ABUNDANCE, DISTRIBUTION, AND MOVEMENTS OF BELUKHA WHALES IN WESTERN AND NORTHERN ALASKA. PHASE 1: DEVELOPMENT AND TESTING OF TAGS AND ATTACHMENTS.

Final Report for the Period
July 1, 1984 through June 30, 1985

for

North Slope Borough
Contract No. 84-165

from

Lloyd F. Lowry, Kathryn J. Frost, and Robert R. Nelson
Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska 99701

Submitted to

Department of Conservation and Environmental Protection
North Slope Borough
Box 69
Barrow, Alaska 99723

31 December 1985

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DISCLAIMER

The opinions, findings, conclusions, and recommendations expressed in this report are those of the authors only and do not necessarily reflect the views of the North Slope Borough.

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I. INTRODUCTION

The population of belukha whales (Delphinapterus leucas) that inhabits the Bering, Chukchi, and Beaufort seas constitutes a resource of considerable importance to coastal residents. In recent years, total harvest in Alaska has ranged from 138 to 247 animals. Large numbers are taken at Elephant Point, Kivalina, Point Hope, Point Lay, and sometimes Wainwright and Barrow. An additional 100-150 are taken in the Mackenzie Delta area (Burns and Seaman 1985). Although these harvests have had no measurable effect on the belukha population, they are of some concern to management agencies such as the International Whaling Commission. The potential effects of commercial fisheries and offshore oil and gas development on belukhas are also of concern. Virtually the entire range of this population is scheduled to be leased for oil and gas exploration over the next few years.

Belukhas off Alaska show major seasonal shifts in distribution. The primary known wintering areas are in the seasonal pack ice of the Bering Sea. In spring, some belukhas move north through leads in the Chukchi Sea pack ice, while others appear at the mouths of major rivers entering Bristol Bay. During summer, concentrations of belukhas occur in western Canada near the Mackenzie River delta and at several locations along the Alaskan coast including Bristol Bay, the Yukon-Kuskokwim delta, Norton Sound, Kotzebue Sound, and Kasegaluk Lagoon. Few belukhas are seen in the coastal zone after October. Migration southward and offshore appears to occur during October through December (Seaman et al. 1985).

Four general categories of information are needed to develop a scientifically based program for conservation and utilization of belukhas. First, because most belukha hunting occurs near summering areas, it is necessary to find out the interrelationships among summering groups. Is the group of whales that appears at Wainwright composed of the same animals that occurred earlier at Point Lay and Elephant Point? Do the same whales return to the same areas every year? Answers to these questions will allow us to determine whether belukhas occurring off western and northern Alaska are a single stock, or whether some or all of the summering groups should be considered separate stocks for management purposes. Second, we need to know the number of whales in each group or "management unit." Estimates of abundance need to be precise enough that changes in numbers can be detected. Third, we need to know the vital parameters of belukhas, particularly the rates of reproduction and mortality. These figures are needed to estimate things such as sustainable harvests and the time required for a stock to recover if it were depleted by an event such as an oil spill. Lastly, we need to know many things about the basic biology of belukhas so that critical seasons and locations can be identified, and the possible effects of human activities at those times and places can be predicted.

Since 1978 the Alaska Department of Fish and Game has been conducting a research program which has addressed these and other questions of importance for conservation and management of belukhas in western and northern Alaska. The program has been conducted with funding provided by NOAA/OCSEAP and in cooperation with the North Slope Borough. The program has had two basic components. The first examined the basic biology of

belukhas primarily through analysis of specimens collected from subsistence harvests. That component is largely completed and the final report has been submitted (Burns and Seaman 1985, Seaman et al. 1985). The second component involved development of techniques for marking and following belukha whales, which is the subject of this report.

Attempts to attach radio and visual tags to whales and dolphins have met with limited success. Major problems encountered have been catching or closely approaching the animal to be tagged, and attaching the tag with a devise that will keep it on the whale for an acceptable period of time. In a two-year pilot study in Bristol Bay we attached visual tags to three animals and radio packages to two. The radio-tagged animals were followed for a period of two weeks until the packages came off. This was the first time that free-ranging belukha whales were radio-tagged and tracked in the wild. The study produced significant information on whale movements and respiration patterns (Frost et al. 1985). Other studies in eastern Canada and Bristol Bay have shown that visual streamer tags can be easily applied to belukhas (Lensink 1961, Sergeant and Brodie 1969).

We encountered two problems in tagging belukha whales. The first was catching whales to tag. This problem may be overcome by working jointly with local belukha whale hunters. In 1983, one of us (R. Nelson) accompanied North Slope Borough personnel to Point Lay during the annual belukha hunt. Observations made there indicated a very good possibility for catching and tagging whales in Kasegaluk Lagoon in conjunction with the belukha hunters from Point Lay. The second problem was with the method of attaching the radio tag to the whales. Our radio tags on whales in Bristol

Bay were attached by a nylon pin through the dorsal ridge. The tags stayed on for two weeks (Frost et al. 1985). We need to develop an attachment that will last for at least two months.

II. OBJECTIVES

Our long-term objectives are to:

1. Determine the interrelationships among groups of belukhas summering in coastal waters of the Bering, Chukchi, and Beaufort seas.

2. Determine patterns of use of summering areas and the degree of fidelity to those areas.

3. Identify important areas and habitats for belukhas, the time period during which the areas are used, and the numbers of whales using them.

4. Identify management stocks of belukhas and estimate the abundance and sustainable yield of each.

Our objectives during 1984-85 were to:

1. Coordinate with representatives from the North Slope Borough, Point Lay, and other interested parties to determine the areas most suitable for conducting tagging studies and to design a plan for tagging and tracking belukhas in summer 1985.

2. Design and construct visual and radio tags and attachments.

3. Test application of tags on dead belukhas taken by subsistence hunters.

4. Test application of tags on live, captive belukha whales.

5. Construct and/or purchase tags and equipment required for future field studies.

III. METHODS

Coordination of current activities and design of future studies was accomplished by discussions and correspondence among interested parties. The North Slope Borough Science Advisor (Dr. Tom Albert) was the principal contact for coordination with local residents. In addition, one of the principal investigators (R. Nelson) traveled to Point Lay during 8-10 July 1985 to discuss belukha whale tagging with members of the community.

The principal investigators provided input on information needs regarding belukha whales at a variety of conferences and workshops, and in responses to study plans produced by various agencies. Research needs were discussed with agency and university representatives from the United States and Canada, and information relative to tagging small cetaceans was exchanged.

Our efforts to design visual and radio tags for use on belukha whales began with studies funded by NOAA/OCSEAP in Bristol Bay (Lowry et al. 1982, Frost

et al. 1985). During those studies we tested two types of radio tags: a Telonics[1] "barnacle tag," and an OAR[2] "backpack." Tests were done primarily to determine the probable reception range of the transmitters and the suitability of attachment mechanisms for use on belukha whales. Results indicated that while the OAR transmitter provided much better reception with antennas at or near ground level, both radios provided adequate reception at a distance of 44 km with antennas on a helicopter at an altitude of 305 m (Lowry et al. 1982). Both types of tags were applied to the carcass of a recently dead, 296.5 cm long, male belukha. The OAR backpack fit well but was somewhat difficult to apply. The Telonics barnacle tags were easy to apply and appeared satisfactory from the surface. However, when the tissue was dissected from around the attachment it was found that the attachment tines had not splayed properly and had penetrated through the skin and blubber and into the muscle. Attempts to reduce the depth of penetration by increasing the curvature of the tines were only partially successful (Lowry et al. 1982). We therefore concluded that the attachment mechanism on the barnacle tag required further development and testing.

OAR backpacks were applied to 2 belukhas in Bristol Bay in June 1982. The radio tags each stayed attached to the animal for only 2 weeks. The large size of the radio package in relation to the amount of tissue involved in the attachment apparently caused the attaching pin to migrate through the tissue (Frost et al. 1985).

Based on our observations, and the fact that Telonics transmitters attached to gray whales (Eschrichtius robustus) with metal tine attachments have

been very successful (Mate et al. 1983), we decided to redesign the barnacle tag for use on belukhas. Our primary concerns were to: 1) insure that the attachment tines spread adequately and penetrated only the skin and blubber and not into the muscle; 2) to increase the probable transmission life of the radio by increasing the number of batteries, without substantially increasing the package size; and 3) to produce a tag that could be more easily serviced than the existing Telonics barnacle tag. The transmitter used was identical to that in the original Telonics barnacle tag: 40 milliwatt power output, 35 millisecond pulse width, pulse rate 120 per minute, and high-shock crystals.

We contracted with Mr. Ned Manning[3] to construct the tags and assist in their design and testing. Modifications were made to the original design of the barnacle tag based on our previous experiences with the OAR and Telonics tags, and engineering and manufacturing constraints.

During our work in Bristol Bay, we attached visual streamer tags to three whales (Lowry et al. 1982, Frost et al. 1985). In order for the tags to be attached, it was necessary to physically capture the whales which was the factor that limited the number of animals tagged. Our observations indicated that it would be possible to tag many more whales if the tag could be applied remotely from a distance of 10 to 15 m. We therefore contracted with Mr. Manning for the design, construction, and testing of a visual tag that could be applied remotely by firing from a 12-gauge shotgun. Design of the tag was based on Mr. Manning's experience with engineering and ballistics, and his design and construction of toggle-head harpoons used by marine mammal hunters.

Two pieces of marine mammal tissue were available on which to test the completed tags: the intact carcass of a 95.8 cm long harbor porpoise (Phocoena phocoena), and the head of a late-term belukha fetus. The radio tag was applied by pushing it by hand until it seated firmly on the surface of the skin. It was then photographed and the tissue dissected away from the tines. The placement of the tines in the tissue was measured and photographed. The tag was applied twice to each tissue specimen. The specimens were judged too small to use for testing of visual tags. Visual tags were tested by firing into a bale of straw covered with 10 mm thick neoprene rubber. Five visual tags were tested.

We had wanted to test our visual and radio tags on captive belukha whales being held at Churchill, Manitoba by Dr. Joe Geraci (University of Guelph). We contacted Dr. Geraci and coworkers regarding this and made preliminary arrangements to travel to Churchill, apply the tags to captive whales, and observe the results. Unfortunately, Dr. Geraci's study was restricted to evaluation of tissue reaction to implanted materials and he did not wish to attach objects such as tags that produced hydrodynamic drag. Tests of our tags could therefore not be accommodated in his experimental protocol. On 15 August 1984, we submitted a modified proposal budget to the NSB indicating that this trip had been cancelled and reducing the contract funding to reflect the cancellation.

IV. RESULTS

A. Radio tags

The new design of VHF radio tag and attachment is shown in Figure 1. The radio with attachment weighs 450 g and when attached to the animal will have a height of 5.5 cm. Diameter of the base plate is 9.1 cm and diameter of the radio is 5.6 cm. Electronics consist of a VHF transmitter (frequency 164-165 MHz) connected to six 2/3 A lithium batteries and a 47 cm long semi-rigid stainless steel whip antenna. Transmitter and batteries are enclosed in a vacuum-sealed type 304 stainless steel canister with a thickness of 0.13 mm on the sides and 0.32 mm on the top and bottom. Based on standard engineering tables, the canister strength is predicted to be adequate to withstand water pressure at a depth of 1,000 meters.

The radio cannister is attached by screws to a Lexan plastic base piece on which are hinged 6 curved stainless spring-steel tines, 2.4 mm in diameter and 6.3 cm long. The tines are set in such a way that the tips will enter the skin of the animal at exactly the point where the basal ends will be when the tag is fully deployed. When deployed, the tines spread to a diameter of 18.0 cm and are prevented from moving by a spring-steel retaining ring in a groove in the Lexan base. Curvature of the tines was designed such that the maximum depth of penetration into the skin and underlying blubber would be 3 cm.

The transmitter was tested for water-tight integrity on 12 August 1985 in Prince William Sound, Alaska. It was activated and submerged to a depth of 150 m for 10 hours. When checked after being brought back to the surface, it was still transmitting properly.

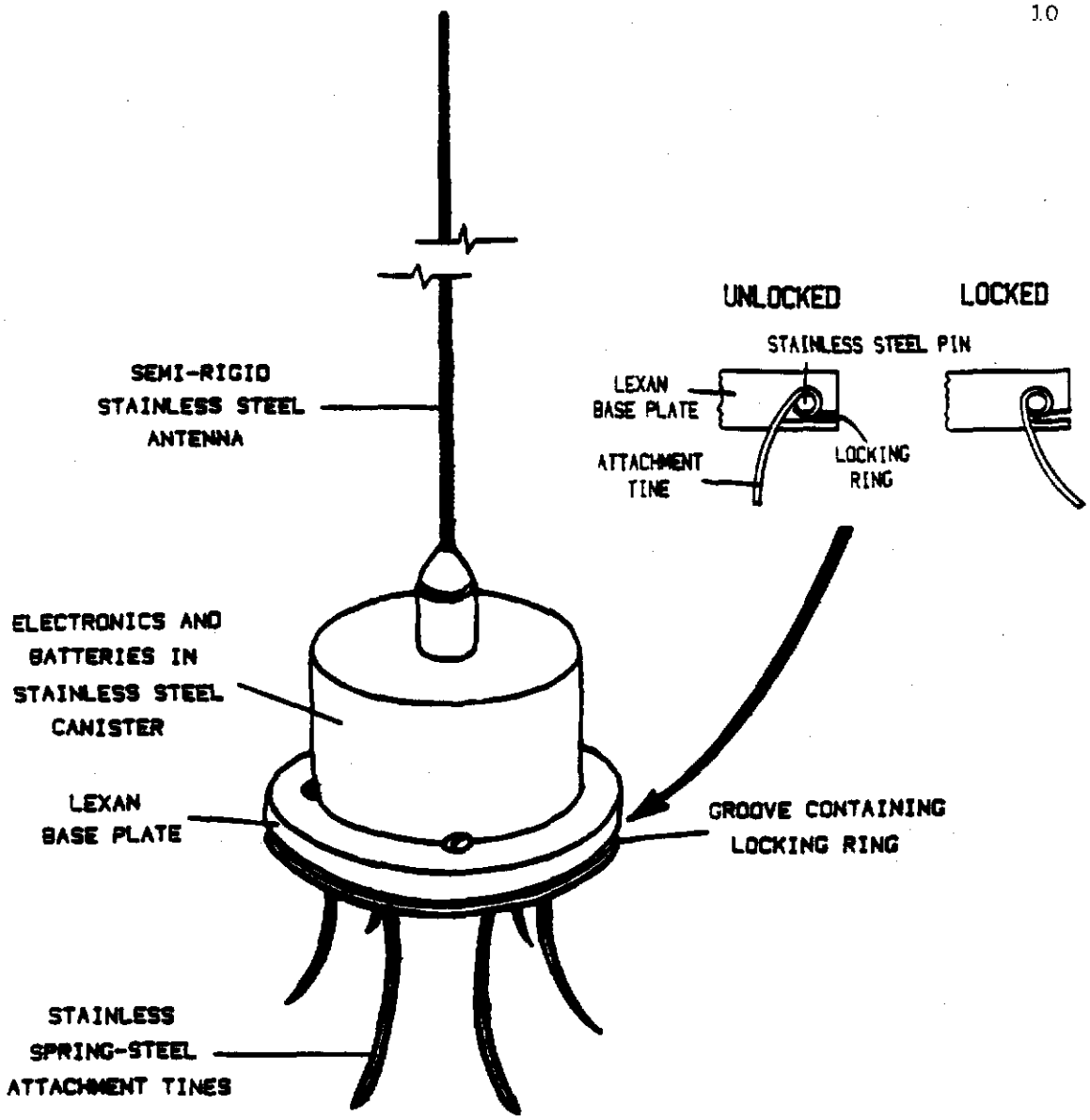

Figure 1. Diagram of the redesigned barnacle tag. Diagram is not to scale, see text for specifications and measurements.

When tested on marine mammal tissue, application of tags required a light to moderate amount of pressure. The attachment mechanism functioned exactly the same during all applications on both types of tissue. Maximum penetration of the tissue was to a depth of 2.9-3.0 cm with the tips of the tines lying at a depth of 2.5-2.6 cm (Figure 2). When the tine locking ring was removed and the transmitter gently pulled off the tines exited through their entrance holes leaving barely noticeable holes approximately 1 mm in diameter in the surface of the skin.

B. Visual tags

Visual streamer tags were constructed of brightly colored (red, yellow, and blue) polyvinyl chloride fabric 0.25 mm thick, and measured 3.8 cm wide and 32.0 cm long. Streamers are attached by 0.07-mm diameter stainless steel wire to a toggling head (Figure 3). The head is 0.38 mm long constructed of type 304 stainless steel rod with maximum diameter of 6.1 mm, and is slightly curved and tapered at both ends. It is designed to penetrate the tissue of the animal to a depth of 5 cm when toggled.

Visual tags were designed to be fired from a 12-gauge open-choke shotgun. The streamer portion is wrapped around the shaft connected to the head and inserted into a standard plastic 12-gauge cartridge with a primer and five grains of type FFFG black powder[4]. The front end of the cartridge is then partially crimped around a brass disc which serves as a stop to limit penetration.

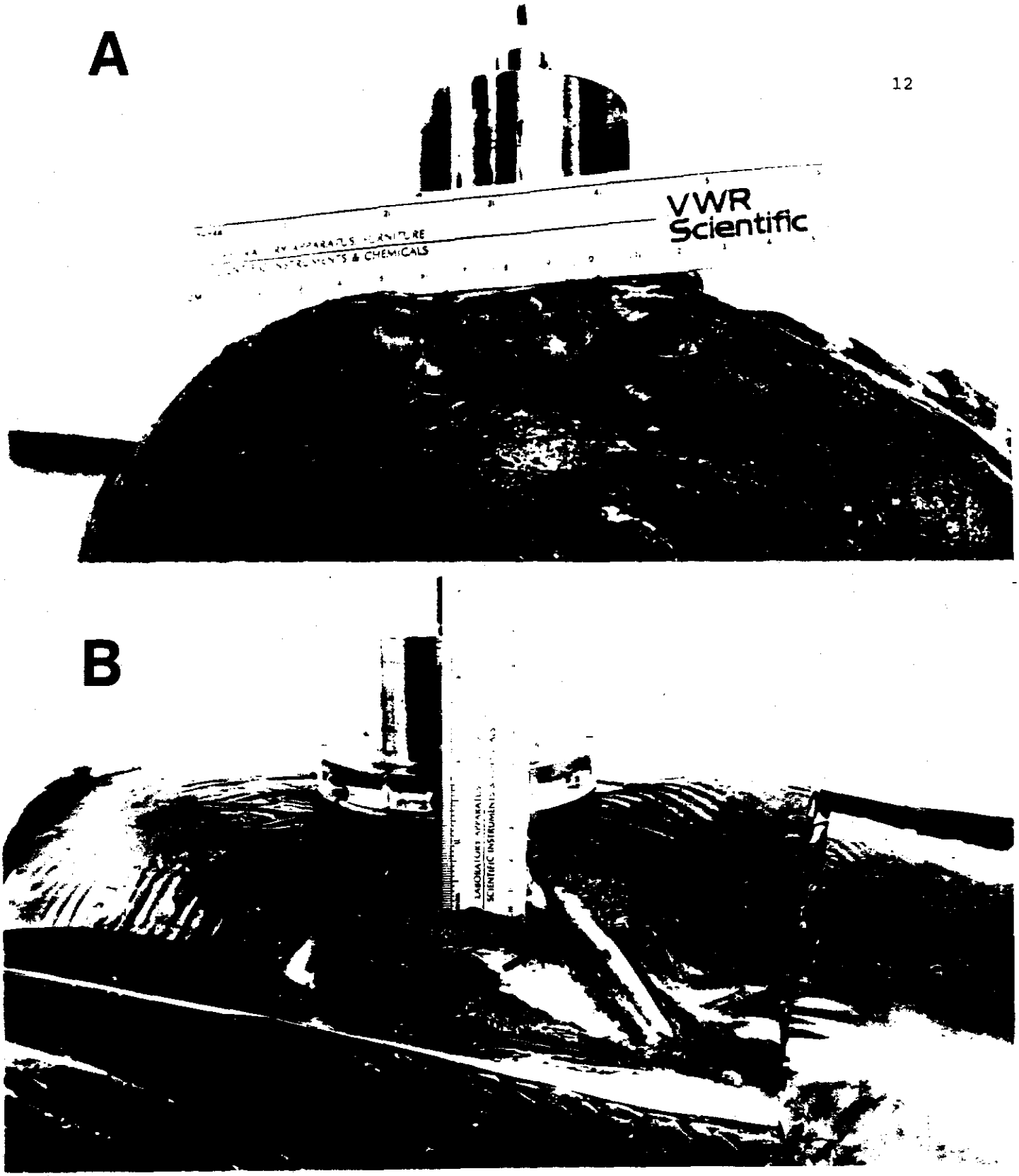

Figure 2. Photographs of the radio tag attached to the head of a belukha fetus (A) and the side of a harbor porpoise (B). Arrows indicate the position of attachment tines.

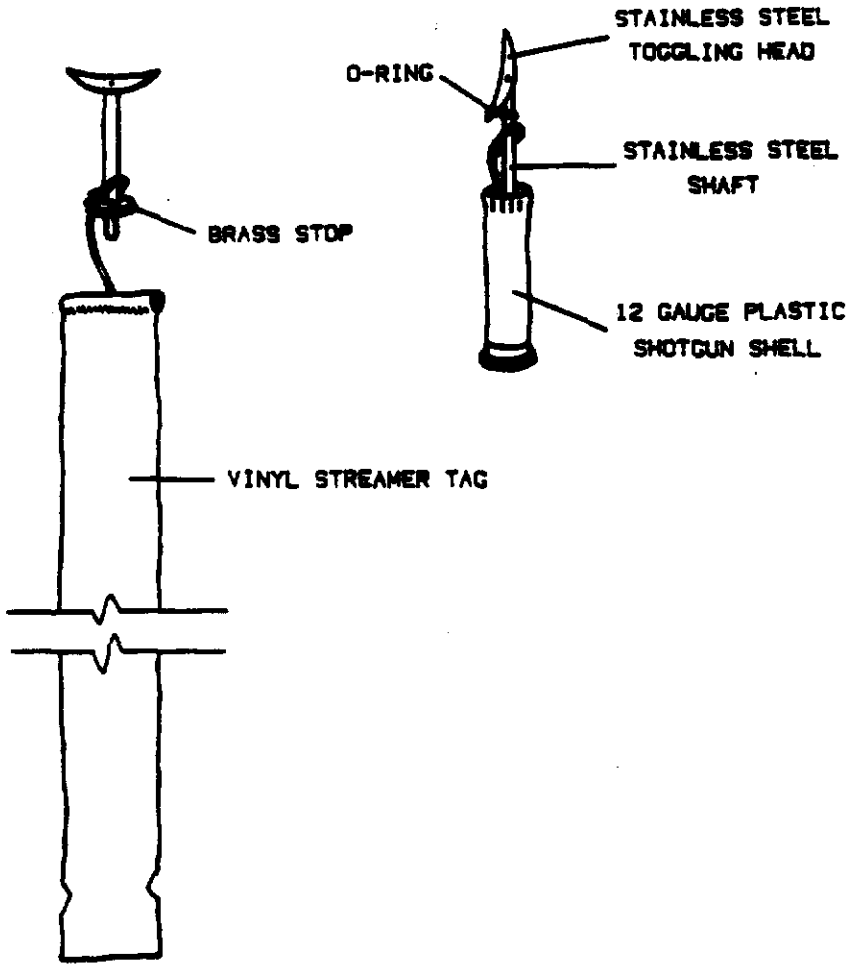

Figure 3. Diagram of the visual streamer tag, deployed (left) and loaded for firing from a shotgun (right). Diagram is not to scale, see text for specifications and measurements.

When visual tags were fired into a bale of straw covered with 10 mm thick neoprene rubber from a distance of 20 m, it was usually possible to hit within 10 cm of the point of aim. The head of the tag penetrated the rubber and toggled properly in the straw when a gentle pull was applied to the streamer.

We were not able to test the visual tags on belukha tissue because a sample of adequate size and blubber thickness was not available.

C. Coordination and planning for future studies

Without further development of deployment mechanisms, whales must be captured before radio tags can be attached. Whales can be live-caught either by using nets or by driving them into shallow water using boats.

Based on our previous experience Point Lay appeared to be a good location to institute a tagging program in coordination with the efforts of subsistence hunters. The extensive shallow water of Kasegaluk Lagoon provides excellent opportunities for driving whales ashore, and belukhas occur here virtually every year. In some years, hunters drive ashore more whales than are needed for food and some animals are allowed to return to sea. One of us (R. Nelson) went to Point Lay during 8-10 July 1985 to discuss the matter of belukha whale tagging with local residents and to observe belukha hunting activity. At that time, two of the more active hunters were out at camp and no hunting activity was occurring near town. Conversations with residents indicated that only one belukha had been taken during the 1984 season. Our contacts later indicated that 18 whales were taken during 1985.

Research plans for future studies of belukha whales have been developed. A proposal and budget was submitted to the United Nations Environmental Program (Appendix I). This study was given a priority rating of "high", but no funds to conduct the work have been made available.

V. DISCUSSION

The radio tag and attachment which we developed is a modification of the umbrella anchor attachment designed and described by Mate et al. (1983), and the barnacle tag produced by Telonics, which we previously tested on belukha whale carcasses (Lowry et al. 1982). When we tested the Telonics barnacle tag on belukha carcasses we found that the tines did not splay reliably; they penetrated too deeply (up to 6.8 cm) and did not spread adequately. We redesigned the attachment so that the tines were hinged instead of rigidly attached to the base plate. This allowed each tine to freely follow a trajectory through the tissue which was determined by the curvature of the tine. We tested the attachment numerous times on styrofoam blocks and 4 times on marine mammal tissue. Every time the tines followed the same path during implantation and penetrated to a maximum depth of 3.0 cm. On a belukha whale, the tines will penetrate through the skin and blubber without contacting the muscle tissue (Figure 4). It is generally thought that muscle tissue is more sensitive to foreign objects than blubber and that objects implanted into the muscle are more likely to cause irritation and physiological responses that could lead to tag rejection.

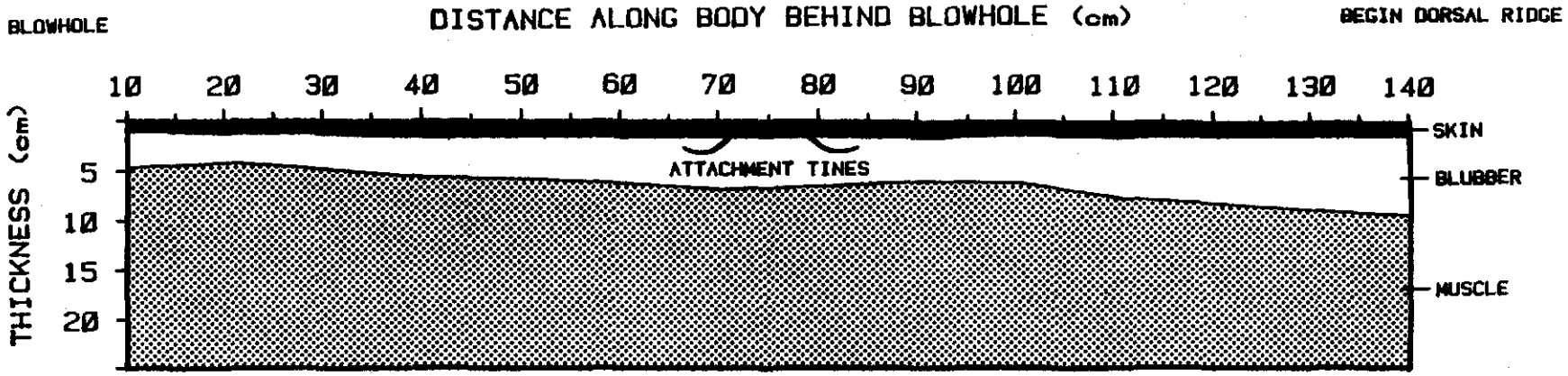

Figure 4. Diagram showing thickness of skin and blubber along the dorsal midline of a 390 cm long belukha whale and depth of penetration of radio tag attachment tines.

During redesign of the attachment system, the electronics packaging was completely revised. The barnacle tags produced by Telonics have the electronics in a metal can that is covered by a hemisphere of polyurethane. The attachment plate with tines is riveted to the bottom of the hemisphere.

Although this system is watertight, its ability to withstand pressure is not known. In the tag we produced, electronics are enclosed in a stainless steel cylinder of known strength. Without substantially increasing the size of the unit it was possible to include 6 lithium cells as compared to 2 in the Telonics tag. The cylinder is closed in a vacuum by placing a stainless steel plate on the bottom which seats against an O-ring. If pressure is applied to the unit, as will happen when it is submerged, the seal can only become tighter. Based on the strength of the stainless steel material, the canister holding the electronics should withstand pressure to a depth of at least 1000 m. The canister is held in the base plate by 3 screws.

If it is necessary to access the electronics, for example, to replace batteries, that can be done much more easily with the new design. In order to get to the electronics in the Telonics barnacle tag, one must break 2 rivets to remove the attachment plate; scrape, cut, or otherwise remove the polyurethane hemisphere; and cut open the can holding the components. In the new design, one removes three screws to separate the canister from the attachment, then the canister is put in a vacuum chamber and the base plate comes off.

A final change we made was the use of a semi-rigid whip antenna rather than the helical coil antenna used in the Telonics tag. The two OAR radios which we applied to belukhas in Bristol Bay had semi-rigid whip antennas and they transmitted exceptionally well. We therefore decided to use this antenna type on the redesigned barnacle tag. Although the whip antenna is much longer than the helical coil (47 cm vs. 22 cm), it is much narrower (2 mm vs. 7 mm) and, therefore, it should not increase the overall hydrodynamic drag.

Differences between the barnacle tag and the redesigned version are summarized in Table 1. The new tag is approximately the same size, weighs about 140 g more, but has three times the batteries and, therefore, a much longer probable duration of transmission. The most marked difference is in the attachment system. With the new system, tines will reliably penetrate to a depth of 3.0 cm and spread to 18.0 cm between the tips.

In November 1985 at the Sixth Conference on the Biology of Marine Mammals (held in Vancouver, British Columbia), the redesigned barnacle tag was shown to several researchers familiar with radio-tagging marine mammals and with the biology of belukha whales. The tag received all positive comments and was considered to be a great improvement over the previous design.

The visual streamer tags that we developed are technically adequate in terms of their ability to be fired from a shotgun and to hit and penetrate a target at a distance of at least 20 meters. Unlike other streamer tags,

Table 1. Characteristics of the original Telonics barnacle tag and the redesigned version.

	Telonics barnacle tag	Redesigned barnacle tag
Transmitter	40 m watt Telonics with high-shock crystals	40 m watt Telonics with high-shock crystals
Antenna	Helical coil, 22 cm long, 7 mm diameter	Semi-rigid whip 47 cm long, 2 mm diameter
Batteries	2 lithium cells	6 lithium cells
Estimated transmitting time	4 months?	12 months?
Transmitter housing	Polyurethane hemisphere 5.4 cm high, 6.8 cm diameter	Stainless steel cylinder 5.5 cm high, 5.6 cm diameter
Maximum waterproof depth	Unknown	1,000 meters
Weight	312 g	450 g
Number of attachment tines	8	6
Tine length	8.0 cm	6.3 cm
Maximum depth of tine penetration	4.8-6.8 cm	2.9-3.0 cm
Spread of deployed tines	16.5-19.0 cm	18.0 cm

such as those manufactured by Floy, our streamers are large and should be clearly visible at a distance of 50 to 100 m. However, questions remain about whether the projectile will adequately penetrate belukha skin and blubber, and how hydrodynamic drag on the streamer will affect retention of the tag head.

Based on our observations at Point Lay in 1985 and reports of hunting success in 1984, it appears that Point Lay may not always be an appropriate location for catching whales to tag. Other options exist where whales can be caught by netting or driving into shallow water, including Kotzebue Sound, Norton Sound, Bristol Bay, and the Mackenzie River estuary. Development of a device that would allow remote deployment of the tag would preclude the need for actually catching the whales and would increase the options for places to conduct tagging.

VI. CONCLUSIONS

We have developed a radio tag and attachment suitable for use on belukha whales. The radio package is small, resistant to water and pressure, and produces signals that should be audible for at least 40 km from aircraft at altitudes of 305 m or more. The attachment mechanism utilizes 6 stainless steel tines that will penetrate to a depth of 3 cm in the blubber and spread to a diameter of 18 cm. We cannot at present predict how live belukha tissue will respond to the attachment tines. Some tests have been conducted to assess the reactions of belukha tissue to implants of various materials but the results are not yet available (Joe Geraci, University of Guelph, pers. commun. November 1985). Tags attached using similar

stainless steel tines have remained attached to gray whales for as much as 27 months (Mate et al. 1983). We expect our tag would remain attached to a belukha whale for at least 2 months. Therefore, although testing of the tag on a live captive belukha would be useful, we conclude that the tag is ready for application to free-ranging belukhas.

The visual streamer tags are technically adequate in terms of their ability to be fired from a shotgun and hit a target at the desired range (10-20 m). However, further testing is required to determine their ability to penetrate and be retained in belukha tissue. Such testing should be conducted on belukha carcasses and, if possible, on live captive belukhas.

No funding is available for further testing of tags or for deployment of radio tags on free-ranging whales. We will continue to solicit funding from appropriate sources for application of radio tags to belukha whales. Since the development, testing, and construction of radio tags has been accomplished by this project, with the support of the North Slope Borough, we are now in a position where field studies of belukha distribution, movements, and behavior can begin as soon as funding becomes available.

VII. *ACKNOWLEDGMENTS*

We gratefully acknowledge the support for this project provided by the North Slope Borough, and by the Bureau of Indian Affairs through the North Slope Borough, Environmental Protection Office. This project could not have been completed without the efforts of Mr. Arthur (Ned) Manning who constructed the tags and assisted in their design and testing. We also thank Dr. Bruce Mate for sharing his original design of the barnacle tag, and for many helpful discussions during our efforts to improve on it.

FOOTNOTES

[1] Telonics, 1300 West University Drive, Mesa, Arizona 85201.

[2] Ocean Applied Research, 10447 Roselle Street, San Diego, California 92121.

[3] Manning Machine and Fabrication, P.O. Box 10013, Fairbanks, Alaska 99701.

[4] Hodgdon Powder Company Inc., 7710 W. 50 Highway, Shawnee Mission, Kansas 66202.

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Appendix I. Research proposal submitted to the United Nations Environmental Program.

PROJECT PROPOSAL

1.1 Title of Project: White whales, Delphinapterus leucas, in Alaskan waters

1.2 Geographical Scope: Coastal waters of southwestern, western, and northern Alaska

1.3 Implementing Organization: Alaska Department of Fish and Game (ADF&G), in cooperation with the North Slope Borough (NSB)*

* The North Slope Borough is a local government with interests in and responsibilities for the people and resources of the northern half of Alaska.

1.4 Duration of Project:

Commencing: July 1985
Completion: December 1987

1.5 Objectives:

Short-term objectives:

a. To attach visual and radio tags to white whales in summering areas and evaluate the effectiveness and utility of tags.

b. To examine movements and habitat-use patterns in summering areas, and fidelity of individuals and groups to specific areas.

c. To examine interrelationships among groups of whales using various summering areas.

d. To determine the numbers of whales summering in various locations along the Alaskan coast.

Long-term objectives:

a. To identify important areas and habitats for white whales, the time period during which the areas are used, and the number of whales using them.

b. To identify management stocks of white whales, and estimate their abundance and sustainable yield.

1.6 Legislative Authority

Global Plan of Action for the Conservation, Management, and Utilization of Marine Mammals, (decision 12/12, Section 1, UNEP Governing Council).

1.7 Background Data:

The white whale (locally known as the belukha), is the most common and significant small cetacean species in coastal waters of western and northern Alaska. They also occur in the northern Gulf of Alaska, particularly in the Cook Inlet region. They are seasonally abundant at a number of coastal locations, where they are sometimes hunted for food by coastal residents. They forage to a considerable extent on commercially important fishes such as salmon and herring, and at times may become entangled and die in fishing gear, particularly gillnets.

White whales inhabiting the Bering, Chukchi, and Beaufort seas as well as the eastern part of the East Siberian Sea are presently considered to comprise a single stock commonly referred to as the western Arctic population. They are most likely isolated from the Cook Inlet population. Movements of Cook Inlet whales are thought to be largely confined to the Inlet, although they range somewhat to the east and west in the northern Gulf of Alaska. The wintering grounds of the western Arctic population is mainly in the pack ice of the Bering Sea. In spring and summer, whales appear in coastal waters, forming significant local concentrations in areas such as Bristol Bay, the Yukon River estuary, Norton Sound, Kotzebue Sound, and the Mackenzie River delta. The interrelationships among animals in these summering groups are very poorly known. Based on temporal distribution patterns, some groups are probably discrete, while in some cases a single group of whales may be seen sequentially at several localities. The degree of interchange among groups during the breeding season and the fidelity, if any, to particular summering areas are unknown. These factors, and others, complicate the assessment of abundance.

The western Arctic population of white whales constitutes a resource of considerable importance to coastal residents. In recent years total harvest in Alaska has ranged from 138 to 247 animals. Large numbers are taken at Elephant Point, Point Hope, Point Lay, and sometimes Wainwright and Barrow. An additional 100-150 are taken annually by Canadians in the Mackenzie Delta area. Soviet Natives living along the Chukchi Peninsula take about 40 animals per year, which are also probably from this stock. Although these harvests have had no visible effect on the abundance of whales, they are of some concern to management agencies such as the International Whaling Commission. The potential effects of commercial fisheries and offshore oil and gas development on white whales are also of concern. A large portion of the range of the western Arctic population is scheduled to be leased for oil and gas exploration over the next few years.

Two types of information are needed in order to plan for the conservation, management, and utilization of white whales in Alaska. First, important habitats must be identified and their role in the biology of the whales must be determined. This information can be used to help prevent or mitigate adverse effects of human activities in marine waters and the coastal zone. Second, management stocks must be identified and enumerated. This information is needed to estimate sustainable yields and to indicate whether regulations on the take of whales may be needed.

Since 1977, the Alaska Department of Fish and Game has been conducting a research program which has addressed these and other questions of importance to the conservation and management of white whales in Alaska. This program has been funded primarily by the National Oceanic and Atmospheric Administration, Outer Continental Shelf Environmental Assessment Program, and the North Slope Borough. This program has involved several components, listed below:

a. Monitoring of the subsistence harvest of whales by Alaska Natives.

b. Determination of biological parameters from whales taken in the subsistence harvest.

c. Determination of the foods utilized by whales in various areas.

d. Examination of distribution, abundance, and movements from aerial surveys and a compilation of available sightings.

e. Examination of the interactions of whales with commercial salmon fisheries in Bristol Bay.

f. Development of techniques and equipment for capturing, tagging with visual and radio tags, and relocating whales.

While this program has produced a significant amount of background data on white whales in Alaska, additional information is needed in order to protect and manage these whales in an ecosystem context. In view of continued directed harvests, interactions with commercial fisheries, offshore petroleum development, and major expansion of human activities along the coast, timely acquisition of such information is important. Existing funding is available for continued development and production of tags for use on white whales. However, no funds are available for field studies involving tagging, aerial surveys, or collection of specimen material available from subsistence hunts.

This project is based on fact sheet MM-SC-8, developed in the framework of the Global Plan of Action for the Conservation, Management, and Utilization of Marine Mammals.

1.8 Activities and Work Plan:

1.8.1 Activities:

The following activities related to this project are currently ongoing:

a. Preparation of a detailed report describing results of white whale research conducted by ADF&G during 1977-1984. Sections of this report will describe natural history, vital parameters, harvest levels, distribution and migrations, and food habits.

b. Design and construction of visual and radio tags. With funding provided by the NSB, 8 VHF radio tags and 100 visual streamer

tags are being constructed. These tags will be tested on pieces of white whale skin and blubber. This work will be completed by June 1985.

c. *Coordination and planning of field activities.* Field activities must be closely coordinated with local governments, organizations, and individuals. The ADF&G and NSB have contacted various local and regional organizations regarding needs for white whale research. The principal investigators will meet with many of these groups to explain the rationale and procedures that will be used in field programs. Coordination and communication with local residents, and actual involvement of some individuals in the field research, will continue throughout the project.

If additional funding is made available, field work will start on a limited scale in the summer of 1985, at Point Lay in the northeastern Chukchi Sea. Residents of Point Lay attempt each year to harvest white whales by driving them into shallow waters of Kasegaluk Lagoon. In some years more whales are driven ashore than are needed for subsistence purposes, and the unneeded animals are allowed to return to sea. Such a circumstance would provide an opportunity to attach tags to those whales. Other options for obtaining whales to tag are to (1) purchase the right to tag and release a whale that would otherwise have been killed, or (2) pay local whale hunters to drive a group of whales ashore specifically for the purpose of tagging them. Local monitoring of tagged whales will be done from shore, small boats, and aircraft. Attempts to relocate radio-tagged whales in offshore waters will be made during an extensive aerial survey of walruses (conducted jointly by ADF&G and the U.S. Fish and Wildlife Service) scheduled to be done in the northeastern Chukchi Sea in September 1985.

The major tagging effort will take place in summer 1986. We will attempt to tag whales at several localities where geographical features and whale distribution and behavior combine to create favorable circumstances. Movements and activities will be monitored from shore, small boats, and aircraft. If tagging efforts are unsuccessful in certain areas in 1986, they may be repeated in 1987.

Aerial surveys of whales will be flown in each of the major summer concentration areas (Cook Inlet, Bristol Bay, Norton Sound, Kotzebue Sound, and Point Lay) during summer 1986. Monitoring of radio-tagged whales will be done during the surveys. Surveys will be repeated in summer 1987.

Wherever possible, measurements and skulls will be collected from harvested whales at locations where tagging efforts are being conducted. Beach-cast and entangled whales will also be sampled whenever possible. Craniometric measurements will be made on skulls obtained, as well as on other skulls available in collections at ADF&G, the University of Alaska, and other institutions and museums. All available data on morphometrics and craniometrics will be compiled and analyzed.

1.8.2 Work Plan and Timetable

Activity	Timetable	Responsibility
Design and construction of tags	Ongoing - completion Jun 1985	ADF&G
Coordination with subsistence hunters and local wildlife management groups	Ongoing and will continue throughout project	ADF&G and NSB
Tag whales at Point Lay and monitor movements and activities	Jul-Sep 1985	ADF&G and local individuals
Collect craniometric material and morphometric data at Point Lay	Jul 1985	ADF&G and NSB
Begin compilation of craniometric/morphometric data	Sep-Dec 1985	ADF&G
Modify and produce tags and tagging equipment	Oct 1985-May 1986	ADF&G
Tag whales in Norton Sound, Kotzebue Sound, and Point Lay, and monitor movements and activities	Jun-Sep 1986	ADF&G and local individuals
Collect craniometric material and morphometric data in Norton Sound, Kotzebue Sound, and at Point Lay	Jun-Jul 1986	ADF&G, NSB, and local individuals
Begin analysis of craniometric/morphometric data	Sep-Dec 1986	ADF&G
Aerial surveys of whales - Cook Inlet, Bristol Bay, Norton Sound, Kotzebue Sound, Point Lay	Jun-Jul 1986	ADF&G
Complete analysis of craniometric/morphometric data	Jan-Mar 1987	ADF&G
Aerial surveys of whales - Cook Inlet, Bristol Bay, Norton Sound, Kotzebue Sound, Point Lay	Jun-Jul 1987	ADF&G

Activity	Timetable	Responsibility
Drafting of final report	Jul-Dec 1987	ADF&G
Submission of draft final report to UNEP	Dec 1987	ADF&G

1.9 Outputs and Their Use

The primary output of this project will be a report describing the numbers of white whales summering at various locations along the Alaska coast, interrelationships among these summering groups, and their habitat-use patterns. The major uses of this information will be for determination of the identity and sustainable yield of the white whale stock(s), and for the identification and protection of important habitats. This information will be of value to regulatory agencies (International Whaling Commission and U.S. National Marine Fisheries Service), the governments of Canada and the Soviet Union, and state, regional, and local wildlife management organizations in Alaska. In addition, by involving subsistence hunters in the planning and conduct of research, an enhanced local understanding of the problems involved in white whale research and management will be achieved.

1.10 Follow-up

It is unlikely that this project will, within two years, be able to unequivocally determine the discreteness and abundance of all aggregations of white whales in Alaskan waters. Additional research required will be detailed in the final report. Other follow-up actions may include development of management plans and formulation of regulations for habitat protection and mitigation of adverse effects of human activities.

1.11 Prerequisites and Assumptions

There are no major prerequisites or assumptions required for the successful completion of two portions of this project. Those are: (1) aerial surveys of white whales, and (2) collection and analysis of craniometric and morphometric data. However, there are several possible difficulties associated with the tagging and tracking of white whales. Those include: (1) obtaining access to live whales for tagging, (2) adequate retention of tags, and (3) adequate ability to follow or relocate tagged animals. Pilot studies have indicated that these difficulties can be overcome in most circumstances. Since white whales are hunted in nearly all locations where conditions are favorable for catching them, cooperation of subsistence hunters will be essential in order to obtain access to whales for tagging.

1.12 Budget

See Appendix 1.

Appendix 1

A. Proposed North Slope Borough contribution (U.S.$)

	1985	1986	1987
2. Travel			
Airfare and expenses at Barrow/ Point Lay	1,500	----	----
3. Subcontract			
Design, construction, testing of radio and visual tag prototypes	6,000	----	----
5. Equipment			
Radio tags	6,000	----	----
Visual tags	2,000	----	----
9. Sundry			
Administrative overhead	1,550	----	----
TOTAL	17,050		

B. Proposed Contribution of the Alaska Department of Fish and Game (U.S.$) (in kind and services).

	1985	1986	1987
1. Personnel			
Project administration and coordination (Biologist IV) (3 mm)	3,600	5,500	5,500
Clerical support (Clerk Typist III) (3 mm)	2,600	2,600	2,600
Administrative support (Admin Assist I) (2 mm)	1,350	2,700	1,350
Local experts/biologists (Biologist III) (4 mm)	5,700	11,400	5,700
Computer/graphics (Programmer II) (4 mm)	2,200	8,600	6,500
2. Travel			
Travel of local experts/biologists	750	1,250	750
5. Equipment			
ADF&G will provide necessary radio-tracking equipment, field camping gear, specimen collection supplies, and laboratory equipment	*	*	*

6.	Premises ADF&G provides office, laboratory and storage space in Fairbanks, Nome, Kotzebue, and Barrow at no additional cost to project	*	*	*
7.	Operation/maintenance of equipment Xerox, computer equipment	500	1,000	500
	ADF&G will provide truck for local transportation in Nome, Barrow, and Kotzebue	*	*	*
	ADF&G will provide small boat in Nome for radio-tracking		*	
9.	Sundry Phone, postage, misc. office supplies	500	1,000	500
	TOTAL	17,200	34,050	23,400

C. Proposed contribution by U.S. Fish and Wildlife Service (U.S.$) (in kind and services).

		1985	1986	1987
7.	Operation of equipment Aircraft (30-50 hrs) for opportunistic tracking of tagged whales	*	----	----
	TOTAL	*	----	----

* No dollar value assignable

D. Proposed UNEP Environmental Fund contribution (U.S.$)

		1985	1986	1987
1.	Personnel Experts (Biologist II and III) (24 mm)	32,700	65,400	32,700
	Technicians (Tech II) (12 mm)	5,300	15,900	10,600
	Clerical/data entry (Clerk Typist III) (4 mm)	1,300	3,900	5,200
2.	Travel Airfare/biologists	1,500	4,000	2,500
	Per diem/subsistence	2,500	6,000	2,000

4.	Meetings			
	Conference on the Biology of Marine Mammals	----	----	1,200
5.	Equipment			
	Expendable equipment and supplies	700	3,000	500
	Radio and visual tags	----	8,000	----
	Procurement of whales to tag from local residents	4,000	4,000	----
7.	Operation/maintenance of equipment			
	Boat rental in villages	2,100	4,500	----
	Aircraft charter	7,000	30,000	25,000
9.	Sundry			
	Freight	500	1,000	----
	Miscellaneous	1,000	2,500	1,000
	Administrative overhead	5,300	13,300	7,300
	TOTAL	63,900	161,500	88,000
	GRAND TOTAL	98,150	195,550	111,400

Possible opportunistic platforms for tracking of tagged whales include U.S. Coast Guard and National Oceanic and Atmospheric Administration (NOAA) ships, and NOAA, U.S. Fish and Wildlife Service, or other government aircraft conducting aerial surveys in the study area.

25 JUNE 1986 – TESTS OF MANNING BELUKHA RADIO-TAGS

Radios placed on the beach at Kotzebue, about 1 meter elevation above the waterline
Antenna (1-2 element Yagi) mounted under the wing on a Twin-otter – flight route to the NNW of the radios

DISTANCE (NM)	ALTITUDE (FT)	FREQUENCY 165.356	165.557
100	11,500	no signal	no signal
90	"	"	"
80	"	"	"
70	"	"	"
60	"	weak, clear	"
55	"	medium, clear	weak, clear
55	6,500	"	"
50	5,500	weak, clear	weak, clear
50	2,500	no signal	no signal
45	"	"	"
40	"	"	"
35	"	"	"
32.5	"	very weak	"
30	"	weak	very weak
25	"	weak, clear	weak
20	"	medium, clear	medium, clear
15	1,000	medium, clear	weak
10	"	strong	strong