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Exxon Valdez Oil Spill Restoration Science Study
Detailed Study Plan

Title: Habitat Use, Behavior, and Monitoring of Harbor Seals in Prince William Sound

Study Number: 1

Principal Investigator: Kathryn J. Frost

Lead Agency: Alaska Department of Fish and Game

Cooperating Agency: NOAA/National Marine Fisheries Service

Cost of Proposal: $181,500

Dates of Study: 1 March 1991-28 February 1993

Principal Investigator Don Calkins for Kathryn J. Frost

Supervisor Donald W. Calkins 6/7/91

Director, OSIAR Division Michael R. Dean/SES

II. INTRODUCTION

The semi-enclosed waters of Prince William Sound (PWS) provide very good habitat for harbor seals (Phoca vitulina) and other marine mammals. Several thousand seals occur in PWS, where they are commonly seen hauled out on rocks, reefs, beaches, and glacial ice. Harbor seals are used for subsistence by residents of coastal communities such as Tatitlek, Chenega, and Cordova. Tourists and recreational users of PWS enjoy watching and photographing harbor seals. They, like other marine mammals, are protected by provisions of the Marine Mammal Protection Act. Because of a population decline that is going on in PWS and other parts of Alaska, it is possible that other protective legislation such as the Endangered Species Act may be invoked to provide for conservation and recovery of harbor seals.

Harbor seals were impacted by the Exxon Valdez oil spill (EVOS) in PWS. They encountered oil in the water and on haulouts. Early in the spill several fetuses, pups, and older animals were found dead in the impacted area. Studies conducted as part of the Natural Resources Damage Assessment (NRDA) program documented a substantial decline in the number of seals in oiled areas.

The number of seals in PWS had been declining prior to the EVOS. Twenty-five haulout sites in eastern and central PWS have been used to monitor trends in abundance since 1984. The mean number of seals in the trend count area during late summer surveys declined by 40% between 1984 and 1988, from 1,796 seals to 1,058 seals, a rate of about 10% per year (Pitcher 1989). Subsequent to the spill, the population decline continued at about the same rate at unoiled locations. However, at oiled sites the decline was much greater. From 1988 to 1990 harbor seals in the oiled portion of the trend count area declined 35%, compared to 13% in unoiled areas.

Because of the decline in harbor seals, which was exacerbated in the area impacted by the EVOS, it is particularly important to understand what factors are limiting the population. We cannot assume, given the ongoing decline, that the number of seals in oiled areas will return naturally to pre-spill levels. It is necessary both to continue monitoring population trends and to identify and appropriately manage areas of particular biological significance in order to augment recovery in any way possible. Most of the information currently available on harbor seals in PWS consists of counts of animals on haulouts during pupping and molting. While these data are essential for monitoring changes in overall abundance, they are not adequate for determining what is causing the seal population to decline, or for designing conservation and management measures to facilitate recovery and ensure its future health. There is no information available on site fidelity, movements between haulout sites, seasonal changes in hauling out patterns, habitats used for feeding, or feeding behavior.

Recently developed satellite-linked telemetry can be used to gather information on all of these important aspects of harbor seal biology. Miniature platform transmitter terminals (PTTs) have created opportunities to monitor location and diving behavior of marine mammals (Mate 1986; Hill et al. 1987; Mate 1989; Stewart et al. 1989; R. Merrick personal communication). The PTTs transmit to a satellite-based Doppler positioning system that calculates locations and tracks movements of animals with considerable accuracy. When combined with appropriate environmental sensors and microprocessor hardware and software, other information about an animal's environment and behavior can be transmitted to the satellite.

The goals of this study are to gather data on the behavior and habitat use of harbor seals in PWS that can be used to design effective conservation measures, and to monitor the abundance and trends of harbor seals at trend count sites in oiled and unoiled areas of PWS using standardized methodology. Habitat use and behavior studies will be conducted by attaching satellite transmitters to harbor seals at selected sites, and determining their movements, diving patterns, feeding locations, and haulout patterns. Population monitoring will be conducted by flying aerial surveys of the trend count route during the autumn molt. Counts will be compared to data collected prior to and during the EVOS in order to document whether and how rapidly natural recovery occurs. In 1991, monitoring will be included as part of NRDA Marine Mammal Study No. 5, Assessment of Injury to Harbor Seals in Prince William Sound, Alaska and Adjacent Areas.

III. OBJECTIVES

1. To describe haulout behavior of satellite-tagged harbor seals in PWS relative to date, time of day, and tide.

2. To describe the use of particular haulouts by satellite-tagged harbor seals in PWS and the frequency of movements between haulouts.

3. To describe patterns of movements of harbor seals within PWS and between PWS and adjacent areas.

4. To describe diving characteristics and feeding behavior of harbor seals in different habitats in PWS.

5. To use the data provided by this study to identify important harbor seal habitat and recommend management actions necessary to safeguard that habitat.

6. To use data provided by this study to interpret aerial survey data and to refine aerial survey methodology.

IV. METHODS

Habitat use and behavior

We propose to begin the investigation of harbor seal habitat use in PWS with a pilot study in which five satellite-linked PTTs will be attached to seals at haulouts that were oiled during the EVOS. Two seals will be caught and instrumented during April 1991 and three others in September 1991.

Seals will be caught using nets deployed near haulouts. Transmitters will be attached to the back of the seal by gluing with epoxy resin (Fedak et al. 1984). The transmitters should remain attached for several months or until the following autumn when they will be shed during the molt.

Information obtained from these tagged seals will be used to evaluate tag performance and to determine baseline values for parameters such as depth of dive and dive duration. This information will allow future tags to be programmed with appropriate default values and threshhold levels such that they will gather and store the maximum amount of useful data.

Data will be aquired from the ARGOS satellite receiving system and analyzed using software provided by the manufacturer of the transmitters. Each PTT (approximate size 15cm x 15cm x 3cm) will transmit geographical locational information to a polar-orbiting satellite whenever an uplink to the satellitle occurs. This will happen when the seal is hauled out or when it surfaces sufficiently long for transmission to occur and the satellite is positioned to receive the signal. Units will also be equipped with built-in programmable microprocessors to collect and summarize data for periods when animals are diving and store it for later transmission, as has been done for crabeater seals (Hill et al. 1987) and Steller sea lions (R. Merrick, personal communication). These data will be stored in memory until the seals haul out on land. A sea water switch will indicate when the animal is hauled out and all data stored in memory will then be transmitted during the next satellite overpass. Dive data will be summarized as histograms and dive profiles. Temperature sensor data will also be reported.

Each PTT broadcasts a unique identification code so that data can be assigned to a particular seal. Position accuracy for all geographical locational information is rated by Service ARGOS to reflect the predicted accuracy of the calculated locations (Fancy et al. 1988, Stewart et al. 1989). Data acquired for harbor seals in this study will be screened for accuracy and interpretation of results will take into account signal quality. Sensor data will be used to validate whether the animal was at sea or hauled out on land when data were acquired, since errors in calculated locations may falsely indicate that a seal is on land or at sea (see Stewart et al. 1989).

Data on the haulout patterns of tagged seals will be examined for indications of daily or seasonal variations, for example to determine whether there is a change in the frequency of haulout by season, or whether the amount of time spent hauled out changes. Plots of locations where continuous signals are received will be used to determine the degree and regularity of use of particular haulout sites. We expect to receive fewer locations of seals while at sea, because the transmitter's antenna will frequently be submerged. However, at-sea locations will be plotted as an indication of areas used for feeding. Information on depth and pattern of diving will be compiled, and can provide some additional information on the general areas used for feeding.

These data will be used to evaluate site fidelity of seals, to quantify the amount of interchange among haulouts within and outside of the area impacted by the EVOS, to determine seasonal importance of particular haulouts, and to identify areas used for feeding. This information will help to identify areas of particular biological significance, and will serve as the basis for management recommendations to ensure the integrity of important seal habitats. They will also be valuable in further refining aerial survey methodology, particularly in determining the best time to conduct surveys.

V. DATA ANALYSIS

Behavior and Habitat Use

Locations calculated by Service ARGOS will be screened for accuracy and plotted on charts of PWS to preliminarily classify whether the seal was on land or a sea. Locational data will be compared with sensor data, when possible, to verify that these classifications are correct. Patterns of diving and hauling out will be presented as histograms. Dive data histograms will present the number of dives at different depth increments and by duration of dive. Means and standard deviations for dive depth and duration will be calculated and compared for seals in different locations or habitats and at different times of year.

Dive data will be presented as graphs and histograms which indicate the range in individual behavior as well as summary data for all seals combined. Dive profiles will be plotted graphically and examined to identify dive patterns, for example deep feeding dives or shallow dives indicative of travelling. Compilation of data on time and location of feeding dives will be used to identify feeding areas near different haulouts. Dive and haul out cycles will be examined relative to time of day, tide, and season. Haulout bouts and tidal cycles will be overlaid and plotted. Summaries of the number and quality of uplink data and at-sea position data will be presented in tabular form. Tabular summaries will also be prepared for use of different haulouts by individual seals; the number of haulout bouts relative to tidal state and time of day; and

frequency of haulout and amount of time spent feeding by season.

VI. SCHEDULES AND PLANNING

Field trips to attach PTTs will take place in April and September of 1991. Field progress reports will be submitted within 30 days of the completion of each field effort. These reports will be in letter form and will summarize dates and activities during the field effort; personnel involved; location and number of seals tagged; the status of signal monitoring; and a brief summary of findings. Data retrieval and analysis will be ongoing throughout the period when PTTs are transmitting data. An interim report will be submitted by December 31, 1991 which will describe progress to date and present the preliminary results in the form of charts, histograms, graphs, and tables. The final report will be submitted by February 28, 1992.

Satellite data and survey data will be archived at ADF&G in digital format. Hard copy will also be generated and filed at ADF&G and a copy sent to the National Marine Mammal Laboratory. Copies of digital satellite data will also be held Texas A&M University. All data will be organized and filed according to standard scientific procedures. Original copies of field data will be retained at ADF&G and copies provided to the Trustees upon request. Copies of study plans, data analyses, summaries, and reports will also be filed at ADF&G.

The project will be coordinated and managed by ADF&G. Cooperators will included Texas A&M University, the Alaska Sea Grant Marine Advisory Program, the National Marine Mammmal Laboratory (NMML), and Cordova District Fishermen United. Application of satellite tags in 1991 will be done under authority of NMFS permit number 584, issued to the NMML.

Identification codes and data aquisition for the five PTTs applied in 1991 will be provided by the NMML. Data analyses will be conducted by personnel from ADF&G, with cooperation and assistance from Texas A&M University.

The Alaska Sea Grant Marine Advisory Program and members of Cordova District Fishermen United will assist by providing some logistics and support of field activities.

Software for programming the PTT microprocessors and for data analysis will be provided by the tag manufacturer. If necessary, additional data analysis software will be developed or acquired by ADF&G.

VII. BUDGET

A line item breakdown of costs, totalling $181,500 from March 1991

through February 1992 is as follows:

Line	Item	Mar-Jun '91	Jul '91-Feb '92
100	Personnel	10,200	43,000
200	Travel	3,700	5,000
300	Services	7,100	32,000
400	Commodities	25,500	45,000
500	Equipment	0	10,000
	TOTAL	46,500	135,000

VIII. PERSONNEL QUALIFICATIONS

Kathryn Frost has conducted research on marine mammals in Alaska since 1975. She has undertaken research on natural history and ecology of seals and beluga whales, including aerial and photographic surveys of seals and whales; radiotagging of beluga whales to study behavior and movements; and studies of food habits and trophic interactions of seals, belugas, walruses, and bowheads. She has conducted extensive aerial surveys of harbor seals in PWS and boat-based observations and sampling of harbor seals as part of damage assessment studies following the EVOS. She is currently conducting a study of the habitat use and haulout behavior of spotted seals in northwestern Alaska, and is initiating a program to attach satellite tags to spotted seals.

Lloyd Lowry is the Marine Mammals Coordinator for the State of Alaska. He has conducted research on marine mammals in Alaska since 1975, including studies of the natural history, ecology, distribution, abundance, and food habits of seals, walruses, and whales. He participated in the EVOS response, and damage assessment studies on harbor seals. He participated in the development and application of radiotags for beluga whales. He has been responsible for project coordination and management of state and federally funded research projects, and is familiar with the federal marine mammal permit system.

Kate Wynne has conducted research on harbor seals and other marine mammals since 1981. She has worked in PWS since 1988 and is familiar with the area and its marine mammal populations. She has worked closely with area residents, particularly fishermen, since 1989 in documenting marine mammal-fishery interactions and in developing awareness of marine mammal issues and concerns. She has had previous experience catching and attaching radiotags to harbor seals and testing prototype satellite tags for walruses. She has conducted harbor seal, sea otter, and whale surveys in PWS and other parts of Alaska.

Randy Davis has conducted research on the biology and physiology of marine mammals since 1976. He specializes in the diving behavior and physiological adaptations for diving in marine mammals and penguins. His research has included field and laboratory studies of swimming energetics, including the swimming metabolism of harbor

seals; under-ice movements of antarctic seals; and the effects of oil on sea otters. He has used radio telemetry and time depth recorders in his studies.

IX. CITATIONS

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