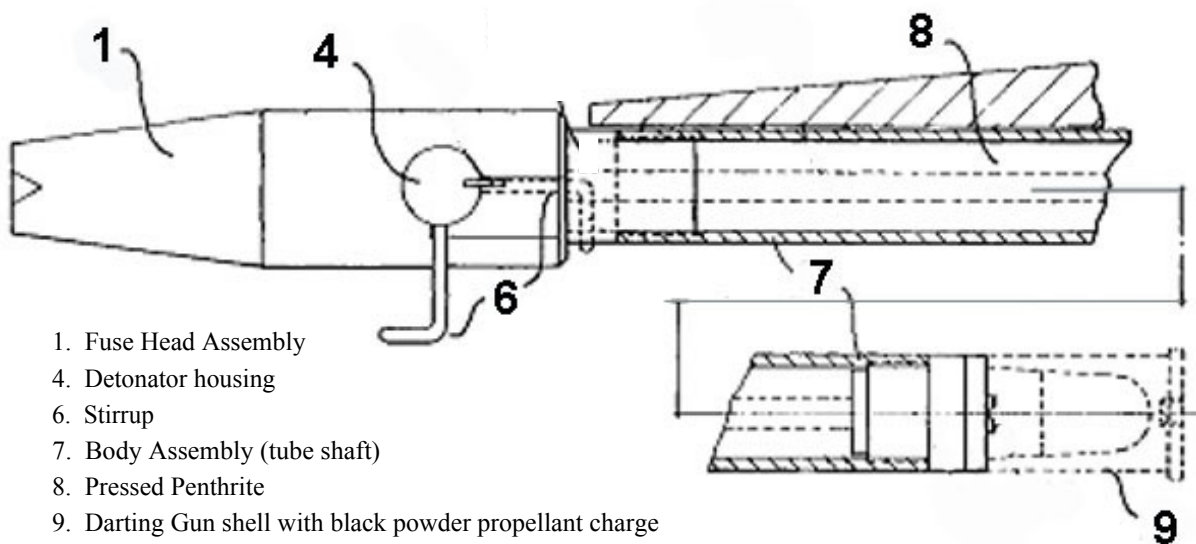
Diagram of penthrite projectile for Bowhead whale

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



1. Fuse Head Assembly
4. Detonator housing
6. Stirrup
7. Body Assembly (tube shaft)
8. Pressed Penthrite
9. Darting Gun shell with black powder propellant charge