

KILLER WHALE MONITORING AND HABITAT STUDIES

Study ID Number: Marine Mammals Study Number 6

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November 1991

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EXECUTIVE SUMMARY

Photographs of individual killer whales occurring in Prince William Sound were collected from May to September 1991 to assess the potential impacts of the Exxon Valdez oil spill on killer whale life history and ecology. Research vessels traversed over 7,000 nautical miles in search of whales or while photographing whales, reflecting 110 days of field research. An unusually high number of killer whales have been reported as missing from the spill area. Of particular concern are the fourteen missing whales from AB pod and ten missing whales from AT pod. In addition to missing whales, changes have occurred in the social structure of affected pods, an increase was documented in the rate of strandings, and unexplained anatomical changes were reported. Detailed results of our efforts to obtain information on killer whale abundance and whale reproductive rates are given in our 1991 annual report conducted under the NRDA Program (Marine Mammal Study Number 2 - Year 3).

To determine habitat use and overall distribution patterns of Prince William Sound killer whales we are in the process of reviewing all available sighting data. Published and unpublished data are being reviewed. Form letters, requesting sighting data on killer whales, were sent to various federal and state agencies. The National Marine Mammal Laboratory's Platforms of Opportunity Program currently contains approximately 30 years of sighting data. These sighting data are being plotted for the Prince William Sound area and adjacent waters. Unfortunately, effort is not consistent among months or years to provide quantitative data on whale seasonality or areas of whale concentrations. Once all data are collected, we will attempt to correlate sighting data with water depth and sea surface temperature. Review of fishery catch data may facilitate correlation of killer whale distribution with potential prey concentrations. The results of these studies will be available in March 1992.

We are also investigating the likelihood of success in placing satellite tags on killer whales to obtain critical information of whale habitats. Scientists with expertise in satellite tagging have been consulted and encourage this work. In addition, killer whale experts have been informed of these studies and agree that satellite tagging will provide extremely useful information on killer whale movements and habitat preferences. Environmental agencies have been alerted to our future plans. The National Marine Fisheries Office in Washington, D. C., has been contacted and has provided valuable advice to facilitate obtaining needed federal permits to conduct this work. Discussions have also taken place with personnel from the Marine Mammal Commission. We will continue our investigations on tag deployment and attachment as well as continue discussions with our colleagues and environmental groups. A final report will be prepared and submitted by March 1992.

OBJECTIVES

1. To determine killer whale reproductive rates and trends in abundance within Prince William Sound and adjacent waters affected by the Exxon Valdez (NRDA).
2. To identify and describe habitat requirements for killer whales, a prerequisite to developing realistic restoration options for the species (Restoration).

INTRODUCTION

Since 1989, photographs of individual Prince William Sound killer whales have been collected to assess the potential impacts of the Exxon Valdez oil spill on killer whale life history and ecology. Field studies have been supported under the Natural Resource and Damage Assessment (NRDA) Program. Results indicate that an unusually high number of killer whales are missing from the spill area. In addition to the missing whales, changes occurred in the social structure of affected pods, an increase was documented in the rate of strandings, and unexplained anatomical changes were reported. Monitoring of the status and distribution of killer whales in Prince William Sound has continued for the last three years to obtain needed information on killer whale reproductive rates and trends in abundance.

To facilitate recovery of injured populations recovery plans must be implemented. Restoration of cetaceans can be enhanced by protecting sensitive habitats, minimizing fishery interactions, reducing or redirecting other human-use activities, and promoting public education. The designation of critical habitats has occurred in the United States to protect recovery of pinnipeds and also internationally to protect cetaceans. Unfortunately little or no quantitative information exists on habitat needs for killer whales in Prince William Sound and adjacent waters on which to base a recommendation to limit or otherwise change human-use activities.

In 1991, in addition to the NRDA studies, companion restoration science studies were initiated. The restoration studies were aimed at determining the adequacy of the damage assessment database to support decisions on habitat protection and other management activities.

STUDY METHODOLOGY

Personnel from the National Marine Mammal Laboratory (NMML), Seattle, Washington (Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA/DOC) developed and coordinated the

killer whale damage assessment activities associated with the Exxon Valdez oil spill. Although NMML personnel participated in field studies, the majority of the field work was conducted by contractors that have recognized expertise in the study area of concern. Field studies were conducted under federal permits issued through the National Marine Mammal Protection Act (MMPA). The development and implementation of restoration studies on killer whales will be conducted by NMML personnel.

Sampling Methods

Killer Whale Reproductive Rates/Trends in Abundance

This work (Objective 1) will be conducted under the NRDA Program (Marine Mammal Study Number 2 - Year 3). The methods used to obtain censusing data are described briefly in this proposal and are reported on in more detail in the 1991 NRDA annual report on killer whales.

Killer whale reproductive rates and trends in abundance will be investigated by using ship surveys to obtain photographs of individual whales. When whales are sighted, researchers will stop to collect photo-identification information. To obtain a high-quality photograph, an approach within 30-60 meters is required. Photographs are taken of the left side of the whale's dorsal fin and saddle patch. In addition to photographs, data will be collected on the general condition of individual whales (e.g., observations of skin disease).

Daily vessel logs will be maintained each day which permits 1) quantification of the amount of time searching for whales versus photographing whales, 2) quantification of search effort under different weather conditions, 3) projection of daily trackline, and 4) the number of vessels/aircraft encountered in the study area.

Habitat Requirements

Initial assessment of habitat use for Prince William Sound killer whales (Objective 2) will include a review of all available sighting data. Federal and State agencies, as well as independent researchers, will be contacted and requested to supply sighting data on killer whales. Published and unpublished data will be reviewed. We will attempt to correlate sighting data with water depth and sea surface temperatures. Review of fishery catch data may facilitate correlation of killer whale distribution with potential prey concentrations. General behavior of killer whales and the presence of other marine mammals will be noted.

To more accurately determine habitat use and overall distribution and movements of killer whales, we will explore the feasibility of

placing satellite transmitters on Prince William Sound killer whales. Recently, many successful deployments of satellite transmitters on cetaceans and pinnipeds have provided important ecological information and each year brings about major advances in technology. If feasible, and after extensive examination of existing technology, we will place satellite tags on at least three whales in Prince William Sound.

Year one investigations (1991) will involve a review of all information pertaining to satellite tagging and a determination of the likelihood of success in placing satellite tags on killer whales. Scientists with expertise in satellite tagging will be consulted. If the likelihood of success is considered high, year two (1992) would be devoted to the engineering of the satellite linked radio tag for placement on killer whales. If the necessary equipment is obtained in 1992 and we are satisfied with all aspects of the work (delivery system, attachment device, minimal disturbance to whales, etc.), we would propose to initiate satellite tagging during the 1993 field season (year three). The permit process for this activity would begin in mid-1992.

Data Analysis

Killer Whale Reproductive Rates/Trends in Abundance

All exposed film of killer whales collected during the 1991 field season would be analyzed for individual identification. Each negative (or prints as needed) is placed under a dissection microscope for identification and notes and sketches are made. Sub-standard photographs (not showing enough detail or improper angle/side) are discarded; reducing the probability of mis-matching photographs. Photographs are grouped by individuals. Each identified whale is visually compared to the historical photographic database available. Once all photographs are properly entered and evaluated, it is then possible to determine 1) if all members of the pod were present, and 2) if pod structure/integrity is similar to previous years. Missing animals are noted. The stability of resident pods over time is such that if an individual is listed as missing for at least one year; that missing whale is considered dead.

To avoid biases in data interpretation, it is important that the amount of effort in searching for and photographing whales is at least equal to (but not less than) that completed in previous years. For a large pod (>12 animals), the likelihood of obtaining photographs of all individuals are increased as the number of encounters are increased. Some individuals, and certain pods, are more likely to approach vessels making photographic documentation easier; while others keep a considerable distance away making for more difficult conditions. Whale behavior also plays a role when attempting to obtain photographs of individual whales. If the pod is resting (typically grouped together), it is easier to obtain

photographs of all whales vs. when the pod is traveling (spread out through an area). General location of killer whales will be recorded each time photographs are taken, allowing comparisons of pod distributions among years.

Calves of the year will be noted and their mothers identified. Natality (number of calves per adult female) will be calculated for each pod for each year and comparisons made between resident and transient groups using descriptive statistics. Mortality rates will also be calculated for resident groups. Mortality for transient pods will be calculated when necessary data are available.

Habitat Requirements

Killer whale habitat usage will be investigated by plotting all observations of killer whales obtained from the various historical databases. A summary report (due March 1992) will be provided and will include any information collected on water depth, water temperatures, and potential prey species.

In addition to the report submitted on overall distribution of killer whales, a progress report will be written assessing the feasibility of placement of satellite transmitters on killer whales based upon the information obtained during 1991 investigations (due March 1992).

STUDY RESULTS

Objective 1. Between 16-24 May and 5 June to 13 September 1991, research vessels traversed 7,340 nautical miles in Prince William Sound in search of whales or while photographing whales. This coverage represents a total of 89 operable days of field research plus 21 days in which researchers were confined to camp due to weather. In 1991, seven resident pods and four transient pods were photographed. The objectives of our NRDA year 3 studies on killer whales were successfully met and detail results are found in the 1991 annual report.

Objective 2. To determine habitat use and overall distribution patterns of Prince William Sound killer whales we are in the process of reviewing all available sighting data. Published and unpublished accounts are being reviewed. Form letters, requesting information on killer whales, have been forwarded to appropriate sources (Figure 1). The National Marine Mammal Laboratory's Platform of Opportunity Program contains approximately 30 years of sighting data from the Prince William Sound area (Figure 2). Data will be reviewed to determined areas of whale concentrations. Unfortunately, the effort is not consistent among months or years to provide quantitative data on whale seasonality. Although a large body of information exists on sightings of killer whales, the

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October 7, 1991

F/AKC3:MED

Address Here

Dear xxx:

Since 1989, the National Marine Mammal Laboratory has been investigating the possible impact of the Exxon Valdez oil spill on Prince William Sound killer whales. As part of that investigation, we are interested in any sighting data on killer whales from Prince William Sound and the adjacent waters of the Gulf of Alaska as far as west as the Kenai Fjords, Seward, Homer, and Kodiak Island and southeast as far Yakutat.

If you have any killer whale sightings from these areas or know of anyone else who might have similar information, I would appreciate hearing from you. Useful information would include the date, time and location of a sighting, number of animals, and any other comments such as behavior or interactions with boats or other marine mammals. Copies of photographs would also be very helpful.

I hope to hear from you soon. Thank you for any information you might be able to provide.

Sincerely yours,

Marilyn E. Dahlheim, Ph.D.
Cetacean Task Leader
Alaska Ecosystem Program

Figure 1. Form Letter requesting killer whale sightings.

Killer Whale Sightings, all years & seasons (1958-1990)

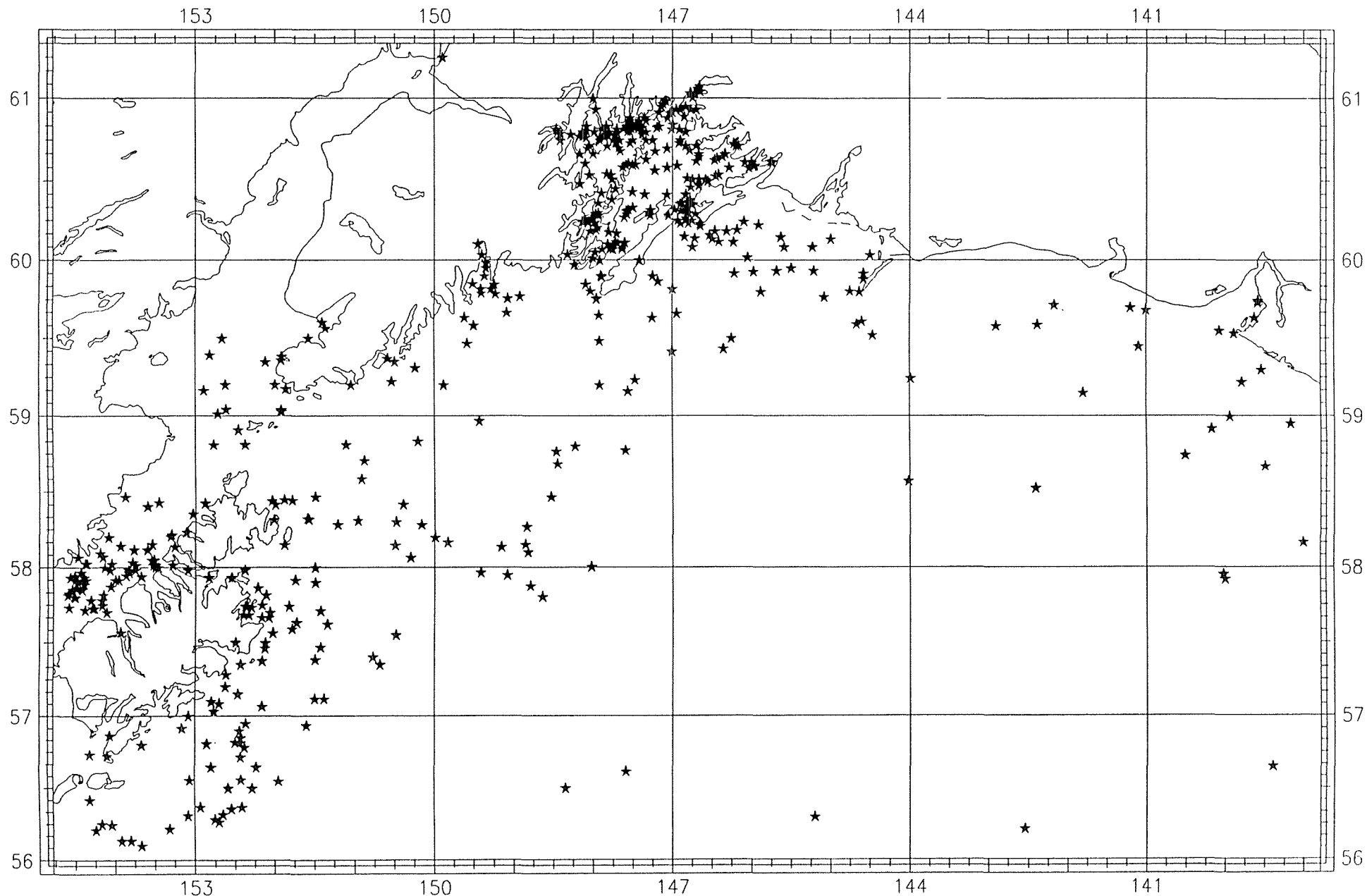


Figure 2. Killer whale sightings Prince William Sound and adjacent waters (1958-1990). Platforms of Opportunity Program (National Marine Mammal Laboratory).

information content is limited pertaining to seasonality, areas of concentrations or habitat requirements. Once all sighting data are collected and all literature is reviewed, we will attempt to correlate sighting data with water depth and sea surface temperatures. Review of fishery catch data may facilitate correlation of killer whale distribution with potential prey concentrations. The results of these efforts will be available in our report due March 1992.

We are currently investigating the likelihood of success in placing satellite tags on killer whales to obtain needed information on killer whale habitats and movement patterns. Scientists with expertise in satellite tagging have been consulted and have supported the continuation of this work. In addition, scientists with expertise on killer whales have been approached and have agreed that work of this type is needed on killer whales. Environmental agencies have been notified. In addition we have contacted our Washington D. C. permit office to obtain advice regarding permit procedures. Future meetings are planned with necessary experts in the field to discuss deployment and attachment of satellite tags to cetaceans. A final report will be prepared and submitted, as scheduled, in March 1992.

STATUS OF INJURY ASSESSMENT

We are currently only six months into our restoration studies. We are on schedule and plan to successfully achieve our objectives and meet our deadlines listed in the study plan. Completed reports will be available in March 1992.

Killer Whale Monitoring and Habitat Studies

Study ID Number: Marine Mammals Study Number 6

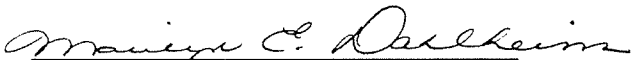
Project Leader(s): Marilyn E. Dahlheim and Thomas R. Loughlin

Lead Agency: National Oceanic and Atmospheric Administration

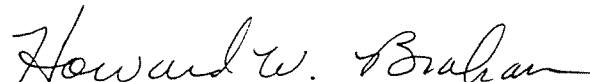
Cooperating Agency(ies): Federal: None
State: None

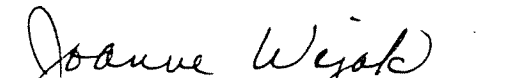
Cost of Proposal: \$ 219.5K

Dates of Study Plan: 1 April 1992 through 31 March 1993
(Year 2).


Marilyn E. Dahlheim, Ph.D.
Project Leader


Thomas R. Loughlin, Ph.D.
Project Leader


Howard W. Braham, Ph.D.
Organization Leader


Joanne Wejak
Financial Officer

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4 November 1991

INTRODUCTION

Photographs of individual killer whales occurring in Prince William Sound were collected from May to September 1989 and 1991 to assess the potential impacts of the Exxon Valdez oil spill on killer whale life history and ecology. Research vessels traversed over 25,000 nautical miles in search of whales or while photographing whales, reflecting 617 days of field research. An unusually high number of killer whales were reported missing from one of the resident pods named AB pod. In addition to missing whales in this pod, significant changes occurred in the pod's social structure.

Continued monitoring of the status of AB pod in Prince William Sound through photo-identification studies is required to document natural recovery of the injured population. In addition, restoration of killer whales can be enhanced by protecting sensitive habitats, minimizing fishery interactions, reducing or redirecting other human-use impacts, and promoting public education. The designation of habitats has occurred in the United States to protect endangered and threatened pinnipeds and also internationally to protect cetaceans. Recently Robson Bight in British Columbia has been designated as a sensitive habitat for killer whales (Rennie, 1989). It should be understood, however, that little or no quantitative information exists on habitat needs for killer whales in Prince William Sound and adjacent waters on which to base a recommendation to limit or otherwise change human-use activities.

The purpose of this study is to obtain photographs of individual killer whales occurring in AB pod to document natural recovery. Photographs collected will be compared to the National Marine Mammal Laboratory's photographic database for the years 1989 to 1991 to determine if changes continue to occur in whale abundance, pod integrity, and mortality or natality rates. Photo-identification studies have been used with a number cetacean studies and the methods well proven. Investigations will continue on the feasibility of satellite tagging killer whales. Data obtained from tagged whales would be used to determine habitat needs for the species. During 1992, a request to place satellite tags on killer whales will be submitted to National Marine Fisheries Service (Office of Protected Species) to obtain necessary federal permits. Transmitters would be attached to at least three killer whales during the summer of 1993. A delay in the 1992 photo-identification field studies could result in the loss of data pertaining to annual killer whale reproductive and mortality rates and would also impact the collection of needed information on habitat requirements for killer whales.

OBJECTIVES

1. To count the number and individually identify killer whales within AB pod.
2. To test the hypothesis that pre- and post-spill killer whale structure and integrity within AB pod have remained constant.
3. To determine killer whale reproductive rates and trends in abundance within Prince William Sound.
4. To identify and describe habitat requirements for killer whales through the use of satellite tags, a prerequisite to developing realistic restoration options for the species.

METHODS

A. Sampling Methods

- 1) Enumeration, Pod Structure and Integrity,
Reproductive Rates and Trends in Abundance.

Personnel from the National Marine Mammal Laboratory (NMML), Seattle, Washington (Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA/DOC) will develop and coordinate all killer whale research activities associated with restoration studies. Field studies will be conducted by either NMML staff and/or contractors that have recognized expertise in the study areas of concern.

A shore-based camp (equipped with a suitable small boat for whale identification work) or a live-aboard chartered vessel will be used in Prince William Sound to conduct photo-identification studies on killer whales from approximately July to September 1992. Study areas will be similar to those areas worked during our 1989 through 1991 seasons. The camp or vessel would be fully self-contained with necessary items for safety and staffed by at least two biologists. For consistency in data collection, key personnel remain in the field throughout the study period.

Weather permitting, field personnel will spend an average of 8 to 10 hours per day conducting boat surveys searching for AB pod. When encountered, other pods of killer whales should be photographed as well. Specific areas, known for whale concentrations, are investigated first. However, if reports of whales are received from other sources, those areas are examined. If AB pod is not located in "known" areas and opportunistic sighting reports are not available; a general search pattern is developed and implemented. Travel routes typically taken by AB pod will be surveyed. When whales are sighted, researchers stop further search efforts and approach the whales to collect photo-

identification information. When whales are encountered, researchers select a vessel course and speed to approximate the animals' course and speed to facilitate optimal photographic positioning.

To obtain a high-quality photograph, an approach within 30-60 meters is required. Photographs are taken of the left side of the whale's dorsal fin and saddle patch. Any high-performance camera system (i.e., Nikon, Canon, Pentax) can be used to collect the data. Motor drives (5 frames/sec) and 300 mm fixed lens are optimal. The camera shutter speed is set to 1/1000th second, or the highest speed possible. The film type should allow for a high shutter speed and good depth of field. For this project the type of film is standardized; black and white Ilford HP5 film (ASA 400), which is taken and developed at ASA 1600. The camera should be held steady and be supported by a shoulder brace if possible. All exposed film during this study will be developed by the same photographic laboratory. Film will be processed throughout the season to allow field personnel to obtain necessary feedback within two weeks of encounters. Proper labelling of exposed film includes date, roll number, photographer's initials, location, species code, and ASA setting. A new roll of film is used for each encounter.

Daily effort logs are maintained each day which will permit 1) quantification of the amount of time searching for whales versus photographing whales, 2) quantification of search effort under different weather conditions; 3) daily vessel trackline, and 4) an estimation of number of vessels/aircraft encountered in the study area.

2) Habitat Requirements

The current sighting data on killer whales does not contain adequate information to allow quantification of critical habitat needs for killer whales. Whale movement patterns are unknown. To more accurately determine habitat use and overall distribution and movements of killer whales, we have explored the feasibility of placing satellite transmitters on Prince William Sound killer whales. Recently, many successful deployments of satellite transmitters on cetaceans and pinnipeds have provided important ecological information and each year brings about major advances in technology. After extensive examination of existing technology, we believe that the technology is available to successfully place satellite tags on at least three whales in Prince William Sound. Year two (1992) will be devoted to the modification of satellite tags for placement on killer whales. In addition, an application will be submitted to obtain the necessary federal permits for this work. If the necessary equipment and permit is obtained in 1992 and we are satisfied with all aspects of the work (delivery system, attachment device, minimal disturbance to whales, etc.), we propose to initiate

satellite tagging during the 1993 field season (year three).

B. Data Analysis

1) Photo-Identification Studies

All exposed film of killer whales collected during the 1992 field season will be analyzed for individual identification. Each negative (or prints as needed) is placed under a dissection microscope for identification and notes and sketches are made. Sub-standard photographs (not showing enough detail or improper angle/side) are discarded; thus reducing the probability of mismatching photographs. Photographs are then grouped by individuals. Each identified whale is then visually compared to the historical photographic database available. Once an individual whale is properly identified, it is relatively easy to identify the pod to which it belongs. Once all photographs are properly entered and evaluated, it is then possible to determine 1) if all members of the pod were present, and 2) if pod structure/integrity is similar to previous years. Missing animals are noted. The stability of resident pods over time is such that if an individual is listed as missing for at least one year; that missing whale is considered dead.

Calves of the year will be noted and their mothers identified. Natality (number of calves per adult female) will be calculated for each pod for each year and comparisons made between resident and transient groups using descriptive statistics. Mortality rates will also be calculated for resident groups. Mortality for transient pods will be calculated when necessary data are available.

2) Habitat Requirements

A progress report will be written assessing the success of obtaining appropriate tags and permits. This would include recommendations for either continuation or cancellation of this aspect of the work.

FUTURE STUDIES

Because killer whale recovery rates are essentially unknown (it may take 25-30 years or more), there is a clear need to continue monitoring population trends for killer whales in the spill area beyond the 1992 field season. Since the historical database was found inadequate to support future decisions to implement restoration (e.g. habitat protection), it is possible that future habitat-use surveys (beyond satellite tagging) would be proposed.

SCHEDULES & PLANNING

A. Data Submission and Archival

No other special reports or additional visual data will be submitted other than those described in the reports.

Reports will be available through the National Marine Mammal Laboratory, Seattle, Washington (Attn: Drs. Dahlheim and Loughlin) summarizing the 1992 studies. Reports are written in a scientific format and contain an Abstract, Title Page, Table of Contents, List of Tables and Figures, Introduction, Materials and Methods, Results, Discussion, and Conclusion/Recommendation Section. Original survey forms, identification cards, daily logs, marine mammal sighting and effort forms are archived at the National Marine Mammal Laboratory. The highest quality photograph for each individual killer whale will be selected and a 2 1/2" by 3 1/2" print will be made for archival purposes.

All documents and materials associated with this monitoring study will be stored at the National Marine Mammal Laboratory, Seattle, Washington under the Alaska Ecosystem Program. Killer whale prints are stored in archival plastic sheets and properly labelled (date/location/photographer). Equipment purchased for the investigations will be properly labelled. Serial numbers will be listed when available. Equipment will be stored in the custody of the Project Leaders at the NMML.

B. Management Plan

NOAA, Alaska Fisheries Science Center, National Marine Mammal Laboratory, 7600 Sand Point Way N. E., Bin C15700, Seattle, Washington 98115 (206/526-4045).

Dr. Marilyn E. Dahlheim, Project Leader

Duties: Project development, research design and implementation. Coordination of, and participation in, field research.

Dr. Thomas R. Loughlin, Project Leader

Duties: Project development and research design.

Ms. Joanne Wejak, Financial Officer

Duties: Administrative officer in-charge of processing financial paperwork associated with research.

Temporary Biologist (x2)

Duties: Laboratory/Field Assistant

NOAA, WASC, Procurement Division, 7600 Sand Point Way N. E., Bldg. 1, Location 22, Seattle, Washington 98115.

Duties: Contract Negotiations and Administration
206/526-6494

BUDGET

A. Costs (in thousands of dollars = K)

	<u>Line</u>					<u>Total</u>
	<u>100</u>	<u>200</u>	<u>300</u>	<u>400</u>	<u>500</u>	
-Projected Expenses 4/92 - 3/93	58.5	11.0	100.0	20.0	30.0	\$219.5K*

PROJECTED EXPENDITURE BREAKDOWNLine 100 - Salaries

<u>Level</u>	<u>Name</u>	<u>Months</u>	<u>Salaries & Benefits/Month</u>	<u>Total</u>
GM-14	Loughlin	1.0	5,800.00	5,800.00
GS-12	Dahlheim	5.0	4,200.00	21,000.00
GS-09	Assistant	6.0	3,000.00	18,000.00
GS-07	Assistant	6.0	2,275.00	13,650.00
			<u>Total</u>	\$58,450.00

Line 200 - Travel

Travel would include trips from Seattle, Washington to Alaska to conduct field research and to Newport, Oregon to consult with experts in the field of telemetry systems. In addition, monies are set aside for travel to Alaska for required restoration meetings.

Total \$11,000.00

Line 300 - Contracts

Contracts for photo-identification studies, modification and purchase of satellite tags for killer whales.

Total \$100,000.00

Line 400 - Supplies

Purchase of air time on Service Argos and necessary supplies.

Total \$20,000.00

Line 500 - Equipment

Purchase of delivery systems and computers.

Total \$30,000.00

GRAND TOTAL \$219,500.00

*Killer whales are a highly valued species. The proposed costs are not disproportionate considering the value of the resource.

PERSONNEL QUALIFICATIONS

Curriculum Vitae of Project Leaders is provided (Attachment 1 and 2).

CURRICULUM VITAE (abbreviated)

Marilyn E. Dahlheim, Ph.D.
National Marine Mammal Laboratory
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Seattle, Washington 98115-0070

From 1978 to the present time have participated and designed marine mammal vessel and aerial surveys in Alaskan waters (Bering, Chukchi and North Pacific). Have collected and analyzed acoustical data on whales and seals inhabiting Arctic waters from vessel, ice, and helicopter platforms. Collected data on movements, behavior, and distribution of marine mammals and correlated distributional data on marine mammals with physical environment. Co-chief scientist on USCGC Icebreaker POLAR SEA in charge of shipboard activities and selection of personnel from multidisciplinary fields to define winter habitat of bowhead whales. Helped developed use of passive acoustics as a censusing device to monitor whales. Training of personnel on correct methods of collection and analysis of scientific data. Responsible for reviewing outside research proposals for accuracy of scientific hypotheses and methods. Review of numerous environmental assessments, impact statements, and marine mammal permits. Reviewer for two scientific journals and participation with other governmental agencies regarding solutions to problems arising from increasing oil development and vessel traffic and the acoustical effect on marine mammals. Principal investigator for five consecutive years conducting acoustical research on gray whales in Mexico. Principal investigator gray whale census (three consecutive years). Task leader on killer whale/blackcod fishery interactions in Prince William Sound, including photo-identification research. Task leader for photo-identification studies on killer whales in the Bering Sea (four years). Project leader on NRDA studies 1989-1991 on humpback and killer whales. Representative of the National Marine Mammal Laboratory at international conferences/ meetings; submission/acceptance of independent research proposals. Has published extensively in peer reviewed scientific journals and lay publications.

CURRICULUM VITAE (abbreviated)

Thomas R. Loughlin, Ph.D.
National Marine Mammal Laboratory
7600 Sand Point Way, NE
Seattle, WA 98115-0070

From 1977 to 1981 was Acting Chief, Research and Management Division, NMFS, Washington, D.C., and was responsible for development, implementation, and coordination of the national research and management program consisting of research into the life history and population dynamics of marine mammals and endangered species. Currently is leader of the Bering Sea/Gulf of Alaska Ecosystem Program, National Marine Mammal Laboratory and is responsible for developing and executing ecosystem based research regarding marine mammal abundance, distribution, trophic relationships, and environmental and fishery data throughout Alaska. Also responsible for the design, supervision, and execution of research addressing marine mammal fishery interactions between foreign and domestic commercial fisheries in Alaska. Has been Chief Scientist on numerous ship and terrestrial research programs spanning fifteen years of marine mammal research along the west coast of North America. Associate Professor (courtesy), Oregon State University, and reviewer for scientific papers submitted to over eleven scientific journals. Has published extensively in peer reviewed scientific journals and lay publications.

SELECTED CITATIONS

The following killer whale articles are pertinent to the studies.

- Anon. 1982. Report on the workshop on identity, structure, and vital rates of killer whale populations. Rept. Int. Whal. Commn, 32: 617-631..
- Balcomb, K. C. 1978. Orca Survey 1977. Final Report of a Field Photographic Study Conducted by the Moclips Cetological Society in Collaboration with the U. S. National Marine Fisheries Service on Killer Whales (Orcinus orca) in Puget Sound. Unpub. Report to the Marine Mammal Division, National Marine Fisheries Service, Seattle, Washington, 10 pages.
- Bigg, M. A. 1982. An Assessment of Killer Whale (Orcinus orca) Stocks off Vancouver Island, British Columbia. Rept. Int. Whal. Commn., 32: 655-666.
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- Braham, H. W. and M. E. Dahlheim. 1982. Killer Whales in Alaska Documented in the Platforms of Opportunity Program. Rept. Int. Whal. Commn. 32: 643-646.
- Calambokidis, J., J. Peard, G. H. Steiger, J. C. Cubbage, and R. L. DeLong. 1984. Chemical contaminants in marine mammals from Washington State. Natl. Oceanic Atmospheric Admin., Tech. Memo, NOS OMS, 6: 1-167.
- Dahlheim, M. E. 1988. Killer Whale (Orcinus orca) Depredation on Longline Catches of Sablefish (Anoplopoma fimbria) in Alaskan Waters. National Marine Mammal Laboratory, Seattle, Washington.
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