

**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 AEWK 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 Diomedé on Little Diomedé 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 AEWK 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.

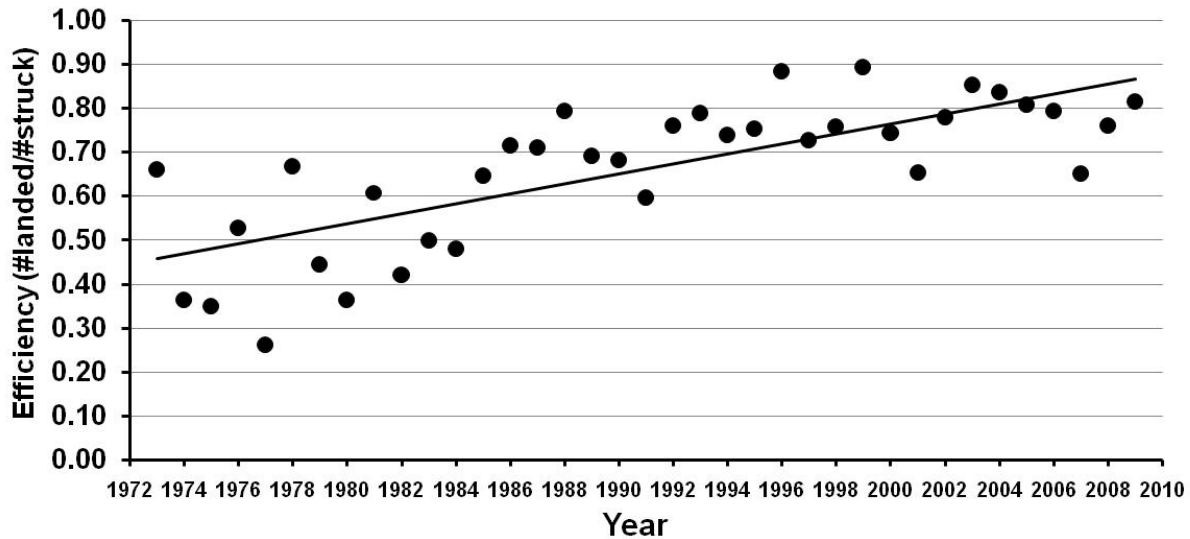
Nine of the eleven subsistence whaling villages hunt in the spring as bowheads migrate north and east from the Bering Sea to the Canadian Beaufort Sea through the spring ice leads. This hunt is conducted from the edge of the shore-fast ice using wood-framed boats made by hand with walrus (St. Lawrence)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

Efficiency in the Bowhead Subsistence Hunt

Historically, the efficiency in the bowhead whale subsistence hunt averaged approximately 50 percent. In 1978, the AEWK 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).

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

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 AEWG 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 AEWG 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 AEWG 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 AEWG Weapons Improvement Program for the Hand-Held Darting Gun

Development of the Penthrite Projectile

Since 1977, the AEWG 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 AEWG'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 1998.²² 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.

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.

²² For a more detailed review of early modifications to the penthrite projectile, see Appendix A to Alaska Eskimo Whaling Commission, 1995

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.³³

Use of the Penthrite Projectile in the Alaskan Bowhead Whale Subsistence Hunt (2003-2009)⁴⁴

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 AEWI 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.

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 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 penthrite on the second whale and reported a very short time-to-death. At

³³ For a detailed overview of the AEWI 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.

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.

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, Alaska

Five whales were taken in Barrow using the penthrate 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 penthrate 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 penthrate projectile, and reported as an instant kill. A second penthrate projectile was used in Barrow as a secondary strike. One whale was taken in Wainwright using a penthrate 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 AEWEC 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 AEWEC 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 AEWEC's commitment to hunter safety, a key component of the AEWEC'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 AEWEC 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 AEWEC 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 AEWEC, and Eugene Brower, Chairman of the AEWEC'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 AEWEC 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

With a new shipment of penthrate projectiles from Henrikson Mek. Verkstad received in February, 2008, the AEWC completed training and certification for the Villages of Pt. Lay, Wales and Little Diomed. 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.

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	31	10	76
2009	31	7	82
12 Year Average of yearly % efficiencies			78.34

* Two whales abandoned due to weather, high seas.

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

In 2009, 38 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 31 animals landed. Total landed for 2009 was a bit less than the average over the past 10 years (1999-2008: mean = 40.1; SD = 7.2). The efficiency (# landed / # struck) of the hunt was 82%, which is about the average during 1999-2008 (mean = 78%, SD = 8%). Spring hunts are logistically more difficult than autumn hunts because of cold weather conditions and the dynamic physical challenges associated with hunting whales in sea ice. Typically, hunt efficiency during spring is lower than autumn. In 2009, however, the efficiency of the spring hunt (85%) was somewhat similar to the autumn efficiency (80%). This is likely due to the extremely difficult environmental conditions during spring 2009, which resulted in relatively few strikes at Barrow, Wainwright and Point Hope. The few strikes that were used were mostly successful. Of the landed whales, 18 were females, 12 were males, and sex was not determined for one animal. Based on total length, 6 of the 18 females were presumed mature (>13.4m in length). Two of the mature females were examined closely. One was pregnant with a 1.63m female fetus and the other was not pregnant. The other mature females were not closely examined as biologists were either not stationed in the villages or the whales were butchered in the water and access to internal organs was limited. Two landed whales were female calves; 6.2 and 6.6m in length. Both animals were taken during the autumn. Fall calves are nearly the size of yearlings and the hunters mistakenly thought these animals were independent subadults.

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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.

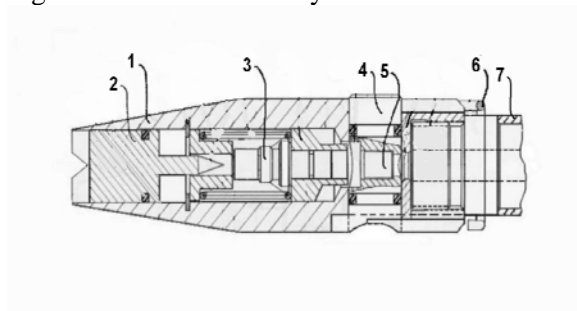
Upon further penetration of the head, the “stirrup” will be hit by the surface of the whale, disrupting another shear-pin and moved to a position flush with the shaft. At this movement of the stirrup, a detonator is moved in a position where it can be ignited by the delay fuse. At the rotation movement

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.

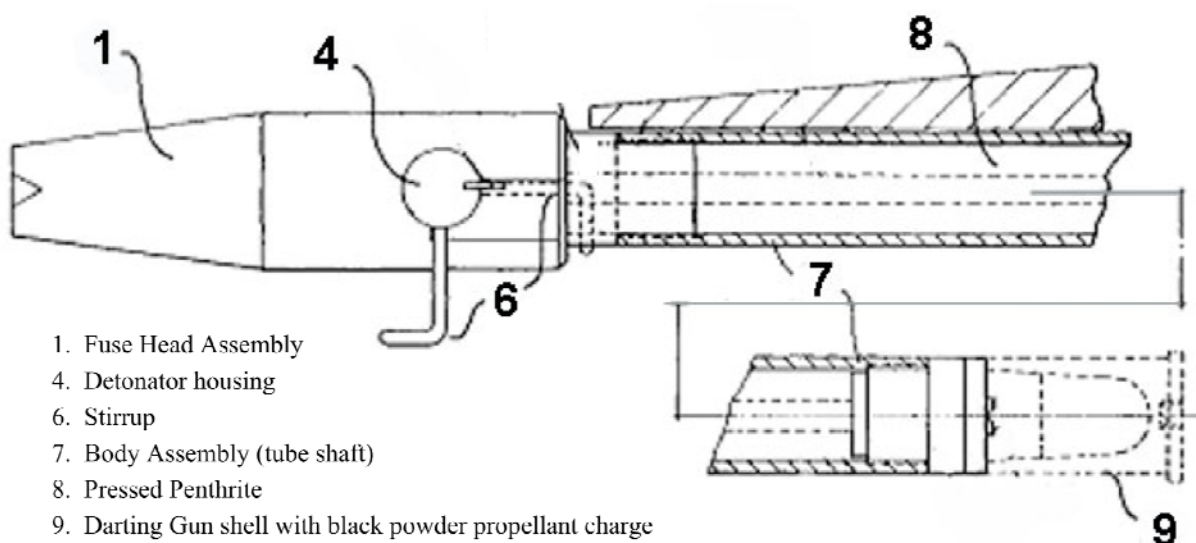
Diagram of penthrite projectile for Bowhead whale

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