

● Investigation of the Occurrence
● and Behavior Patterns of Whales
● in the Vicinity of
● the Beau-fort Sea Lease Area
●
●

STATUS REPORT FOR THE
PERIOD JULY 1 THROUGH NOVEMBER 30, 1979

Prepared for:
U.S. Department of Interior
Bureau of Land Management
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Anchorage, Alaska

NAVAL ARCTIC RESEARCH LABORATORY

Barrow, Alaska

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INTRODUCTION

The project entitled the Investigation of the Occurrence and Behavior Patterns of Whales in the Vicinity of the Beaufort Sea Lease Area was initiated in September, 1978. The project is a multidisciplined study centered on the endangered whales in and near the waters included in the proposed Federal/State Beaufort Sea Lease Area. The whales of prime concern are the bowhead whale (*Balaena mysticetus*) and the gray whale (*Eschrichtius robustus*). The Naval Arctic Research Laboratory (NARL) at Barrow, Alaska, conducted this study commonly termed PROJECT WES. The various project investigators included both in-house researchers and others representing various universities in Alaska and elsewhere. Each was selected because of specific expertise in the areas of investigation.

This report reviews the research accomplished on PROJECT WHALES during the period 1 July through 30 November 1979. The report presents only the status of various research projects. The final report will be completed on 31 January 1980.

Included in this report are the results of the following Research Units: Bioacoustics (RU 179); Biotelemetry (RU 379); Tissues (Structure/Function) (RU 579); and Trophies and Baleen Plate Fouling (RU 679). These are the only research units which conducted investigations during this reporting period.

INVESTIGATORS

Ray Dronenburg, B.S.

John J. Kelley, Ph.D.

STATEMENT OF TASK

Determine the presence or absence of endangered whales in or near the proposed Federal/State Beaufort Sea Lease Area.

PURPOSE

The primary objective was to investigate the behavior and occurrence of bowhead and gray whales with the aid of passive acoustical instruments and to perform this research in and adjacent to the proposed Beaufort Sea Lease Area. A base camp was established at Flaxman Island. Visual observations are included as per the RU 179 Science Plan (outlined in FY 79S Proposal) and in conjunction with ground truth flights. Due to extensive oil and gas exploration being conducted in the immediate area of the base camps, additional information was gathered on "man-made" sounds encountered and their identification. Since this research was conducted during a period of expected minimal ice conditions, much of the acoustical data was collected from aircraft or from onboard ship (R/V *Watchik*). The ship and aircraft were based at Flaxman Island.

SCOPE

Four tasks were identified and coordinated through a senior scientist, Mr. Ray Dronenburg. The motor vessel, R/V *Alumiak*, was designated as the Data Center. It was stationed at Flaxman Island and near Prudhoe Bay later in the field season (Fig. 1).

Task 1: R. Dronenburg

To monitor movements of gray whales with aircraft between Point Barrow and Flaxman Island during the period 1 July to 15 August, 1979. Observations of stranded whales were also to be reported.

Monitoring required a minimum flight frequency of once per week. A single engine aircraft was to be used whenever practical.

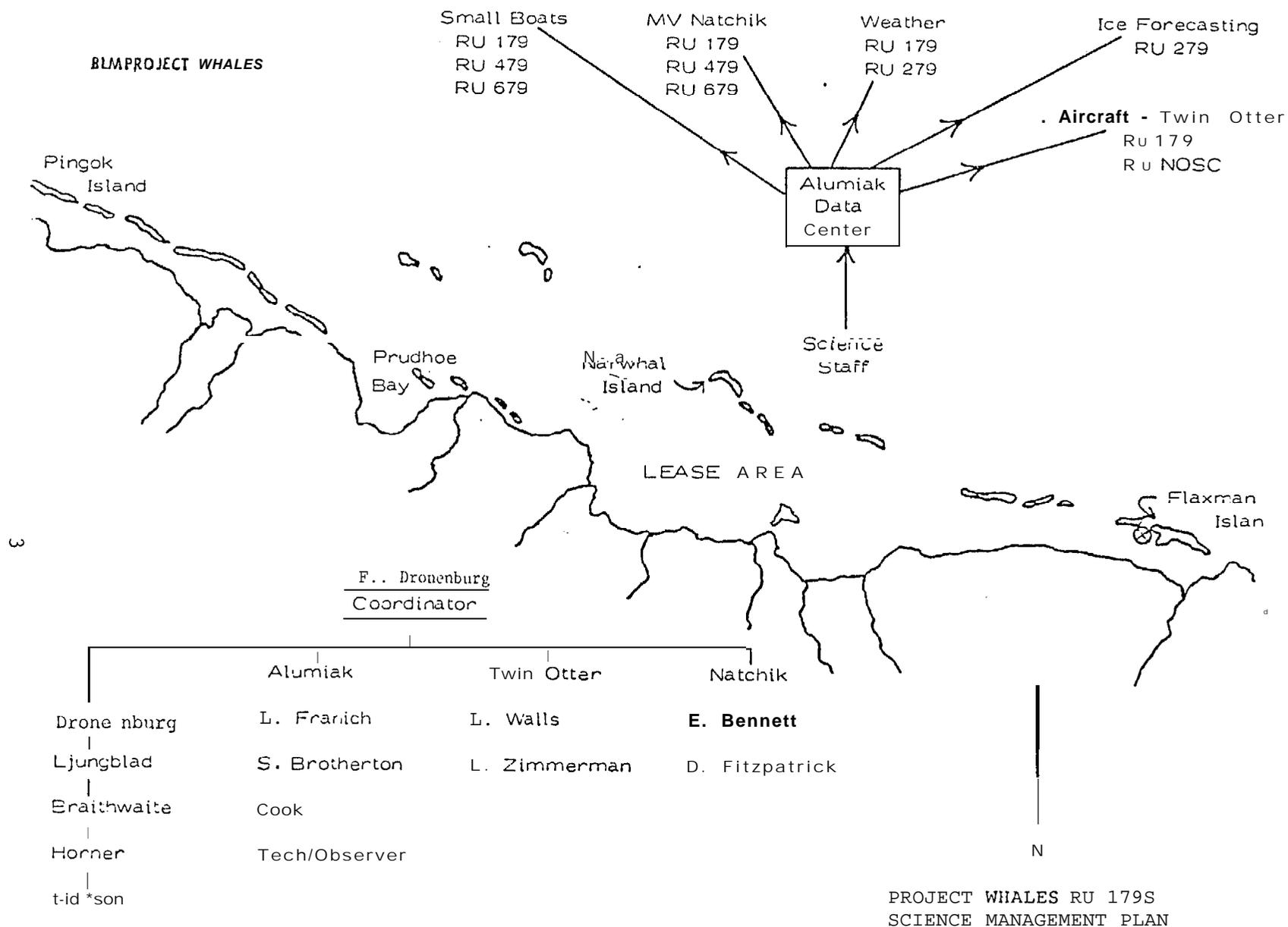


Figure 1.

Peripheral environmental data were recorded on these aircraft transects, such as ice concentration and presence and location of whales and other marine mammals .

Task 2: R. Dronenburg

To establish a mobile field base and data control center convenient to the lease area and to effect a ship and air surveillance program for endangered whales.

On 14 August 1979 the R/V *Natchik* and R/V *Alumiak* arrived at Flaxman Island, which was used as a base camp for acoustic observations during the period of fall whale migration.

The primary study area was confined to a 24 x 96 km perimeter bordered on the south by the Barrier Islands. The search in the grid was aided by support aircraft. Sonobuoys were deployed by air and ship.

When advised by patrol aircraft, travel to an area where intercept with westward moving whale pods was to be accomplished in accordance with the Science Plan. Acoustic data, plankton samples and basic hydrography were accomplished, as assisted by staff representing RU 679.

Flaxman Island was chosen as the field camp because of its location in the lease area and the presence of an air strip. Seasonal living quarters were set up on the barge with secondary land-based quarters also being established as a cost effective measure to the project. A twin-engine aircraft (Twin Otter) was stationed at Flaxman Island, Bullen Point, and Deadhorse at alternate times to reduce the transit time from Barrow and to provide maximum time to search the survey grid. The air survey was accomplished by Naval Ocean Systems Center (NOSC) and NARL staff.

Task 3: D. Ljungblad (Funded directly by BLM)

To accomplish aircraft overflights of the lease area in order to monitor the occurrence and behavior of endangered whales and the sounds made by them, in the lease area.

This task was accomplished by making aircraft overflights in the lease area. The flight transects followed a standard grid. The flight transect

originated at the Flaxman Island station and other suitable alternate stations to maximize project efficiency and to minimize costs.

Task 3 was to closely coordinate with Task 2.

Task 4: W. Ellison, Ph.D.

Cambridge Acoustical Associates, Inc.

1. Review and analyze data collected during the spring 1979 period from the Narwhal and Pingok Island camps.
2. Develop an acoustics study plan for the oceanic region associated with the edge of the seasonal ice zone and projected whale transit areas.
3. Develop a scientific plan for the fall 1979 (FY 79, 80) data collection effort.

Summary of Fall 1979, 1980 Scientific Plan*:

Sonobuoys are used as sensing devices and monitored from aircraft or land/ship based platforms. Acoustical surveys are used to augment visual observations of whales and other environmental phenomena. By utilization of a response team concept, this research unit would be able to manage and integrate the following types of data in a timely manner:

Whale sightings

- Species Identification
- Number, Movement and Direction
- Behavior Observations

Whale Vocalizations

- Sonobuoy Deployment
- e Recording of Sounds

Ice Observations (with RU 279)

- e Lead Systems
- o Coincidence with Whale Sightings

It should be noted that the Alaska Eskimo Whaling Commission (AEWC) associated with PROJECT WHALES by providing an observer in the field. The

* This plan was presented to the BLM/OCS Project Manager, August 1979.

Department of Labor/Alaska Federation of Natives under a CETA grant provided additional assistance by supporting a field technician.

MATERIALS AND METHODS

Passive sonobuoys were deployed from field base camps by ship and aircraft during the fall migration.

It was expected that the whale migration would follow the seasonal ice zone (SIZ), which necessitated data acquisition from RU 279. Data would be gathered and transmitted to the NARL via the field data center. The duration of the observations concentrated on the period of maximum migration.

An essential element of this program was to provide critical services and equipment through outside agency cooperation in order to bring about a more cost effective program. The NOSC continued to participate under separate contract with BLM. The results of observations made by NOSC were to be made available to PROJECT WHALES. Program coordination in the field and integration were to be effected through the Co-principal Investigator, R. Dronenburg.

AN/SSQ sonobuoys were used. It has a transmitter power of 1.0 watt and a sensitivity of ± 19 KHz and a deviation in sound field of 9 ± 3 db above 1 u-bar at 440 Hz. The DEI receiver has a frequency response of 0 to 40 KHz. The Nakamichi recorder "550" has a frequency response of 40-17,000 Hz [± 3 (SXor EX11 tape)]. All Nakamichi recorders have been bench calibrated per Nakamichi Company requirements. All analyses of relevant data collected on the tape recordings will be analyzed after the conclusion of the field program.

RESULTS

All observations during the late summer/fall period were carried out from a mobile base (R/V *Alumiak*) at Flaxman Island. The Science Plan called for overall data management to be under the direction of the RU 179S coordinator, Mr. Ray Dronenburg, at Flaxman Island. Observations were made aboard the NARL Twin Otter aircraft, as well as from the R/V *Natchik*. If a pod of whales was seen in the lease area, the R/V *Natchik* was to be notified and it would rendezvous with the whales, if possible. Once contact with the

whales was made, sonobuoys would be deployed and behavioral observations would be recorded. Although few whales were sighted, no pods of whales were seen inside the lease area or in range close enough for an encounter with the vessel. Routine acoustic surveillance was conducted from onboard the vessel.

The Science Plan was followed until the R/V *Natchik* and R/V *Alumiak* were returned to Barrow. Mr. Ljungblad, NOSC, carried on the aircraft operations until 1 October, when it was necessary to return the Twin Otter to Barrow, pending resolution of funding for PROJECT WHALES and performance of a routine 100 hour check on the aircraft. Mr. Ljungblad returned to San Diego and observations continued on 8 October with two technicians from NOSC and one each from the NARL and the AEWC. Prudhoe Bay was designated by BLM as the base of observations. All data collected by NOSC were sent directly to San Diego and are unavailable for this summary. Only NARL staff pilot reports will be included at this time.

Following this section is a summary of observations of mammals in or around the Beaufort Sea Lease Area (aircraft surveillance). Data are abstracted from field notes and pilot logs and are to be considered as preliminary at this time.

As a result of consultative meetings with BLM, National Marine Fisheries Service, Marine Mammal Commission and others in Seattle during August, 1979, the scope and mission of PROJECT WHALES was changed accordingly by 1. September 1979. A new draft plan primarily for execution during the FY 80 season was presented verbally to the BLM Anchorage office. A written outline of a Response Team concept was also presented.

Associated with this analysis and response to changing BLM objectives was the development of two new proposals submitted to the PROJECT WES Principal Investigators. They are:

1. The Feasibility of Radar for the Remote Surveillance of the Concentration and Movement of Marine Mammals, including Whales (Meteorology Technology Enterprises, Inc., Boulder, Colorado)
2. Acoustic Monitoring of Zooplankton Biomass and Distribution in the Beaufort Sea (Institute of Marine and Coastal Studies, USC, California and Tracer, Inc.)

Associated with the development of a more substantial statement of acoustical phenomena in future or present draft EIS reports, a letter proposal was presented to the BLM Anchorage office (W. Ellison, CAA) to provide a new section II.A.4.i. , "Underwater Noise" in the Beaufort Sea Final Environmental Impact Statement. The rewritten section would include descriptions of all ambient noise sources such as:

- Wind
- Waves
- Gross ice movement
- Thermal stress production
- Snow grain saltation
- Biological input
- Sound propagation in shallow water
and under ice

Data: The following data have been presented to BLM/Anchorage in an earlier informal status report dated 25 September 1979.

ABSTRACT

A field camp was established at Flaxman Island and acoustical surveys were conducted in and around the lease area using aircraft and a ship. Passive acoustical surveillance equipment was used in all cases. Whales were sighted but none were in the lease area. Analysis of recorded vocalizations is underway and will be described in a later report.

COOPERATION

The cooperation and assistance of the AEWG representatives and the CETA employees is gratefully acknowledged. Surveillance efforts were conducted in cooperation with NOSG staff. The staff of RU 679 participated in the field effort, principally in the collection of benthic fauna from the lease area.

Number and Location

<u>Date</u>	<u>Whales*</u>	<u>Seals**</u>	<u>Walrus</u>	<u>Bear</u>
<u>1979</u>				
8/12	70°4'N 140°32'W BE	70°25'N 148°27'W RI, BD	70°15'N 147°00'W	
8/13		70°13'N 146°52'W BD		
8/20	70°35'N 143°20'W BO, G			
8/21	70°30'N 144°20'W BO			
8/24		70°18'N 147°25'W RI		
8/25		70°23'N 147°15'W RI		
8/30		70°24'N 145°44'W RI		70°19'N 145°58'W 2 female, 3 young
8/31		70°14'N 144°29'W RI 70°37'N 148°31'W RI		
9/7	70°37'N 145°24'W BO 70°39'N 143°38'W BO	70°35'N 146°13'W 14RI, BD 70°14'N 145°21'W 10RI, BD 70°39'N 144°02'W 20 RI and BD mixed	70°33'N 145°54'W	

* BO = Bowhead
BE = Beluga
G = Gray

** RI = Ringed
BD = Bearded

<u>Date</u>	<u>Whales*</u>	<u>Seals**</u>	<u>Walrus</u>	<u>Bear</u>
9/8		70°20'N 148°25'W RI	70°38'N 149°10'W	
9/13				70°13'N 146°17'W
9/18	70°34'N 145°4'W 2 BO			
9/19		70°39'N 145°5'W BD		
9/21		71°6'N 147°46'W 10 RI 71°11'N 147°29'W 26 RI 71°11'W 148°28'W 5 RI		
9/24	70°13'N 143°47'W BO 69°56'N 141°52'W BO 69°55'N 141°47'W 4 BO 69°56'N 141°49'W 6 BO 69°55'N 141°50'W 10 BO			
9/25	69°55'N 141°50'W BO			
9/26	69°57'N 141°51'W 4 BO 69°55'N 141°52'W 3 BO 70°24'N 146°32'W 2 BO (Less than 5 n. miles from lease area)			

* BO = Bowhead
BE = Beluga
G = Gray

** RI = Ringed
BD = Bearded

<u>Date</u>	<u>Whales*</u>	<u>Seals**</u>	<u>Walrus</u>	<u>Bear</u>
10/1	73 °24'N 155°37'W	500 to 1000 BE	Note:	This is almost 10 days exactly and 10 miles away from the same area as a similar sighting made last fall. Whales were following lead systems.

The following data are derived from reports of the pilot-in-command of the NARL aircraft. NOSC data are unavailable.

10/6	70°24'N 145°59'W 2 BO			
	70°13'N 143°48'W BO			
	70°15'N 143°49'W BO			
	70°14'N 143°45'W BO			
	70°13'N 143°44'W 3 BO ***	*** Note:		Near Barter Island eight bowheads were seen heading west: 1 cow with calf, 1 adult.
	70°13'N 143°30'W 2 BO			
10/7	70°34'N 146°34'W BO			
10/8	70°37'N 147°15'W BO ***	*** Note:		Believed to be same family as seen on 10/6.
	70°37'N 147°15'W 2 BO ***			
	70°39'N 146°58'W 2 BO			
	70°39'N 147°7'W BO			

* BO = Bowhead
BE = Beluga
G = Gray

** RI = Ringed
BD = Bearded

<u>Date</u>	<u>Whales*</u>	<u>Seals**</u>	<u>Walrus</u>	<u>Bear</u>
	70 °41'N 147°7'W 2 BO 70°40'N 147°11'W 1 BO			
10/11	70°42'N 148°2'W 3 BO			

All sonobuoy tape recordings are currently under review at the NARL and will be made available to BLM at the conclusion of review and notation.

* BO = Bowhead
BE = Beluga
G = Gray

** RI = Ringed
BD = Bearded

The following is a brief narrative summary of observation aboard the R/V NATCHIK.

General: The NATCHIK was equipped with:

DEI Receiver
Nakamichi Cassette Tape Recorder
Modified 41A Sonobuoy

The hydrophore was deployed over the side of the NATCHIK - away from the ship's hull. The NATCHIK had been rigged so that only 12 volt power was required for life support systems and consequently no "ship noise" would disturb recordings. The ship would transit to an area designated and then shut down. The intention was to then drift for a sufficient time to monitor underwater sounds - if any.

The following is a list of dates and locations monitored by the NATCHIK together with surface mounted buoys deployed and their locations:

8-16-79 70 14.2'N 147 4'w to
 70 19'N 147 14'W then to
 70 23.5'N 147 32.5'W where remained overnight.

NOTE : No significant sounds.

8-17-79 70 17'N 147 31'W to
 70 16.5'N 147 13'W

Anchored buoy at the Newport entrance.

NOTE : No significant sounds. Heavy ice movement near anchored buoy.

8-18-79 Anchored buoy at Mary Sachs entrance.

NOTE : No significant sounds. Heavy ice movement near anchored buoy. Clocked ice movement at plus 3 knots via radar.

8-19-79 Monitoring from behind Flaxman Island.

NOTE : No significant sounds.

8-20-79 Determined that buoy at Mary Sachs is gone. Preparations to get underway.

8-21-79 70 14.5'N 147 02'W transect 270°T to
 70 14.5'N 147 04'w
 70 14'N 147 12'W transect 300°T to
 70 14'N 147 14'W

NOTE : No significant sounds.

8-22-79 70 16.8'N 147 03'W transect to 270°T
 70 16.8'N 147 05'W
 70 16.8'N 147 11'W transect to
 70 16.8'N 147 14'W

NOTE : No significant sounds.

8-23-79 70 18'N 147 21'W transect to 310°T to
 70 18'N 147 24'W
 70 22.5'N 147 31'W transect 270°T to
 70 22.5'N 147 33'W

8-24-79 Remain in the vicinity of Narwhal Island.

NOTE : Was able to contact KARLUK via radio and determine
 their source and frequency.

8-25-79 70 19'N 147 39'W transect to
 70 17.5'N 147 39'w
 70 24'N 148 32'w monitor

8-26-79 70 24'N 148 32'w monitor

NOTE : No significant sounds.

8-27-79 70 29'N 148 30'W transect to
 70 29'N 148 26'w

NOTE : No significant sounds.

8-28-79 70 29.5'N 148 21'W
 70 27'N 148 23'W transect to
 70 27'N 148 21'W

NOTE : No significant sounds.

8-29-79 70 10.6'N 146 53'w

NOTE : No significant sounds.

8-30-79 70 05.5N 146 12'W

NOTE : No significant sounds.

8-31-79 Anchored buoy at
 70 07'N 146 15'W

NOTE : Two hours after setting buoy it was carried away
 by ice.

9-1-79

NOTE : No vessel monitoring.

9-2-79 Buoy anchored at
70 07'N 146 12'W

NOTE : Between 9/3 and 9/5 buoy was again removed by ice.

9-3-79 70 12'N 146 00'W

NOTE : Attempted to place a modified 57A sonobuoy outside Flaxman Island using a kayak. The buoy lasted to 9/7/79 but no significant sounds were heard.

At this time the ice was in such close proximity to the island that on the night of 9-7-79 our camp was visited by a mother polar bear with two yearling cubs. The evening of the 7th, the winds and current direction combined to impact the ice floes against the shoreline. Also at this time the water temperature had dropped from a previous plus 6 degrees C to 0 degrees C in a 24-hour period. The air temperature had fallen from 5.50 to 0 degrees C. It now appeared that freeze-up would not be too far behind and camp was then pulled back to the abandoned DEW Line site at Savakvik Point (Bullen Point).

Between 9/8/79 and 9/16/79 there were only three days of good weather. For the most part, heavy fog together with blowing snow were the "norm. " On 9/16/79 it was decided that the vessels could be of no further value, although a buoy had been deployed at 70° 13'N 147° 00'W from 9/10/79 to the departure date, with no significant sounds recorded.

In order to utilize Bullen Point as much as possible, stores were removed from the ALUMIAK with the intention of inhabiting an abandoned building. A radio was installed for communication. A three-wheeler was left for transportation from the aircraft parking area to the buildings (approximately one and one-half miles) . Unfortunately, the three-wheeler would not function correctly. After making that walk in freezing weather several times and with one of the survey personnel being handicapped in walking ability (Don Ljungblad) , it became obvious that Bullen Point would have to be abandoned. The project moved to Deadhorse and NANA Camp.

All sonobuoy tape recordings are currently under review at the NARL and will be made available to BLM at the conclusion of review and notation.

NOTES

R. Dronenburg

On the 19th of August 1979 we were visited by a group of Eskimo people from Barter Island. It is their habit to come to Flaxman Island at this time of year to hunt caribou. The people involved were:

Daniel Akootchook
George Akootchook
Mary Akootchook
Joe Akootchook
Eddie Rexford - young adult
Lloyd Gordon - young adult
Thomas and Dorothy Panningoona

Mr. Daniel Akootchook and Mary reported on whaling that had taken place in the Flaxman Island area in years past. They related that the old sod hut that is reported to have been built by the explorer, Leffingwell, was actually built by the great grandfather of Mary Akootchook and that Mary had lived in the hut for many years while her family hunted and fished that area. Mary Akootchook was born on Flaxman Island in 1928.

Daniel Akootchook (a whaler in Barter Island) stated that in past years whales would be found close to the shore of Flaxman Island and that Flaxman Island was a good place for a camp. Fish and caribou were available nearby. Flaxman Island is about a 4 hour run by small boat from Barter Island.

Thomas and Dorothy Panningoona verified the fact that whales were seen from the Flaxman area. Camden Bay was especially a good place to hunt.

NOTES

Unusual Sounds Recorded by R/V NATCHIK

R. Dronenburg

8/24/79

The R/V NATCHIK had been working towards Narwhal Island all day and then had reached an area where she intended to anchor for the evening. There were two divers on board who were working over the side of the R/V NATCHIK. The R/V NATCHIK would have been anchored at approximately $70^{\circ} 23.5'N$ $147^{\circ} 30'W$. Underwater sounds were heard which were at first faint and then grew stronger. A radio check revealed that the KARLUK (a vessel operated by the USGS) 'was in the area performing work with an underwater device. They later reported that they were producing a 1 KHz signal on a 1/2 second pulse and that they were then on a course that took them from $70^{\circ} 22'N$ $147^{\circ} 27'W$ to $70^{\circ} 22'N$ $147^{\circ} 37'W$. The time period involved was 1050 hours to 1125 hours. The wind was almost dead calm with a very heavy fog laying on the water. There were some small floes of ice in the area behind Narwhal Island to about 2/5 coverage. There was no wave activity. In the early afternoon the sun was trying to burn the fog off.

Weather logs for Flaxman Island area indicated a wind speed of 1.5 to 7.0 KM/s for the entire day. Pressure ranged (kPa) 75.7 to 76.00 with wind direction E/NE. Temperatures were about 30°F.

INVESTIGATOR

Erich H. Follmann, Ph.D.

STATEMENT OF TASK

Continue development of a new dart-propelled radio-tag for marking whales. Test the radio-tag in preparation for marking whales in San Ignacio Lagoon, Baja Sur, Mexico during the winter of 1979-80.

PURPOSE

The ultimate purpose of this research project is to radio-tag whales in the Beaufort Sea to determine their movement patterns and migration routes relative to the proposed Federal/State Beaufort Sea Lease Area.

To accomplish this project, new radio-tags are being developed for testing on gray whales in Mexico. Specific objectives are to:

1. Develop and test ten radio-tags for use in Mexico.
2. Tag up to ten gray whales in San Ignacio Lagoon, Mexico, in cooperation with the tagging program of Oregon State University under the direction of Dr. Bruce Mate.
3. Determine the effectiveness of both the tagging procedure and the radio-tag.
4. Determine the radio-tag's utility for tagging whales in arctic waters.

SCOPE

Radio-zags will be tested in Fairbanks for range of transmission, flight characteristics, penetration characteristics and durability. Up to ten gray whales will be tagged in Mexico to determine their usefulness for arctic projects.

METHOD S

The radio-tags are developed to be propelled from a dart gun. The dart gun was originally designed to fire dart syringes for chemical restraint of animals. The radio-transmitter is built inside of a dart-like housing that has a total length of about 16 cm. A trailing whip antenna of about 40 cm is attached and an attachment device is situated at the front of the dart

housing. The type of attachment device has not been selected to date, pending further tests. It will be designed for about 7.5 cm of penetration into the skin and blubber. The dart housing and whip antenna will be external and lay on the skin of the whale.

Sections of bowhead skin and blubber have been obtained from whales harvested at Barrow, Alaska. These will be used to test penetration characteristics and holding effectiveness of attachment devices.

Gray whales will be tagged from small inflatable boats in San Ignacio Lagoon, Mexico. Whales will be monitored from ground stations, from small boats and from an aircraft.

RESULTS

The type of radio-transmitter has been selected and two have been built. All stainless steel dart housings and antenna caps have been machined. Two sections of bowhead whale blubber and skin have been obtained from a bowhead whale stranded during October near Barrow, Alaska.

Preliminary testing of the flight characteristics of the radio-tag and the durability of the radio-transmitter have been conducted. The results are very promising.

ABSTRACT

Development and preliminary testing of a new radio-tag were accomplished during this reporting period. Plans are to tag up to ten gray whales in San Ignacio Lagoon, Mexico, during the winter 1979-80. Results of these tests will determine the usefulness of radio-tags for movement studies of whales in arctic waters.

COOPERATION

I wish to thank Telonics, Inc. for continued development and suggestions with regard to the transmitter used in the dart. The creative suggestions and machining talents of Mr. Ned Manning, have been instrumental in the successful development of the new radio-tag. The staff of RU 579 provided the additional bowhead whale tissues for testing the radio-tags.

TISSUES (STRUCTURE/FUNCTION) (Ru 579)

INVESTIGATOR

Thomas F. Albert, V. M.D., Ph.D.

STATEMENT OF TASK

In endangered whales, determine the basic structure and function of tissues that are likely to be directly or indirectly affected by offshore oil development.

PURPOSE

There are four major objectives:

1. To obtain basic biological information from individual bowhead and gray whales, utilizing animals harvested by Eskimo hunters, as well as stranded whales. Areas of particular interest include the structure of those tissues most likely to be adversely affected, either directly or indirectly, by offshore oil development. Such tissues include the visual apparatus, digestive tract, reproductive tract, skin and respiratory structures. Similarly, values for the tissue concentrations of toxic substances (heavy metals, etc.) will be determined prior to offshore activity. In addition, a search will be made in all tissues examined for evidence of age-related changes, any changes indicating disease, and differences between the *ingutuk* and other bowheads. Both external and internal parasites will be collected when encountered, and identified. Also, stomach samples will be collected for identification of individual food items.
2. To develop data for comparison with future studies to determine the effects of development within the oil lease area on bowhead and gray whales.
3. To provide physiological and structural data on the endangered whales that occur in the lease area of the Beaufort Sea. Such data will also be useful on a comparative basis.
4. To provide continued direct support by means of baleen collection for Research Unit 380, Baleen Plate Fouling.

SCOPE

This Research Unit is concerned with the endangered whales occurring in the proposed lease area, namely the bowhead and gray whales. This investigation

deals with the individual whale and then relates this information to the population. A major effort is directed toward the determination of the normal structure of critical tissues and organs and thereby assessing function.

This is a multifaceted research effort with the nature of the tissue examinations being: gross, microscopic, clinical-chemical, radiographic, microbiological, cytogenetic, parasitological and toxicological.

Examination of individual whales is limited to those which are either hunter-killed or stranded. Hunter-killed whales are available during the spring from Barrow, Wainwright and Point Hope to the west of the lease area, and during the fall from Barrow to the west and from Kaktovik to the east.

Although the bowhead travels through much of western and northern Alaskan coastal waters (and thereby through proposed and potential lease areas), the animal is available for sampling only at the whaling villages. Such sites represent unique opportunities for the collection and examination of critical tissues from this far-ranging whale.

METHODS

The basic method of collecting data was to examine those tissues collected during the fall 1979 whaling season.

Collection of Tissues

Hunter-Killed Whales. Five whales were harvested during the fall of 1979. The method of examination is described below,

Examination of Tissues

When examining tissues, major emphasis is placed upon the following:

1. Determine the normal structure of the tissue and its relationship to other tissues.
2. Search for changes that are associated with age in other better studied animals.
3. Search for evidence of disease (infectious, toxic, etc.).
4. Search for differences between the *ingutuk* and other bowheads.
5. Assessment of tissue function in light of the determined structure and clinical chemical findings.

Tissue examinations include gross, microscopic, clinical-chemical, radiographic, microbiological, cytogenetic, parasitological and toxicological. The

nature of these examinations is described below.

Gross examination of tissues. To the extent possible, the entire reproductive tract, stomach and one lung are transported to the Animal Research Facility (ARF) at the NARL. At the ARF they are examined for orientation, gross structure, and the other determinations identified above.

Microscopic examination of tissues. Suitable samples are preserved and examined by light microscopy and in some instances, electron microscopy. Tissues examined include the visual apparatus, reproductive tract, digestive tract, respiratory tract, skin, cardiovascular structures, immune tissues, and others.

Clinical-chemical examination of tissues. Blood and urine examinations include: cellular studies, ionic concentrations, hormone levels (particularly reproductive hormones), and others.

Radiographic examination of tissues. The limited data available indicate that ossification (as noted radiographically) of the carpal bones may be correlated with total body length (age?). In addition, variability has been noted in the number of metacarpal bones. Therefore, the bones of a flipper are examined for apparent density and numerical variation.

The long bones of the flipper are examined for the presence or absence of the epiphyseal cartilage. This cartilage is present in the long bones of physically immature animals. The flippers which contain such long bones are kept by the whalers. Flippers, are temporarily borrowed so that the necessary "X-rays" may be taken at the ARF. The frozen flippers are returned to their owners unharmed. At present, there is no reliable way of aging bowhead whales. The method described here differentiates between mature animals and those still growing. Bone density studies may also be helpful in resolving the degree to which the *ingutuk* differs from other bowheads.

Microbiological examination of tissues. Serum from harvested whales is examined serologically for evidence of contact with: known marine mammal pathogens, major pathogens of domestic *mammals* and certain exotic diseases.

Viral and bacteriological isolation efforts concentrate on the mouth, throat and upper respiratory tract. Emphasis is placed on attempts to isolate pathogens and to provide an insight into the normal microbial flora of the upper regions of the respiratory and digestive tracts. Pathogens and potential pathogens often reside in these two areas and are usually kept in "check" by bodily

defense. In a stressed animal or one weakened by another condition, these microorganisms may break through the bodily defenses and cause disease. An obvious source of stress is an unsuccessful chase with the animal escaping. A less obvious source of stress, but one which may affect large numbers of bowheads, is the unknown impact upon the population from significant offshore development.

Cytogenetic examination of tissues. The cytogenetic examination of bowhead whale tissue is of particular importance as a possible means to reveal the degree to which the *ingutuk* differs from other bowheads. The methods employed are the usual procedures of mammalian cytogenetics; i.e. , the establishment of cultivated cell lines and heterogeneous staining (or "banding") of fixed, air-dried cells. Chromosomal polymorphism in cetaceans is particularly well demonstrated by a staining procedure called "C-banding".

Parasitological examination of tissues. Intestinal contents, liver, muscle and "blubber" are examined for parasites. The parasite burden of harvested whales should be determined so that basic information is available prior to offshore development.

Toxicological examination of tissues. The methodology includes a determination of the following toxic substances: chlorinated hydrocarbons, such as DDT (including its breakdown products) and PCB's; and metals including lead, mercury, zinc and cadmium. The blubber is examined for chlorinated hydrocarbons and the liver, spleen, kidney and skeletal muscle for heavy metals. In view of the possibility that offshore development might increase the deposition of toxic substances in whale tissues, and noting that the bowhead whale is a human food item, it is deemed essential that such chemical determinations be performed in a laboratory whose capability and commitment of safeguarding human health are above reproach. The U.S. Department of Agriculture, Meat Inspection Service, was requested to perform these examinations. Preliminary discussions have indicated that they are willing to perform such determinations at their Beltsville, Maryland laboratory with funding to be provided through an interagency agreement between USDA Meat Inspection Service and BLM.

In view of the long range implications that offshore development may have upon the accumulation of toxic substances in the bowhead whale and its utilization

as a human food item, an active tissue storage program was undertaken. Archiving of tissue samples allows for the retrospective analysis of tissues so that when hydrocarbon analytical procedures are refined, pre-development baseline values can still be generated. It also provides for the retrospective analysis of tissues.

RESULTS

A total of eight whales were examined during the period of August through October, 1979. There were six bowhead whales and two gray whales. Three of the whales were stranded (2 gray and 1 bowhead) and five (bowheads) were harvested by Eskimo hunters. Six of the whales were examined by T. F. Albert, one was examined by a consultant to the project (L. Dalton) and one by another investigator on the project (G. Jarrell), who at the time was a part-time employee of the National Marine Fisheries Service).

Findings pertaining to these eight whales are included below under the following headings: Stranded Whales, Eskimo Harvested Whales, and Summary of Findings.

Stranded Whales

Three stranded whales were examined (1 bowhead and 2 gray). The two gray whales were located during a two week period in August when efforts were made to examine the coastline by aerial survey from Point Lay (southwest of Barrow) to Kaktovik (on Barter Island). The coastline was ice free; however, poor weather resulted in a reduced effort. Single engine aircraft were used.

Barrow and Southwest to Point Lay. Two stranded gray whales were seen. One (GW 79-1) was at the water's edge approximately 27.2 km above Wainwright. It was a well-decomposed male, 8.0 m in length. A blubber sample was taken for toxicological determinations. The second stranded gray whale (GW 79-2) was nearly covered by sand at the water's edge approximately 3.2 km below Wainwright. It was well-decomposed and approximately 8.7 m in length. Sex could not be determined due to extent of burial. A blubber sample was collected for toxicological determinations and the right eye was collected for

morphological studies. Two feeding gray whales were seen approximately 1.6 km offshore; one was 8.0 km below Wainwright, the other 16 km above Wainwright.

No stranded bowhead whales were seen between Barrow and Point Lay; however, six bowhead skulls were noted at various spots along the beach. The skulls were all well-bleached and obviously the whales had died years before. Two skulls were located near Feint Franklin, one about 27.2 km above Wainwright, two about one-half way between Wainwright and Icy Cape, and one about 6.4 km below Icy Cape.

Barrow and Southeast to Kaktovik. On 16 October 1979, a stranded bowhead whale was located approximately 12.8 km southeast of Point Barrow on a barrier island. Its location was called to our attention by an Eskimo hunter (Harry Brewer, Sr.). The animal was examined by cooperating personnel of the Naval Arctic Research Laboratory (Dr. Les Dalton, study consultant and veterinarian, and Mr. George Selby, supervisor, Animal Research Facility). The animal was a male, 15 m in length and presently frozen in ice. The cause of death of the animal is not apparent at this time. The exposed muktuk was harvested by Eskimo hunters. The cooperating NARL personnel obtained various specimens including skin and an eye. They also collected samples and took measurements for the National Marine Fisheries Service.

On 30 September, while going to Kaktovik for fall specimen collection, a large (approximately 6 m in length) object was noted on the beach of one of the barrier islands, approximately 16 km southeast of Point Barrow. Due to high winds a landing was not possible. The object seemed to be the remains of a carcass consisting of numerous bones and fleshy remnants. From its size it was likely the remains of a whale. A return visit approximately two weeks later showed no trace of the carcass. A severe storm had occurred during the interval.

During the August aerial survey no stranded whales were seen between Barrow and Kaktovik. One bowhead skull was seen approximately 40 km west of Barter Island. It was from bowhead whale 78KK1 which was butchered at that site during the fall 1978 whaling season.

Eskimo Harvested Whales

During the fall whaling season, 'bowhead whales are regularly hunted by residents of Barrow and Kaktovik. As indicated earlier, five bowhead whales were taken 'Dy Eskimo hunters during the fall 1979 whaling season. All five were taken in waters off the village of Kaktovik which is on Barter Island, east of the lease area. The whales were pulled onto the beach for butchering. The successful whaling captains and their crews were very cooperative and with their assistance numerous specimens were collected. Due to the nature of the fall hunt, it is often several hours from the time the animal is killed until samples can be collected. Such a delay resulted in some of the animals being examined at night which, therefore, limited both the quantity and quality of the tissue specimens. We were especially fortunate to have obtained several very valuable specimens which included: stomach contents from all five whales, three intact brains, a piece of the cervical part of the spinal cord, an intact blowhole, eroded areas in the rear of the mouth of one whale, most of a heart, a uterus and a pituitary gland. The presence of freshly ingested material in the stomach of each of the five whales indicated that the whales were feeding in the Barter Island vicinity. In each instance the stomach contained 4 to 23 liters of "fluidy" material. The fluid portion was rusty red to dark red in color and seemed somewhat "oily", being a little more viscous than water. The particulate material consisted of numerous small (2-20 mm long) "shrimp-like" organisms. Many other tissues were collected and most are mentioned below. Listed below are each of the five harvested whales and pertinent observations. The various samples collected have been sent to other investigators associated with this Research Unit for detailed study.

Bowhead Whale 79KK1. This animal was captured by Joseph Kaleak on 20 September 1979. While towing the whale to shore, it was lost in a storm. When the storm subsided it was readily located and beached on 22 September. It was a male, 12.5 m in length.

Samples collected for histological study include: several skin samples, surface of tongue, Jacobson's organ, roughened areas of upper lip, hairs on

lower jaw, entire penis, nipples, cross section of fluke, intact blowhole, eye, tendon, "core sample" extending from skin through blubber to underlying muscle. The animal seemed to be a sexually mature male with the testicles being approximately 82 cm in length and 38 cm in diameter. Unfortunately the testicles were undergoing decomposition and, like other internal structures, are of limited histological value. Approximately 3/4 of the heart was recovered intact. Due to extensive decomposition it is of value only for gross studies. Since the heart is a prized food item, this nearly complete specimen may be one of the few (or the only) that will be available for study. Other samples include: stomach and colon contents, a urine specimen and tissue samples for parasitological and toxicological evaluation. Several swabs were collected for bacterial and viral isolation. An intact segment of gum with baleen plates still in place was obtained for use in the Baleen Fouling Study (RU 679).

Bowhead Whale 79KK2. This animal was captured by Joseph Kaleak on 6 October 1979. It was a female, 10.5 m in length. Samples collected for histological study include: several skin samples, an area of erosion in the rear of the mouth, a "core sample" extending from the skin through the blubber to the underlying muscle, several ear canal samples, vascular rete from foramen magnum, intact brain, area of meninges beneath brain, kidney, lymph node, small piece of ovary, pancreas, eyelids and entire stomach. Other specimens include: stomach contents, colon contents, intact brain and tissue samples for parasitological and toxicological evaluation. Several swabs were taken for bacterial and viral isolation. Skin and lung were collected for cell culture. An intact segment of gum with baleen plates still in place was obtained for use in the Baleen Fouling Study (RU 679).

Bowhead Whale 79KK3. Tunis animal was captured by Alfred Linn on 8 October 1979. It was a male, 10.1 m in length. Specimens collected for histological study include: skin, irregular gray colored areas of skin in rear of mouth, spinal cord surrounded by vascular rete in vertebral foramen of first cervical vertebra, contents of the vertebral foramen from a vertebra just behind the ribs, bone (vertebral spinous process) and entire spleen.

Small blocks of skin extending from the surface to the underlying tissue were collected for electron microscopy. Other specimens collected include: tissue samples for parasitological and toxicological evaluation, stomach contents, colon contents, intact brain, several swabs for bacterial and viral isolations and skin for cell culture.

Bowhead Whale 79KK4. This animal was captured by Isaac Akootchook on 10 October 1979. It was a male, 10.6 m in length. Specimens collected for histological study include: pituitary, meninges beneath brain with underlying vascular rete, intact atrio-ventricular valves, intact semi-lunar valves of heart (aortic?), lung with pleura, mucosa of roof of mouth with baleen on each side, small baleen with the skin medial and lateral to it, section where upper lip meets roof of mouth anteriorly with a groove marking the junction, spinal cord from vertebral foramen of first cervical vertebra, contents of vertebral foramen of a vertebra just behind ribs, intact penis and intact spleen. Other specimens include: tissue for parasitological and toxicological evaluation, stomach contents, colon contents, a serum sample, intact brain and a louse. Several swabs were taken for bacterial and viral isolation. Skin and lung were taken for cell culture.

Bowhead Whale 79KK5. This animal was taken by Archie Brewer on 11 October 1979. Stomach contents were collected by National Marine Fisheries Service personnel at the site (G. Jarrell).

Summary of Findings

1. Eight whales (6 bowhead and 2 gray) were examined from August through October.
2. Of the eight whales, three were stranded (2 gray and 1 bowhead) and five were hunter-killed bowheads.
3. The two stranded gray whales were southwest of Barrow.
4. The stranded bowhead was located approximately 13 km southeast of Point Barrow (between Point Barrow and the lease area).
5. During the fall, Eskimo hunters regularly hunt the bowhead in the waters off Kaktovik and Barrow.
6. The five hunter-killed bowheads were taken in waters off Kaktovik, to the east of the lease area.

7. All five hunter-killed bowheads had recently ingested food in their stomach, indicating that bowheads feed in the Barter Island area.
8. One of the harvested bowheads (79KK1) appeared to be a sexually mature male.
9. Specimens collected that are of major significance include: stomach contents, a nearly intact heart, intact uterus, three intact brains, a pituitary gland, spinal cord sections and erosions in the mouth of one whale.
10. Cooperation provided by the successful whaling captains and their crew members during the butchering process was excellent.
11. Cooperation between PROJECT WHALES personnel and National Marine Fisheries Service personnel at the butchering site was excellent and resulted in an enhancement of the field success of each.

ABSTRACT

A total of eight whales (6 bowheads and 2 grays) were examined from August through October, 1979. Three were stranded (2 gray and 1 bowhead) and five bowheads were harvested by Eskimo hunters in Kaktovik. Samples were collected from all whales and these are currently being analyzed by the various investigators associated with this project. Results will be included in the final report.

COOPERATION

Tine cooperation and assistance of the various Eskimo whaling captains are gratefully acknowledged. NARL and NMFS personnel aided significantly with the collection of tissues. Baleen plate sieves with attached gums were provided to Dr. Lee Braithwaite for Baleen Fouling Studies (RU 679).

INVESTIGATOR

Lee F. Braithwaite, Ph.D.

The Trophies Research Unit is subdivided into two separate studies. The first involves collection and identification of prey species in the proposed Federal/State Beaufort Sea Lease Area and in the digestive tracts of bowhead and gray whales. The second is a study of the filtration rates and efficiency of the baleen apparatus, including determination of the effects of oil on the baleen. Work was conducted on both studies during this reporting period. Each is discussed separately below.

BENTHIC STUDIES (RU 679a)

STATEMENT OF TASK

Research will identify the kinds and relative abundance of major prey species in the Beaufort Sea Lease Area and in the digestive tracts of bowhead and gray whales.

PURPOSE

This research will determine natural, baseline, ecological conditions for the lease area, an area vulnerable to possible future petroleum spills. It will also prepare information that will determine if the food and feeding habits of bowhead and gray whales will suffer or change if a spill of petroleum occurs.

Stomach and intestinal contents will be obtained from bowhead and gray whales. Pelagic and planktonic species found free in the environment and in the alimentary canals of the whales will be identified. A census will be made of epibenthic and shallow burrowing organisms in the lease area to determine ultimately if any of these organisms are present as food in the whales.

Finally, there will be a comparison of findings of the plankton in whale digestive tracts with the plankton found free in the water.

SCOPE

The scope of this research is to determine the food of bowhead and gray whales by looking at what food is available in the oil lease area and what food

is actually in the digestive tracts of whales. Results from the study will be vital for comparison with possible future studies of whale food and feeding after an oil spill, if such were to occur.

METHODS

Food contents from stomachs and intestines of bowhead and gray whales were obtained. Prey were taken from five whales by Dr. Tom Albert, after Eskimos had harvested the whales. Pelagic, planktonic and benthic prey species found in the alimentary canals of whales will be identified.

Collections were made of potential whale prey in the Beaufort Lease Area by SCUBA collections, bait box experiments with time-lapse underwater photography, dredging and grab sampling of epibenthic and shallow burrowing organisms. It will then be determined if any of these species from the lease area are present in the whales. The research will coordinate plankton findings in whale guts with the plankton identification and distribution studies made by Dr. Rita Homer (RU 479).

RESULTS

A BLM decision during this quarterly period allowed stomach and intestinal contents of bowhead whales to be sent directly to John Burns for identification of prey species under a separate contract.

A collection of epibenthic and shallow-burrowing organisms in the oil lease area was carried out between 15 August and 15 September, 1979. A total of four grab samples were taken near Flaxman Island, as indicated in Figure 2 (G 1-4). Much better quantitative and qualitative collections of benthic organisms were made with dredge sampling; therefore, grab sampling was terminated. Sampling operations were based on Flaxman Island, working from the *Alumiak* and using SCUBA photography to document bottom types and benthic populations of both seaweeds and macro-invertebrates.

A total of 74 dredge samples were taken throughout the oil lease area. Thirty-nine dredge samples, 5 km in length, were taken using a Boston Whaler from the NARL, and a total of 37 dredge samples were taken with the *Natchik* from the NARL. Localities of dredge samples taken with the Boston Whaler are



Figure 2.

indicated on Figures 2-5 (dredge samples D 1-39). Localities of dredge samples taken with the *Natchik* are indicated on Figures 5 and 6 (dredge samples D 40-74). The coordinates for each *Natchik* dredge sample are included in Table 1.

All collections of seaweeds and macro-invertebrates recovered from the dredging operations are stored at the Brigham Young University in Dr. L. F. Braithwaite's laboratory. In the future, if there is an oil spill in the area where the collections were made, and if BLM decides to compare benthic faunas and floras before and after a spill, the collections will be available for possible identification and quantification of the marine organisms present.

ABSTRACT

Epibenthic and shallow-burrowing organisms were collected in the proposed Beaufort Sea Lease Area. A total of 74 dredge samples were taken. Samples are being stored at Brigham Young University.

COOPERATION

The staff of RU 179 provided field support for collections in the Beaufort Sea.

BALEEN FOULING STUDIES (RU 679b)

STATEMENT OF TASK

Research will determine the filtration rates and efficiency of the bowhead whale's baleen apparatus before and after exposure to experimental Prudhoe Bay crude oil, diesel oil (#1 and #2), gasoline and oil dispersal solutions found at spill locations. Future studies will include similar investigations using other baleen whale species for comparative purposes.

PURPOSE

This research will determine to what degree the feeding habits, baleen filtering efficiency, and the general well-being of the bowhead whale will be affected if a petroleum spill occurs in the Beaufort Sea.

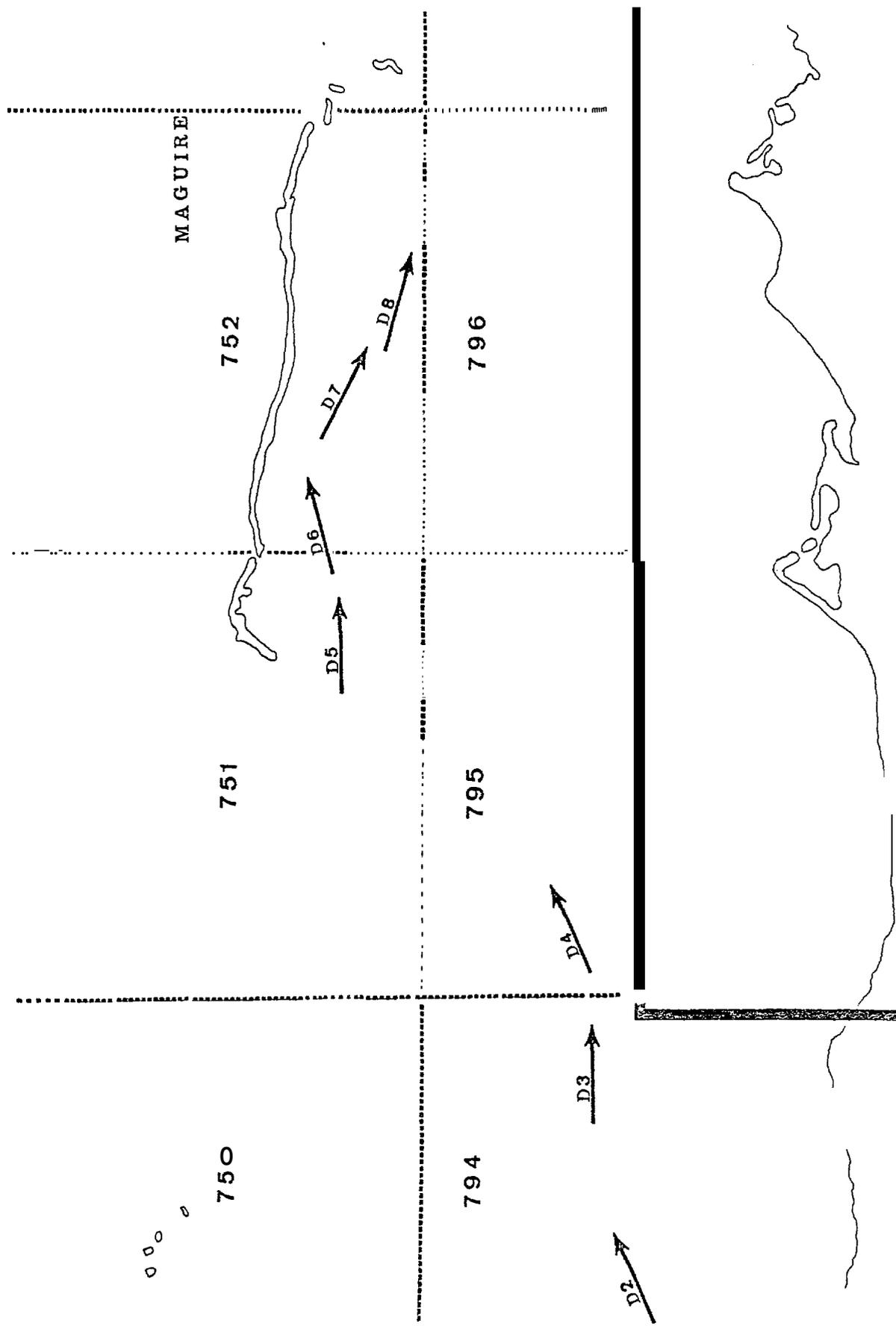


Figure 3.

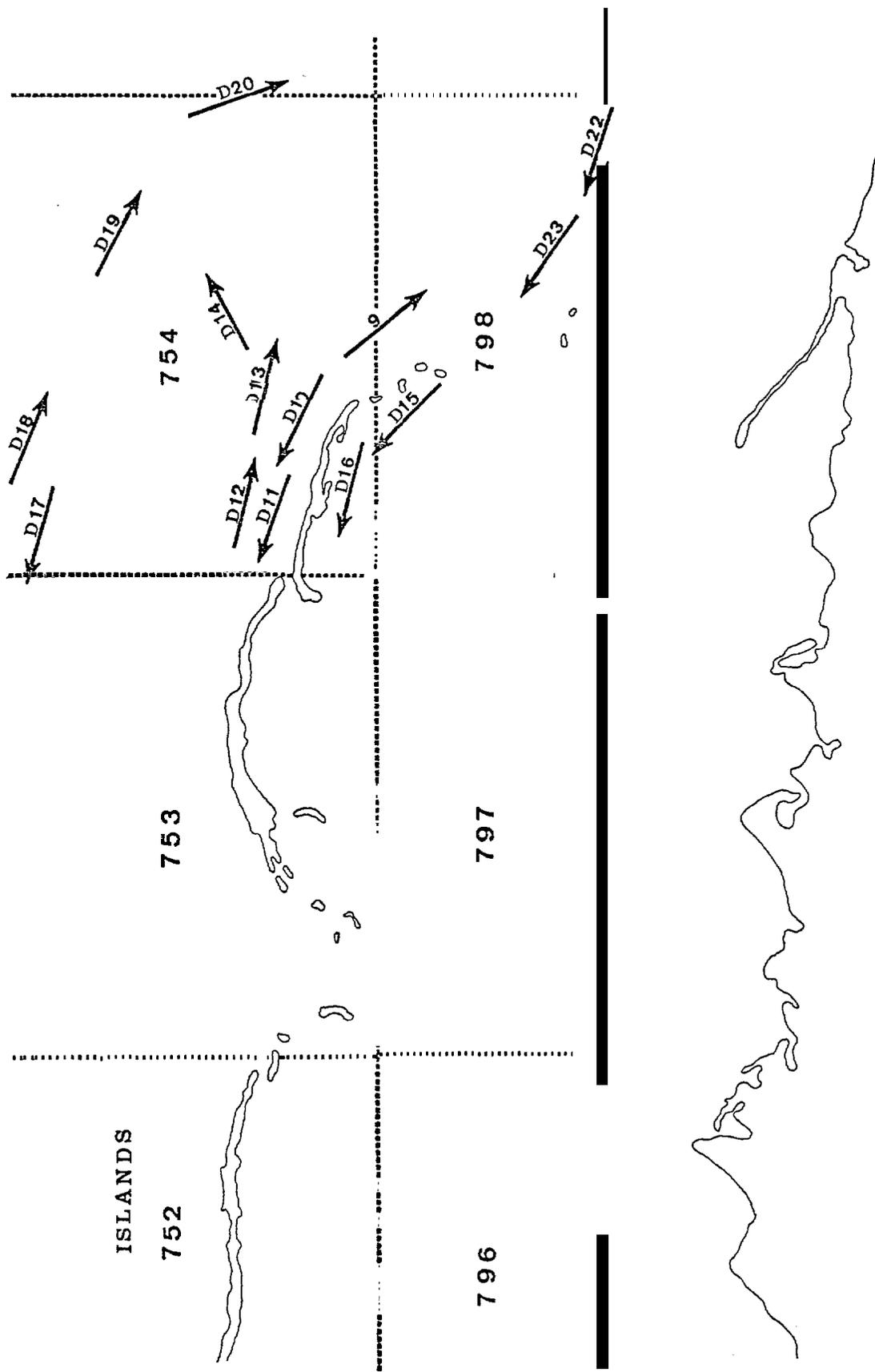


Figure 4.

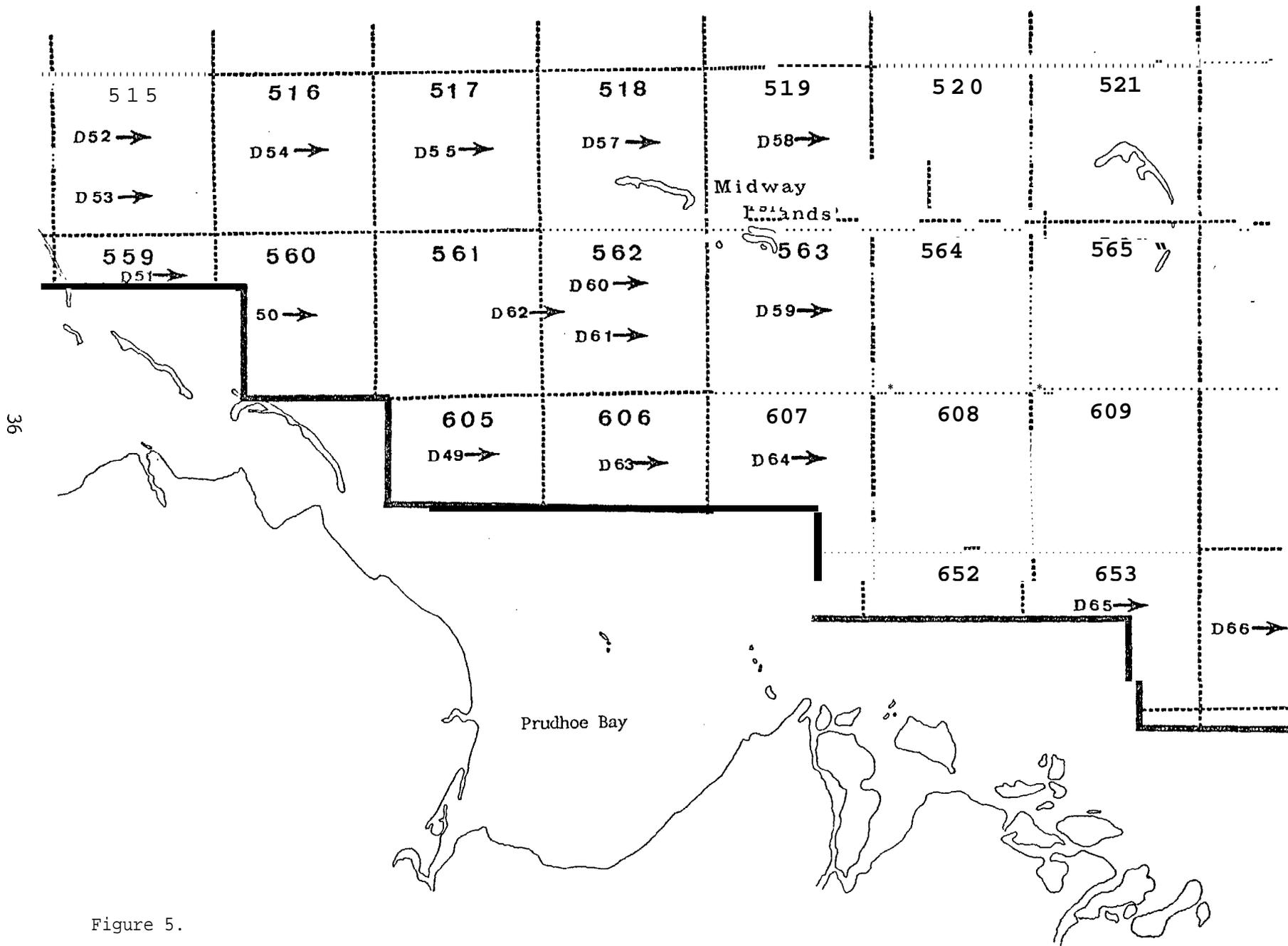


Figure 5.

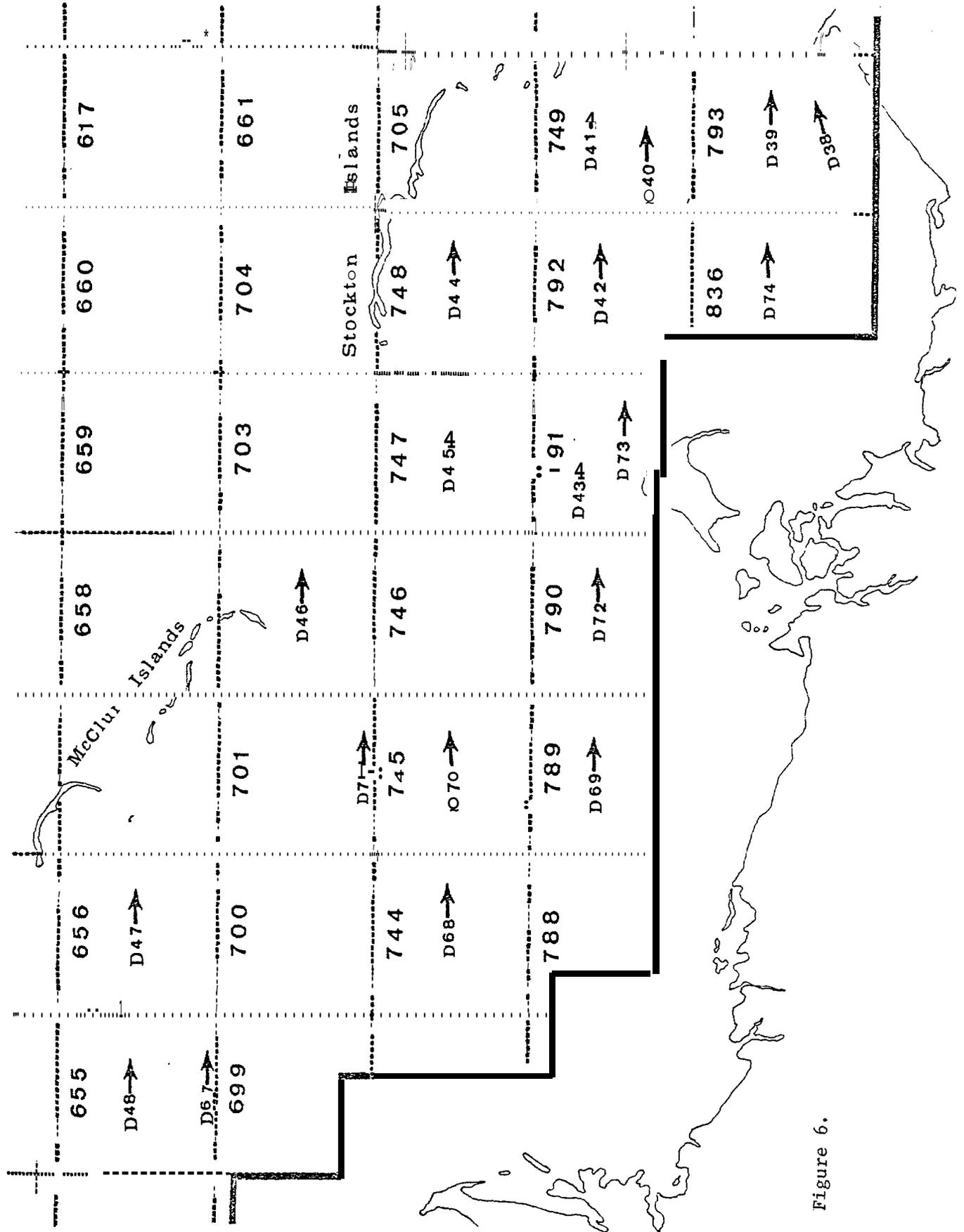


Figure 6.

TABLE 1. Dredge Samples taken with the *Natchik*

Coordinates of Dredges	Section Number	Dredge Sample No.
146° 55' W 70° 13' N	749	40
146° 57' W 70° 14' N	749	41
147° 3' W 70° 14' N	792	42
147° 10' W 70° 14' N	791	43
147° 5' W 70° 17' N	748	44
147° 11' W 70° 17' N	747	45
147° 21' W 70° 21' N	702	46
147° 34' W 70° 23' N	656	47
147° 43' W 70° 24' N	655	48
148° 34' W 70° 25' N	605 borderline	49
148° 41' W 70° 27' N	560	50
148° 47' W 70° 28' N	559	51
148° 48' W 70° 30' N	515	52
148° 45' W 70° 30' N	515	53
148° 38' W 70° 29' N	516	54

TABLE 1. Cent inued

Coordinates of Dredges	Section Number	Dredge Sample No.
148° 30' W 70° 30' N	517	55
148° 21' W 70° 29' N	518 (no organisms)	56
148° 11' W 70° 27' N	518	57
148° 8' W 70° 27' N	519	58
148° 12' W 70° 27' N	563	59
148° 17' W 70° 26' N	562	60
148° 22' W 70° 27' N	562	61
148° 27' W 70° 27' N	562/561 border	62
148° 18' W 70° 25' N	606	63
148° 9' W 70° 24' N	607	64
147° 58' W 70° 24' N	653	65
147° 49' W 70° 21' N	654	66
147° 39' W 70° 19' N	655/699 border	67
147° 36' W 70° 16' N	744	68
147° 29' W 70° 16' N	789	69

TABLE 1. Continued

Coordinates of Dredges	Section Number	Dredge Sample No.
147° 26' W 70° 17' N	745	70
147° 28' W 70° 18' N	701/745 border	71
147° 19' w 70° 15' N	790	72
147° 13' w 70° 15' N	791	73
147° 3' W 70° 13' N	836	74

Specific objectives are to:

1. Determine the water flow rates and filtration efficiency through the baleen apparatus before experimental petroleum and petroleum dispersal agents used during spill cleanup are used for fouling of the baleen hairs.
2. Determine to what specific degrees fouling of the baleen hairs produces matting and other abnormalities to the points where filtration efficiency diminishes by allowing other than normal size classes of plankton to escape that would, under unfouled conditions, be caught.
3. Formulate a statistical model from experimental data gathered that will predict which spill conditions will pose danger to the feeding capabilities and well-being of the bowhead whale population in the Beaufort Sea.

SCOPE

This project will determine what the plankton-filtering efficiency is for baleen plates under unfouled as well as under varying degrees of petroleum-fouled conditions. The results of this research program will allow prediction of the point at which the feeding of baleen whales might be impaired due to petroleum fouling of the baleen feeding apparatus. Feeding impairment could cause the whales to move out of their preferred habitats and possibly threaten the well-being and survival of bowhead and gray whales, in particular, and baleen whales, in general.

METHOD S

Design of the Experimental Apparatus

The experimental apparatus of the presently operating system (Model number one) consists of a water chilling and storage unit and a baleen filtration unit with inter-connecting plumbing, valves, flow meter, and a marine water pump, that sends water throughout the entire system.

The water chilling and storage unit consists of a 0.7 m³ freezer (with a water storage tank inside) and three 725 l water storage tanks, one of which has a glass front. The freezer and the two storage tanks

without a glass front contain crushed ice to chill experimental sea water to arctic equivalent temperatures.

The baleen filtration unit consists of a plexiglass container that is subdivided into chambers. Above, a water receiving chamber lies next to a filtering chamber, and below, there is a water level regulatory chamber and further below a water collecting chamber with a filter connection leading from it.

The filtration chamber has a series of 50 baleen plates mounted in its base with the baleen hairs' and upper, medial faces of the baleen plates forming the floor. The floors of the receiving and filtering chambers have the same curved profile as the natural curvature of the medial face of the series of baleen plates. A gate separates the receiving chamber from the filtering chamber. The gate's lower edge has the same curvature as the floor of the chambers. When the gate is opened a uniform layer of water is introduced over the baleen plates.

The first, **upcurrent** half of the baleen plate series, is completely covered with a piece of thin plexiglass. Water flows over the leading edges of the plates. The hairs, up to 20 cm in length, stream at right angles **downcurrent** to form a filtering layer over the spaces between the baleen plates. If the first spaces between plates weren't covered, they would have incomplete hair coverage and make filtration data invalid. Hairs from the covered plates extend beyond the covering to provide natural hair coverage for the exposed portion of the baleen series.

The baleen plate series is mounted into the filtering chamber with the whale's intact gum providing natural spacing of the baleen plates at one end and a milled plexiglass bar with grooves providing the proper spacing at the other. Both ends of the baleen plate series are then placed in box-like receptacles at the ends of the filtering chamber and embedded securely in wax; thus leaving an extensive central area of the baleen series free for filtration testing. The chamber below the filter chamber maintains a constant water level above and around the baleen plates during filtration experiments as water passes down through the baleen plates by gravity force. The water collecting chamber below the chamber just described has

a drain pipe leading from it. This pipe leads back to the water storage tanks. It has a nitex net installed inside an enlarged PVC pipe section, so that only completely filtered water is allowed to return to the water storage tanks.

Functional Operations of the Experimental Apparatus

By opening a 15.2 cm valve, water with plankton is allowed to pass from the glass front water storage tank to the water receiving chamber of the baleen filtration unit. The water then passes beneath the elevated gate of the receiving chamber and flows over, down, and between the baleen plates. As in a baleen whale's mouth, plankton is filtered from the water and retained by the stratum of numerous fine baleen hairs that extend at right angles across the regular spaced openings between the baleen plates. The filtered water then passes through the water level regulatory chamber by way of a valve and to the water collecting chamber below. From the latter chamber, the water, with assistance from the water pump, passes through the pipe and tube with the nitex net. Any plankton that slipped through the baleen plates is trapped in the net. Water then flows back to the water storage tanks to be recirculated. The flow meter quantifies the amount of water passing through the baleen filtration apparatus with each experimental run.

Experimental Procedures

1. Brine shrimp from the Great Salt Lake near the Brigham Young University are used as the experimental plankters. Very large populations of these organisms occur in the lake because of a lack of predators in their habitat. The upper size range of adult shrimp is comparable to the upper size of natural euphausiid krill upon which bowhead whales feed. In the laboratory, brine shrimp eggs are hatched regularly, and their larvae are raised by feeding them cultured algae. The nauplius larval stages are harvested on a regular schedule to get a gradient of plankton-class sizes. The smaller larval stages of the shrimp are comparable with the sizes of copepods on which bowhead whales most commonly feed. Brine shrimp serve extremely well for the experimental filtration requirements of this study because of ontogenetic uniform classes of growth sizes,

their great local abundance and their size similarity to the natural foods of bowhead whales.

2. **Unfouled**, unchilled to chilled water with plankton of one size at a time is pumped through the baleen filtration system using numerous test runs to calculate the filtering efficiency of **the** baleen apparatus. The number of introduced **planktonic** organisms and total mass of the plankton are calculated at the start of an experimental run. A similar calculation of plankton individuals and mass is made from plankton that escapes through the baleen apparatus and caught by the nitex filter net in the return plumbing line. The filtering efficiency of the whale's baleen plate apparatus is determined by subtracting the counts caught in the **nitex** filter net from the counts introduced initially in the glass front storage tank.

3. Chilled and unchilled waters with suspended petroleum and oil spill chemical dispersants are passed, one combination at a time, through the apparatus for varying periods of time to produce a gradient of conditions for baleen hair fouling. Plankton of differing class sizes is sent through the experimental apparatus to check comparative filtering efficiencies. Petroleum and chemical dispersant buildup on the baleen hairs is carefully measured microscopically. The gradient of conditions, from slightly to strongly fouled, will be tested for comparative filtering capabilities, and results will be compared with those of **unfouled** test runs.

4. After performing the fouled baleen experiments, the apparatus and baleen plates are cleaned thoroughly with a detergent. Clean baleen plate runs will periodically be tested with a comparison of results with the original **unfouled** runs to make sure clean plate runs have the same filtration characteristics as the **unfouled** runs. Also, when a calculated 5% of the baleen hairs have been lost during experimental runs, a new baleen series will be installed in the apparatus. Hairs collected in the nitex net will be retained to calculate the total hair loss.

Concurrent Experimental Projects

1. Baleen plate series' from *ingutuk*, gray, blue, humpback and other baleen whale species will be similarly and comparatively tested in the above described experimental apparatus. Results will be plotted against the feeding habits and food size requirements for each species to see which would be the most seriously affected by oil spills. Presumably the bowhead whale would be the most seriously affected by oil spills because of the extremely small food organisms that are filtered from the water.

2. Baleen hairs from the above species of baleen whales will be studied using a scanning electron microscope. The coarseness, texture and distribution of the hairs will be compared with the fouled and unfouled filtration characteristics and food size utilization for each of the whale species studied.

3. A second experimental filtration apparatus is being designed. It will basically be a tall plexiglass box with a median vertical partition inside. Baleen plates will be installed in a natural vertical position, as in a whales mouth, on the side of the right chamber. Plankton nets will be installed in the side of the left chamber. Filtration of baleen plates, fouled and unfouled, will be tested as the entire apparatus passes underwater at the bow of a slow-moving boat. A simple comparison of plankton catches in both chambers will give the filtration efficiency of the tested baleen plate series.

RESULTS

During this reporting period the apparatus described above was fabricated and installed. Filtering experiments are currently underway and the results will be presented in the Final Report.

ABSTRACT

An apparatus to test the filtration rates and efficiency of baleen plates was designed, fabricated and installed. Tests are currently being conducted using brine shrimp as the experimental filtrate.

COOPERATION

The staff of RU 579 provided baleen plate series from whales harvested at Kaktovik, Alaska.

INVESTIGATORS

John J. Kelley, Ph.D.
Gary A. Laursen, Ph.D.
Erich H. Follmann, Ph.D.

STATEMENT OF TASK

This unit provides for the management of PROJECT WHALES.

PURPOSE

Primary responsibility is to respond to the contractual needs of the BLM Outer Continental Shelf Office and, also, to coordinate all research efforts and report preparation to meet project objectives.

SCOPE

This effort entails management and project organization for all research efforts included in PROJECT WHALES.

METHODS

All project organization, management and budgetary tasks are coordinated and conducted by Drs. Kelley and Laursen. Report preparation is the responsibility of Dr. Erich Follmann, the PROJECT WHALES' Research Coordinator.

RESULTS

During this reporting period four project related meetings were held:

1. A writing workshop was conducted in Seattle to complete the FY 78 Fall Final Report and the FY 79 Spring Status Report. This meeting was attended by representatives of all research units and BLM.
2. A planning meeting was conducted in Barrow to develop the continuation proposal and research objectives for the Fall 1979 whaling season. Bioacoustics, Tissues, Trophies, and Project Management were represented at this meeting.
3. A meeting was held with BLM in Anchorage where a long-range whale research project was presented to BLM. This program was proposed for funding during FY 80.

4. A multi-agency meeting was attended in Seattle to discuss and plan the long-range direction for whale research in the arctic. This meeting was attended by BLM, NMFS, Marine Mammal Commission, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, LGL Ltd. , University of Washington Fisheries Science Center, Marine Mammal Tagging Office, National Oceanic and Atmospheric Administration, NARL, University of Alaska Arctic Environmental Information and Data Center, and the Alaska Eskimo Whaling Commission.

During this period the FY 78 Fall Final Report, the FY 79 Spring Status Report and a Status Report on Whale Movement in and Around the Beaufort Sea Lease Area were completed and submitted. In addition, finalization of the FY 79 Spring Final Report was underway. A proposal for the period 1 October 1979 through 31 January 1980 was completed and submitted.

ABSTRACT

Meetings related to PROJECT WHALES were held and others were attended. Three reports and one proposal were completed and submitted. Finalization of the FY 79 Spring Final Report is underway.