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VOLUME 5

DETAILED OPERATIONAL PLANS FOR STUDIES

IN THE

STATE/FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT PLAN FOR THE EXXON VALDEZ OIL SPILL

DRAFT

CONFIDENTIAL

Birds

Technical Services

LIST OF STUDY PLANS BY VOLUME

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	MM2	Killer Whale
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	MM4	Sea Lion
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	MM7	Sea Otter
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	B12	Shorebirds
Technical Services	TS1	Chemistry
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Title:	Beached Bird Survey
Study ID Number:	Bird Study Number 1
Co-Principal Investigators:	Kent Wohl and Lynn Denlinger
Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$258,000
Date of Plan:	March 1989 through February 1990

Co-Principal Investigators: Kenton D. Wohl Date: 10-20-89

Lynn M. Denlinger Date: 10-20-89

Marine & Shorebird Oil Spill Damage Assessment Coordinator: Kenton D. Wohl Date: 10-20-89

Migratory Bird Oil Spill Damage Assessment Study Coordinator: Robert R. Leedy Date: 10/20/89

Biometrician: David C Bowden Date: 10/20/89

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1011 E. Tudor Road
Anchorage, Alaska 99503

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II. INTRODUCTION

Because carcasses of marine birds float and are relatively durable, they are frequently washed ashore following their death at sea, and their appearance on beaches provide an index of mortality. The death and littering of beaches with carcasses of oiled birds is often the most visible biological impact of an oil pollution incident. A systematic survey of beached birds will be conducted in Prince William Sound to estimate the proportion of mortality of waterbirds found on walkable beaches resulting from the Exxon Valdez oil spill. Overall mortality of waterbirds will be estimated using the results of the Beached Bird Survey, numbers of dead birds reported to the receiving stations, historical data, relevant literature, and the results of other studies.

III. OBJECTIVES

A. Determine the species composition, number and location of dead and dying waterbirds in Prince William Sound and the Gulf of Alaska, as reported to receiving centers in Valdez, Seward, Homer, and Kodiak.

B. Determine the mortality of waterbirds observed on walkable beaches in the Sound, the Gulf, and along the southern coast of the Alaska Peninsula.

C. Estimate what proportion of mortality of waterbirds was found on walkable beaches.

D. Estimate overall mortality using historical data, cited literature and the results of other studies.

E. Synthesize the beached bird survey literature and create a Beached Bird Survey Database.

Objective D in the Public Review Draft is not included in this proposal because there is not a sufficient database of historical beached bird survey information in Prince William Sound. Objectives E and F in the Public Review Draft are not included in this proposal because they are not applicable to this study. Objective E of this proposal was included because the creation of a database is an integral part of completing analysis of the data.

IV. METHODS

General methods for conducting beached bird surveys are well-established. Only unique details are presented below.

A. Sampling Methods

Objective A:

Information on the number, species composition and location of dead birds will be obtained from all receiving centers and summarized. This information will represent the minimum mortality of waterbirds.

Objective B:

Continuing mortality in the Sound will be estimated by initiating a systematic beached bird survey of selected beaches. Eighty walkable beaches that were in the path of the oil spill will be randomly selected and surveyed once each month. Appendix A presents an index of randomly selected beaches. The selected beaches will be sampled by one or two observers once each in June, July, August, and February (1990). All dead birds found will be identified to species and aged, if possible, and removed from the beach. Extent of oiling and decomposition will also be noted. Occurrence of oil on beaches will be noted. All birds will be examined for bands and to determine causes of death.

Objective C:

To calculate the overall mortality of birds killed by oil and the proportion of birds found on beaches is a factor of several variables including how long they float, how long they last on a beach, and the percentage that die at sea and are actually deposited on a beach. The following experiments are designed to act as pilot projects to provide some insight into the many variables affecting estimates of total mortality and are not designed to provide statistically reliable data.

Waterbird Floating Experiment: The floating times of oiled waterbirds will be monitored at the Service's Naked Island camp. The oiled birds will be obtained from collection centers as frozen specimens. Twelve birds will be selected. This sample size was selected since only twelve birds would fit in the floating enclosure. One red-throated loon, one horned puffin, one surf scoter, four murrelet species, four murre species, and one pigeon guillemot will be selected. A floating PVC enclosure will be anchored in protected waters. The enclosure will be buoyed, flagged, and have netting stretched over its top and bottom surfaces. Birds will be tethered with light line to the inside of the enclosure in a pattern that will not allow tangling with other birds.

Beached Bird Longevity Experiment: The length of time that a beached carcass stays on the beach will be monitored on three beaches (other than those beaches selected for regular monitoring) at Naked Island or other appropriate locations in the Sound. The experiment will be conducted in August and in February. Unless enough unoiled carcasses are found by the beached bird survey crew, chickens will be sacrificed for this experiment. The carcasses will be randomly distributed along the length of the selected beach along the highest tide line. Presence of the birds will be monitored at least twice daily at twelve-hour intervals. Their fate on at least one beach will be determined. The length of time carcasses remain on the beach and their suspected demise will be recorded.

Wooden Block Drift Experiment: The focus of this experiment is to determine the percentage of seabirds dying at sea and reaching the beach to be potentially detected by a beached bird surveyor. The experiment will be repeated at two locations on Naked Island; Outside Bay, a protected area and McPherson Bay, an exposed area. The experiment will be conducted in August and in February.

Wooden blocks will be dropped within 200m of the shoreline at two different locations (head-of-bay and side-of-bay) in the same bay, once at low slack tide and once at high slack tide. Two sizes of blocks, 50 of each size, will be dropped 100m offshore at the head of the bay. A second set will be dropped 200m offshore at the head of the bay and will also include 50 blocks of each size. This grouping will be repeated on the side of the bay at 100m and 200m distances from the beach. A total of 400 blocks will be released at the head of the bay and 400 at the side of the bay.

The blocks will be cedar wood of two different sizes (4" x 4" x 8" and 2" x 4" x 6") to simulate small marine birds such as alcids and larger birds such as seaducks. All blocks will be painted orange or yellow for easy detection on the beach. The blocks will also be numbered with a black paint marker.

The size, number and location of release (head or side of bay) will be recorded for each block released. The experiment will be conducted twice; once at a low, slack tide and once at high, slack tide. Wind speed and direction will be recorded at the time the blocks are released using a combination of National Weather Service broadcasts and estimates of the observers.

The blocks will be recovered over a 3-day period following their release. All beaches in the bay will be searched with binoculars and walked to pick up blocks. Other beaches in the vicinity of the experiment will be searched with binoculars and any blocks recovered. The size, number and location (head or side of bay) of every block recovered will be recorded. The date, time of day and tidal levels will also be recorded.

Objective D:

Total mortality of waterbirds from the <u>Exxon Valdez</u> oil spill will be estimated utilizing (1) records of dead birds from both the receiving centers at Valdez, Seward, Homer, and Kodiak and the Service's systematic beached bird surveys in the months of June, July and August of 1989 (2) historical data (3) relevant literature, and (4) results of other studies. This combination of information will permit a more reliable estimate of total mortality.

V. DATA ANALYSIS

A. Tests

It will be assumed that all carcasses will be found on each transect. A bias may be present in this assumption.

B. Analytical Methods

Standard expansion methods or ratio estimators described in Cochran, (1977) will be used. Direct inference will be made to walkable beaches only.

C. Products

The products listed below will be produced by this study.

1. Map of beached bird transects
2. Map of the locations of beaches used for each experiment
3. Tables of species composition of dead oiled birds retrieved in the Prince William Sound, Kenai Peninsula, Kodiak, and Alaska Peninsula regions.
4. Tables of bird populations at risk by geographic region
5. Table comparing percentages of selected species groups of retrieved birds by geographic region
6. Alaska Beached Bird Survey Database
7. Report synthesizing the information collected during the study

VI. SCHEDULES AND PLANNING

A. Data Submission Schedule

Begin first Beach Bird Survey on June 15, 1989
Begin second Beached Bird Survey on July 15, 1989
Begin third Beached Bird Survey on August 15, 1989
Complete draft report on December 21, 1989

B. Special Reports

None

C. Visual Data

None

D. Sample and Data Archival

Data from this study will be archived in the Fish and Wildlife Service's Beached Bird Survey Database. All original data forms and field notebooks will be placed in the Fish and Wildlife Service oil spill file system in Anchorage, Alaska.

E. Management Plan

This study will be managed by Co-Principal Investigators, both of whom will work under the general guidance of the Fish and Wildlife Service's Marine Bird and Shorebird Oil Spill Study Coordinator (Marine Bird and Shorebird Coordinator) and Migratory Bird Oil Spill Study Coordinator or their designees. The Marine Bird and Shorebird Coordinator is responsible for achieving maximum coordination with all other marine bird oil spill studies during the planning, implementation, and reporting phases of studies. The Co-Principal Investigators are responsible for either coordinating the collection of, or generating field data, and for the timely reporting of the data in draft and final reports.

Co-Principal Investigator - Kenton D. Wohl
Co-Principal Investigator - Lynn Denlinger
Marine Bird and Shorebird Oil Spill
  Damage Assessment Coordinator - Kenton D. Wohl
Migratory Bird Oil Spill Damage Assessment
  Coordinator - Robert Leedy

F. Logistics

To complete the proposed study will require use of a 25-foot vessel and support from a larger vessel and field camps. The Fish and Wildlife Service's two 65-foot vessels - MV Curlew and Surfbird - will be used to support this study in Prince William Sound and Gulf of Alaska. The Fish and Wildlife Service's vessel MV Ursa Major will also be used in support of operations in the Kodiak area.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries

Co-PI - Wohl	.30FTE	$ 18,000
Co-PI - Denlinger	.75FTE	25,000
Temporaries		46,000
Subtotal		89,000
Travel		9,000
Contract		-0-
Supplies		10,000
Equipment		150,000
TOTAL		$258,000

B. Personnel

See VII. A.

C. Qualifications

1. Co-Principal Investigator - Kenton D. Wohl

Since 1970, Wohl has been engaged in assessment of environmental impacts to marine birds and mammals and coastal ecosystems from human perturbations in Alaska. Since 1973, Wohl has participated in identifying marine bird and mammal management issues and research needs, and developing study proposals to resolve management needs. He directed the Fish and Wildlife Service's effort in the Minerals Management Service-National Oceanographic and Atmospheric Administration/Outer Continental Shelf Environmental Assessment program of studies by developing, implementing, and coordinating marine bird and mammal studies related to Alaska's outer continental shelf. He directed the Fish and Wildlife Service's effort in the National Oceanographic and Atmospheric Administration/Outer Continental Shelf Environmental Assessment program of studies. Wohl developed the first beached bird survey in Alaska in 1977 while with the Fish and Wildlife Service. This beached bird survey study builds on his earlier efforts to develop an index of marine bird mortality as seen on beaches. Wohl is presently the Project Leader for the Fish and Wildlife Service's Marine and Coastal Bird Project and is actively involved in marine bird management and studies throughout Alaska.

2. Co-Principal Investigator - Lynn M. Denlinger

Lynn has participated in a variety of roles involving assessment of environmental impacts and development of resource management plans. A great deal of that work has been in the State of Alaska including the period of time previous to the D-2 Lands Bill. While working for the National Park Service, she conducted field research to obtain information necessary to create and implement a management plan for a remote river drainage in Katmai National Park on the Alaska Peninsula. On two separate assignments to east Africa, Lynn participated in a wild ungulate study to assess range utilization relationships between domestic goats and cattle and wild African ungulates and served as a U.S. Peace Corps Volunteer in Kenya, East Africa. In that position, Lynn acted as a technical advisor to the Kenyan Fisheries Department and liaison between the Kenyan and U.S. Governments regarding habitat management and enhancement as it relates to aquaculture. She organized, planned, and implemented a new fisheries program in a remote area and designed, and supervised the construction of freshwater ponds for culturing several species of freshwater fish. The last year has been spent working with seabirds and endangered species as a Refuge Manager for the Hawaiian Islands National Wildlife Refuge. There she conducted field research to obtain information regarding the biological status of up to 17 species of Hawaiian seabirds, the threatened green sea turtle, and the endangered Hawaiian Monk Seal.

VIII. CITATIONS

Ainley, D.G. et al. 1980. Beached marine birds and mammals of the North American west coast: A manual for their census and identification. Rept. No. FWS/OBS-80/03. Fish and Wildlife Service. Washington, D.C. 207 pp.

Andrews, J.M. and K.T. Standring (eds.). 1979. Marine oil pollution and birds. Royal Society for the Protection of Birds. Sandy, U.K. 122 pp.

Cochran, W.G. 1977. Sampling Techniques. 3rd. ed. John Wiley. New York. 428 pp.

Elliot, R.D. 1985. Avalon and Miquelon beached-bird surveys from January 1984 to March 1985: Oil-related seabird mortality. Canadian Wildlife Service. 20 pp.

Stowe, T.J. 1982. An Oil spillage at a guillemot colony. Mar. Poll. Bull. 13 (7): 237-239.

Threlfall, W. and J. Piatt. 1983. Assessment of offshore seabird oil spill mortality and corpse drift experiments: Rept. for Mobil Oil Canada Ltd. 31 pp.

Wohl, K.D. 1978. Survey of beached marine birds in Alaska. pp. 857-876. In Environmental Assessment of the Alaskan Continental Shelf. Ann. Rept. of Prin. Invest. Vol. 3. NOAA. Boulder, CO.

IX. OTHER INFORMATION

Appendix A: USFWS, Beached Bird Survey Index, Prince William Sound
Appendix B: USFWS, Alaska Beached Bird Survey Data Form

Appendix A
BBS - Beached Bird Survey

USFWS
Index: BBS Walkable Beaches - PWS

BBS Code (Region-Area-Transect #)	Location Description
PWS-GRI-004	Prince William Sound-Green Island
PWS-GRI-012	" " " - " "
PWS-MOI-046	Prince William Sound-Montague
PWS-MOI-053	" " " - " "
PWS-MOI-069	" " " - " "
PWS-MOI-074	" " " - " "
PWS-MOI-081	" " " - " "
PWS-PEI-119	Prince William Sound-Perry Island
PWS-PEI-123	" " " - " "
PWS-NAI-134	Prince William Sound-Naked Island
PWS-NAI-140	" " " - " "
PWS-NAI-142	" " " - " "
PWS-NAI-152	" " " - " "
PWS-PKI-164	Prince William Sound-Peak Island
PWS-LAI-177	Prince William Sound-Latouche Island
PWS-LAI-178	" " " - " "
PWS-LAI-190	" " " - " "
PWS-LAI-191	" " " - " "
PWS-ELI-232	Prince William Sound-Elrington Island
PWS-FLI-237	Prince William Sound-Flemming Isl.
PWS-BAI-245	Prince William Sound-Bainbridge Isl.
PWS-BAI-250	" " " - " "
PWS-BAI-253	" " " - " "
PWS-BAI-256	" " " - " "
PWS-BAI-258	" " " - " "
PWS-ELE-493	Prince William Sound-Eleanor Island
PWS-DII-509	Prince William Sound-Disk Island
PWS-DII-510	" " " - " "
PWS-GLI-523	Prince William Sound-Glacier Island
PWS-GLI-527	" " " - " "
PWS-GLI-559	" " " - " "
PWS-GLI-564	" " " - " "
PWS-AXI-576	Prince William Sound-Axel Lind Isl.
PWS-CUI-593	Prince William Sound-Culross Island
PWS-CUI-598	" " " - " "
PWS-CUI-598A	" " " - " "
PWS-CUI-601	" " " - " "
PWS-API-605	Prince William Sound-Applegate Isl.

PWS-FAB-622	Prince William Sound-Falls Bay
PWS-FAB-623	" " " - " "
PWS-CRI-626	Prince William Sound-Crafton Island
PWS-FAB-629	Prince William Sound-Falls Bay
PWS-PTN-630	Prince William Sound-Point Nowell
PWS-PTN-650	" " " - "
PWS-WHB-669	Prince William Sound-Whale Bay
PWS-WHB-675	" " " - " "
PWS-WHB-677	" " " - " "
PWS-WHB-680	" " " - " "
PWS-WHB-680A	" " " - " "
PWS-BAP-710	Prince William Sound-Bainbridge Pass.
PWS-CUI-711	Prince William Sound-Culross Island
PWS-BAI-259	Prince William Sound-Bainbridge Isl.
PWS-ELI-267	Prince William Sound-Elrington Isl.
PWS-BAI-270	Prince William Sound-Bainbridge Isl.
PWS-BAI-283	" " " - " "
PWS-BAI-311	" " " - " "
PWS-EVI-314	Prince William Sound-Evans Island
PWS-EVI-320	" " " - " "
PWS-ELI-346	Prince William Sound-Elrington Island
PWS-ELI-346A	" " " - " "
PWS-EVI-352	Prince William Sound-Evans Island
PWS-EVI-358	" " " - " "
PWS-CHI-375	Prince William Sound-Chenega Island
PWS-CHI-396	" " " - " "
PWS-KNI-397	Prince William Sound-Knight Island
PWS-KNI-402	" " " - " "
PWS-KNI-418	" " " - " "
PWS-KNI-433	" " " - " "
PWS-KNI-436	" " " - " "
PWS-KNI-441	" " " - " "
PWS-KNI-443	" " " - " "
PWS-KNI-457	" " " - " "
PWS-KNI-460	" " " - " "
PWS-KNI-467	" " " - " "
PWS-KNI-469	" " " - " "
PWS-KNI-483	" " " - " "
PWS-KNI-488	" " " - " "

U.S. Fish and Wildlife Service

APPENDIX B

Alaska Beached Bird Survey

Beach Name: ______________________ Date: ______________________

Transect Start: ______________ Finish: ______________ No. Km: ______________

Oil on Beach: No oil ________ Lightly Oiled ________ Moderately Oiled ________ Heavily Oiled ________

Species	Number	Age	Sex	Oil	Condition	Cause of Death	Notes

Observer(s): ____

Codes

Age: IM, AD

Sex: M, F

Oil: (Y)es, (N)o, (L)ight, (M)oderate, (H)eavy

Condition: (A)live, (F)resh, (D)ecomposing, (O)ld/dried, (S)cavenged

Cause of Death: oil, shot, tangled in line, etc.

If unknown, write "Unk"

Return to: Beached Bird Survey Project, Marine and Coastal Bird Project, USFWS, 1011 E. Tudor Road, Anchorage, AK 99503

Title:	Surveys to Determine Distribution and Abundance of Migratory Birds in Prince William Sound and the Northern Gulf of Alaska
Study ID Number:	Bird Study Number 2
Co-Principal Investigators:	Steven P. Klosiewski and Lee A. Hotchkiss
Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$565,000
Date of Plan:	March 1989 through February 1990

Co-Principal Investigators: Steven P. Klosiewski Date: 10-20-89

Lee A. Hotchkiss Date: 10-20-89

Marine & Shorebird Oil Spill Damage Assessment Coordinator: Kenton D. Wohl Date: 10-20-89

Migratory Bird Oil Spill Damage Assessment Study Coordinator: Robert R. Leedy Date: 10/20/89

Biometrician: David C Bowden Date: 10/20/89

Address: U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907) 786-3444

II. INTRODUCTION

The shorelines of Prince William Sound and the northern Gulf of Alaska support abundant waterfowl and waterbird populations throughout the year (Dwyer et al. 1976, Forsell and Gould 1981, Hogan and Murk 1982, Irons et al. ms., Nishimoto and Rice 1987). Potential injuries to waterbirds from exposure to the Exxon Valdez oil spill include, but are not limited to, death, changes in behavior, and decreased productivity. This study will examine if responses to the oil spill ultimately result in changes in the distribution and abundance of waterbirds in Prince William Sound and the northern Gulf of Alaska.

III. OBJECTIVES

A. To determine distribution and estimate abundance (with 95% confidence limits) of waterfowl and waterbirds in Prince William Sound and the northern Gulf of Alaska.

B. To test the null hypothesis that estimates of waterfowl and waterbird relative abundances, using new and comparable historic data, are not significantly different ($\alpha = 0.05$) between oiled and non-oiled areas in Prince William Sound and the northern Gulf of Alaska.

C. To estimate the long- and short-term recovery rates of populations that were reduced by the oil spill.

D. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS

A. Sampling Methods

1. Boat-based surveys.

Surveys will be done from small boats manned with an operator and two observers. Observers will record all birds seen in the survey transect and whether the bird was in the water, on land, or in the air. Binoculars will be used as needed. Date, time of survey, and environmental variables., i.e, wind speed and direction, air and water temperature, weather, observation conditions, sea state, tide, presence or absence of oil, and human activity, will be recorded for each transect.

a. Prince William Sound

A stratified random sampling design, that includes shoreline, coastal/pelagic, and pelagic strata, will be used to meet objectives A-C.

The shoreline stratum, i.e., all water within 200 m of any shoreline, will be surveyed by travelling 100m offshore, parallel to the coast, at 5-10 knots. One observer will record all birds seen between the coast and 100m offshore while the other will record all birds 100-200m offshore. The survey window extends approximately 100m ahead of and 100m above the moving boat. The shoreline stratum will be divided into transects consistent with those of Irons et al. (ms.).

Pelagic and coastal/pelagic strata consist of plots of water delineated by 5-minute intervals (latitude and longitude) on NOAA charts and exclude any water within 200m of the coast. Coastal/pelagic and pelagic plots differ in that the boundaries of coastal/pelagic plots include more than 1nm (nautical mile) of shoreline, whereas pelagic plots contain less than 1nm of shoreline. Two north-south transect lines extending 100m on each side of the boat and located 1-minute inside of the east and west boundaries of the plot are steered by a combination of compass heading and LORAN-C coordinates. Boat speed is slightly faster than for shoreline surveys, ranging from 15-20 knots, depending on observation conditions.

Poststratification of each stratum into oiled and non-oiled areas will be based on information from the Coastal Habitat Study and the Air/Water Studies. Further poststratification based on other habitat data may occur to reduce variances and increase the power of statistical tests.

Twenty-five percent of the total shoreline, and 25% of the pelagic and coastal/pelagic plots will be surveyed three times during summer and once during February. Sample sizes were based on the amount of shoreline transects, and coastal/pelagic and pelagic plots three boat-survey crews could do in a three week period. The sampling time-frame was chosen to minimize the potential for increased variances due to seasonal migrations into and around the Sound.

b. Southern Kenai Peninsula

The southern coast of the Kenai Peninsula from Point Adam to Cape Resurrection will be surveyed in a fashion similar to the shorelines of Prince William Sound. However, transect widths will be 300m wide to allow comparisons with data collected by Nishimoto and Rice (1987).

A simple random sample of 25% of the transects surveyed previously by Nishimoto and Rice (1987) will be selected to meet objectives A-C. Two surveys will be done during summer and one during February.

Poststratification into oiled and non-oiled areas will be based on information from the Coastal Habitat Study and the Air/Water Studies.

c. Kodiak Island

Shoreline and pelagic transects will be done off the western and northern coasts of Kodiak Island. Shoreline transects will be chosen based on habitat type following the criteria of Irons et al. (1988) and then a simple random sample of 25% of the transects will be surveyed three times during the summer and once during March. Survey methods will be the same as those in Prince William Sound.

All pelagic transects surveyed by Forsell and Gould (1981) will be surveyed three times during summer and once during February. Survey methods will be the same as those of Forsell and Gould (1981).

The shoreline of the north and west end of Kodiak will be divided into transects based on exposure following the criteria of Irons et al. (1988) and then a 25% simple random sample will be chosen for sampling. Surveys will be done three times during summer and once during February.

Poststratification into oiled and non-oiled areas will be based on information from the Coastal Habitat Study and the Air/Water Studies.

2. Aerial surveys.

Four surveys per year will be conducted based on normal seasonal migrations of waterfowl and waterbirds. The spring survey will be conducted during May; the summer survey during late July - early August; the fall survey during October; and the winter survey during February.

Four aircraft, three single engine - fixed wing and one multi engine amphibious aircraft, will be used for the surveys in order to take advantage of fair weather periods. The fixed wing aircraft will each contain one pilot and one observer in a side by side seating arrangement. The multi-engine amphibious aircraft will contain at least one pilot and two observers, one observer seated in the right seat beside the pilot and one seated on the pilots side of the aircraft.

All single engine fixed wing aircraft will be configured for float operations. The aircraft will be flown at approximately 150 ft above water level and 200 meters offshore, following the shoreline as closely as possible given the aircraft's capabilities, and maintaining an airspeed of 95 - 100 mph. The pilot will record all birds and sea mammals observed within a 200 meter space out the left side of the aircraft. The observer will be responsible for recording all observations within that 200 meter distance between the aircraft and the shoreline, including the immediate shoreline. Date, time of survey beginning and stop time, environmental variables., i.e. wind speed and direction, air temperature, cloud cover and type, ceilings and visibility will be recorded for each survey date. Times will be recorded on the hour (or about on the hour) throughout each days survey.

Surveys will be restricted to a minimum of 1,500 ft ceilings, 10 miles horizontal visibility, and surface winds of 15 knots or less.

The entire coastline and a random sample of pelagic and coastal/pelagic plots in Prince William Sound and southern Kenai Peninsula, including Kachemak Bay, will be surveyed during each of the four seasonal surveys. Pelagic and coastal/pelagic plots will be based on quarter sections of 1:63,360 USGS maps. This stratified design will be used to meet objectives A-C.

Poststratification of each stratum into oiled and non-oiled areas will be based on information from the Coastal Habitat Study and the Air/Water Studies. Further poststratification based on other habitat data may occur to reduce variances and increase the power of statistical tests.

3. Paired boat-aerial surveys.

Paired boat and aerial shoreline surveys will be conducted to develop visibility correction factors for all avian species. Approximately 250 km will be surveyed by boat and air during each seasonal survey. Population estimates and associated variances will be calculated for each species using double sampling techniques described by Bowden (1973). Correction factors will also be applied to aerial survey data collected immediately following the spill to allow for valid comparisons between aerial counts and beached bird surveys.

B. Citations

General methods for conducting shoreline surveys have been described in:

Bowden, D.C. 1973. Review and distribution of May waterfowl breeding ground survey. Unpubl Manu. 74 pages.

Forsell, D.J., and P.J. Gould. 1981. Distribution and abundance of marine birds and mammals wintering in the Kodiak area of Alaska. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-81/13. 81 pages.

Irons, D.B., D.R. Nyeswander, and J.L. Trapp. 1988. Prince William Sound sea otter distribution. U.S. Fish and Wildlife Service, Anchorage, Alaska. Unpublished Report, 31 pages.

Irons, D.B., D.R. Nyeswander, and J.L. Trapp. ms. Prince William Sound waterbird distributions in relation to habitat type. U.S. Fish and Wildlife Service, Anchorage, Alaska. 24 pages.

Nishimoto, M., and B. Rice. 1987. A re-survey of seabirds and marine mammals along the south coast of the Kenai Peninsula, Alaska during the summer of 1986. U.S. Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, Homer, Alaska. Unpublished Report, 79 pages.

C. Standard Operating Procedure Requirements

See "IV METHODS".

D. Equipment Protocol

None.

E. Quality Assurance and Control Plans

1. Boat-based surveys.

To ensure that project design and procedures are followed, 1) all crew members will partake in trial surveys prior to initial surveys, 2) one person on each boat will be responsible for maintaining consistent data collection procedures, 3) standardized forms will be used during data collection, and 4) data forms will be checked at the end of each day to insure the integrity of the data.

2. Aerial surveys.

Careful scheduling of the seasonal aerial surveys will provide standardization of aircraft, pilots and observers participating in this project insuring that data compilation and transcription to permanent data base files will remain constant throughout the project.

Raw survey data will be transcribed in the same manner and entered into a computer file using the DBase IV program. Raw field data tapes will be stored for future reference in a secure storage file located in the Migratory Bird Management Office.

F. Histopathology

None.

G. Information Required From Other Investigators

Shoreline and pelagic boat-based surveys in Prince William Sound will be conducted in conjunction with sea otter surveys outlined in Marine Mammals Study Number 6. Field data collection, computer data entry, and quality control will be performed by biologists and technicians from both the Marine Mammal Project and the Marine and Coastal Bird Project.

Poststratification of shoreline and pelagic transects based on presence or absence of oil will be based on data collected by the Coastal Habitat Study, the Air/Water Studies, and the Technical Services Study Number 3. These data will be obtained through the GIS steering committee and the Technical Services Study Number 3.

V. DATA ANALYSIS

A. Tests

The primary assumption is that all birds within the survey transect are seen. Violations of this assumption occur when 1) birds are under the water, 2) observation conditions interfere with detectibility, and 3) detectibility is a decreasing function of distance from the observer.

The problem of birds below the water's surface is minimized by the relatively slow survey speeds, and the short dive times of the birds. Because the survey window extends 100m ahead of the boat there is a high probability that most diving birds will be observed. The bias associated with birds under the water will result in an underestimate of population size and bird densities, however, this bias will be the same in both oiled and non-oiled areas and thus will have no effect on comparisons between areas and years.

To minimize the effect of observation conditions on detectibility of birds, surveys will not be done when seas are larger than wavelets.

The detectibility of birds as a function of distance from the boat has not been empirically tested. The assumption that all birds within 100m of the boat are detected appears reasonable for most waterfowl and waterbirds, particularly in calm seas. Transect widths of this size or larger have been used repeatedly in previous surveys (Forsell and Gould 1981, Sealy and Carter 1984, Irons et al. ms.). Biases associated with decreasing detectibility and distance from the boat will have no effect on comparisons between areas and years.

B. Analytical Methods

Objective A:

Estimates of waterfowl and waterbird abundance and variances will be done using ratio estimators and statistics appropriate for stratified random sampling as outlined in Cochran (1977).

Objective B:

Differences between oiled and non-oiled areas will be done using t-tests. If areas are stratified further based on habitat type then ANOVA will be used. ANOVA will be used to make comparisons between pre- and post-oil spill data with respect to oiled and non-oiled areas. Here a significant oil effect will be based on the interaction between the oiling and time factor.

Objective C:

Short- and long-term recovery rates, if there is a significant oil effect, will be done using a repeated measures ANOVA. Trends may also be compared using regression techniques.

C. Products

Maps indicating distribution and abundance of birds will be produced for each survey to illustrate differences between surveys and oiled and non-oiled areas. Graphs of bird abundance will be produced and updated with each survey to show population trends and differences. Bird density and abundance estimates will also be presented in tabular form.

VI. SCHEDULES AND PLANNING

A. Data Submission Schedule

Survey 1 - June 1989
Survey 2 - July 1989
Survey 3 - August 1989
Survey 4 - February - 1990

Data entry deadline for first three surveys - October 15, 1989
Data quality control/editing deadline - October 30, 1989
Final Report - December 23, 1989

B. Special Reports

None

C. Visual Data

None

D. Sample and Data Archival

Original copies of the field data sheets will be archived in the USFWS oil spill file system. Complete set of photocopies will be archived at the USFWS offices of the Marine Mammal Project and the Marine and Coastal Bird Project.

Original aerial survey data tapes will be archived in the USFWS oil spill file system.

E. Management Plan

This study will be managed by Co-Principal Investigators. Klosiewski works under the general guidance of the Fish and Wildlife Service's Marine Bird and Shorebird Oil Spill Damage Assessment Coordinator (Marine Bird and Shorebird Coordinator) and Hotchkiss under the Migratory Bird Oil Spill Study Coordinator or their designees. The Marine Bird and Shorebird Coordinator is responsible for achieving maximum coordination with all other marine bird oil spill studies during the planning, implementing, and reporting phases of marine bird studies. The Co-Principal Investigators are responsible for either coordinating the collection of, or generating field data, and for the timely reporting of the data in draft and final reports.

Co-Principal Investigator - Steven P. Klosiewski
Co-Principal Investigator - Lee A. Hotchkiss
Marine Bird and Shorebird Oil Spill
    Damage Assessment Coordinator - Kenton D. Wohl
Migratory Bird Oil Spill Damage Assessment
    Coordinator - Robert Leedy

F. Logistics

1. Boat-based surveys.

To complete the proposed study will require the use of three 25-foot vessels and support from a larger vessel and field camps. The Fish and Wildlife Service's two 65-foot vessels - MV Curlew and Surfbird - will be used to support this study in Prince William Sound and the Gulf of Alaska. The Fish and Wildlife Service's vessel MV Ursa Major will also be used in support of operations in the Kodiak area.

Pelagic and shoreline transects will be plotted on NOAA navigation charts and master copies will be archived in the Marine and Coastal Bird Project office, USFWS, Anchorage. Photoreductions of these charts are not of suitable quality for inclusion in this study plan.

2. Aerial surveys.

Aerial survey aircraft will obtain logistical support for fuel at airport fixed base operators in Cordova, Valdez, Whittier, Seward and Homer. Aircraft used will remained based at OAS in Anchorage.

Aerial survey shoreline transects and pelagic transects will be plotted on USGS 1:63,360 scale quadrangle maps. Master Copies will be archived in the USFWS oil spill file system.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries			
Co-PI Klosiewski	0.9 FTE	$40,000	
Co-PI Hotchkiss	0.6 FTE	$28,000	
Other Biologists		$60,000	
Vacant Temporaries		$50,000	
	Subtotal		$178,000
Travel/Per Diem			$ 15,000
Contracts (Aerial)			$ 50,000
Supplies			$ 25,000
Equipment			$297,000
	Total		$565,000

B. Personnel

See VII.C.

C. Qualifications

1. Co-Principal Investigator - Steven P. Klosiewski

Steven P. Klosiewski received his B.S. In Water Resources - Fisheries Management from the University of Wisconsin - Steven Point in 1978. He received his M.S. in Zoology from The Ohio State University in 1981. He is presently completing the requirements for a Ph.D. in Zoology from The Ohio State University.

Mr. Klosiewski has worked for Wisconsin's Department of Natural Resources, the Oak Ridge National Laboratory, and the Savannah River Ecology Laboratory. Much of his work has dealt with sampling designs and statistical analysis of large data sets. He co-authored a paper on using presence-absence data to detect changes in avian densities. While with the Fish and Wildlife Service, Steve worked on analyzing data from a project on bird-habitat relationships on the North Slope of Alaska.

2. Co-Principal Investigator - Lee A Hotchkiss

Lee A Hotchkiss received his B.S. in Wildlife Management from Oregon State University, in 1968. Mr. Hotchkiss began working for the USFWS in 1966 as a Refuge Manager Trainee on the National Bison Range in Montana and Camas National Wildlife Refuge in Idaho. During his 23 year association with the USFWS, he has worked on Umatilla and Bear Lake National Wildlife Refuges in Oregon, Washington and Idaho and on the Yukon Delta and Togiak National Wildlife Refuges in southwest Alaska. While working on these refuges he received extensive training in waterfowl/waterbird survey techniques while on the ground and when conducting aerial surveys.

Mr. Hotchkiss received his pilot training in Oregon where he qualified for his Private and Commercial Pilots License in 1969. Mr Hotchkiss received specific natural resource flying training from USFWS pilots in Idaho and Oregon, concentrating on techniques in low level survey work and aerial waterfowl census. Mr Hotchkiss has accumulated more than 4,500 hours, of which more than 4,200 hours were in Alaska dealing with natural resource related work.

3. Survey Biologist-Greg Balogh

Gregory R. Balogh received his B.S. in Wildlife Management from The Ohio State University in 1984. He also received two M.S. degrees from The Ohio State University; one in Environmental Biology (1986), and one in Zoology (1989). Mr. Balogh's Zoology degree was earned in the field of remote sensing as it applies to wildlife habitat assessment.

Mr. Balogh has spent the summers of 1986-1988 and the autumn of 1988 working for the Fish and Wildlife Service on the Arctic Coastal Plain of Alaska for the North Slope Bird Habitat Study. On this project, he served as a camp leader, supervising a four-man field crew in data collection on habitat use of birds. During 1987 and 1988, he conducted geobotanical habitat classification of the entire Coastal plain study site.

4. Survey Biologist - Robert M. Platte

Robert M. Platte received his B.S. in Wildlife Biology from Michigan State University in 1980. Mr. Platte has worked for the USFWS since 1985. He spent the summers of 1985 and 1986 conducting field research on the Arctic National Wildlife Refuge. During that time he participated in various waterfowl studies including coastal lagoon migratory bird surveys, oldsquaw behavior and habitat relationships, tundra swan surveys, and snow goose behavior and energetics.

Subsequently, Mr. Platte was employed by the Division of Realty, USFWS, where he participated in the design and implementation of a state-wide model for ranking all inholdings in Alaskan refuges according to priority for inclusion into a Geographical Information System.

VIII. CITATIONS

Bowden, D.C. 1973. Review and evaluation of May waterfowl breeding ground survey. Unpubl Manu. Fish and Wildlife Service. Anchorage, AK. 74 pages.

Cochran, W.G. 1977. Sampling Techniques. John Wiley and Sons, Inc. New York, New York. 428 pages.

Dwyer, T.J., P. Isleib, D.A. Davenport, and J.L. Haddock. 1975. Marine Bird Populations in Prince William Sound Alaska. U.S. Fish and Wildlife Service, Anchorage, Alaska. Unpublished Report, 21 pages.

Forsell, D.J., and P.J. Gould. 1981. Distribution and abundance of marine birds and mammals wintering in the Kodiak area of Alaska. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-81/13. 81 pages.

Hogan, M.E., and J. Murk. 1982. Seasonal distribution of marine birds in Prince William Sound, based on aerial surveys, 1971. U.S. Fish and WIldlife Service, Anchorage, Alaska. Unpublished Report.

Irons, D.B., D.R. Nyeswander, and J.L. Trapp. 1988. Prince William Sound sea otter distribution. U.S. Fish and Wildlife Service, Anchorage, Alaska. Unpublished Report, 31 pages.

Irons, D.B., D.R. Nyeswander, and J.L. Trapp. ms. Prince William Sound waterbird distributions in relation to habitat type. U.S. Fish and Wildlife Service, Anchorage, Alaska. 24 pages.

Nishimoto, M., and B. Rice. 1987. A re-survey of seabirds and marine mammals along the south coast of the Kenai Peninsula, Alaska during the summer of 1986. U.S. Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, Homer, Alaska. Unpublished Report, 79 pages.

Sealy, S.G., and H.R. Carter. 1984. At-sea distribution and nesting habitat of the marbled murrelet in British Columbia: problems in the conservation of a solitarily nesting seabird. ICBP Technical Publication No. 2: 738-756.

IX. OTHER INFORMATION

None.

Title:	Population Surveys of Seabird Nesting Colonies in Prince William Sound, the Outside Coast of the Kenai Peninsula, Barren Islands, and Other Nearby Colonies
Study ID Number:	Bird Study Number 3
Principal Investigator:	David Nysewander
Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$440,000
Date of Plan:	March 1989 through February 1990

Principal Investigators: David R. Nysewander Date: 10/20/89

Marine & Shorebird Oil Spill Damage Assessment Coordinator: Kenton D. Wohl Date: 10-20-89

Migratory Bird Oil Spill Damage Assessment Study Coordinator: Robert R. Leedy Date: 10/20/89

Biometrician: David C. Bowden Date: 10/20/89

Address: U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907) 786-3444

II. INTRODUCTION

There are 157 seabird colonies in the four geographic areas of this study. At least 125 of these colonies, not including the Semedi Islands, occur within the area affected by the oil spill; they contain about 670,000 breeding seabirds (Sowls et al. 1978). Some of these colonies are among the most visited by tourists in Alaska. Cliff-nesting seabirds are an important part of this human use/tourism. Most of these colonies have been censused at least twice or more in the last 17 years, which provides a base line for determining injury caused to the colonies by the oil spill.

Diving seabirds are known to be easily impacted by oil spills (King and Sanger 1979). In addition, these species are long-lived with low reproductive rates, thus making any mortality of adults a critical factor in these species' ability to recover from loss. The oil spill moved through colony areas just prior to breeding when many species like murres concentrate on the water in large rafts near colonies and in the nearby waters. Although there are up to at least 18 species breeding at any one of the colonies, the monitoring strategies of the Fish and Wildlife Service will be to select certain species based on a variety of factors which included known techniques of census, representation of the different facets of the food chains, geographic range, and susceptibility to impacts. The selected species will be cliffnesters like murres, kittiwakes, and cormorants. When feasible, other species like small alcids, gulls, and pigeon guillemots will also be censused.

III. OBJECTIVES

A. Determine if the numbers of selected species of breeding colonial seabirds within the oiled area have decreased compared to numbers previously censused at these sites. Non-oiled nesting colonies will be surveyed as a control.

B. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS

A. Sampling Methods

Objective A:

The assessment of injury to population numbers of selected seabirds is being considered in four general areas: 1) Prince William Sound, 2) Kenai Fiords (Chiswell and Pye Islands), 3) Barren Islands, and 4) Semidi Islands/Alaska Peninsula/Kodiak Island. The study in each area will look at changes in numbers of breeding adults with primary emphasis on cliff nesters with the following species listed in descending order of priority if choices must be made: murres, kittiwakes, and cormorants. There will be a secondary emphasis on counts of other selected species (tentatively pigeon guillemots or parakeet auklets and large gulls) if weather, logistics, timing, and geography allow. The census of these other species will occur at the smaller colonies typical of Prince William Sound and the Kenai Fiords. At large colonies like the Semidi and Barren Islands, it is better to have plots and subdivisions of the colony for statistical analysis, but there is no such system on many of the sites being considered in this proposal. Plot systems have been set up and used on the Semedi Islands over the past ten or more years, but they have not been set up on many of these sites because of complications due to difficult weather, sea, and topography.

Consequently, two strategies will be used: 1)counts of adult seabirds on plots from land-based observation points; 2)counts from boat-based observation vantage points where land-based observations are not possible. In this latter case, it will be necessary in the first year to make some type of total colony count along with the establishment of a plot system so that comparison may be made more easily in the future with past estimates. These plots may also serve as a correction factor for total counts or estimates. If plots or subdivisions are not possible, then total counts or photography will be the sole option.

The above strategies determine that the sample plan will have three basic applications: 1)Total counts from boats will be used in Prince William Sound and Kodiak Island area since the colonies are smaller, not feasible to do from land, in more protected waters, and have a history of counts in recent years. 2)A combination of total counts and establishment (or review) of plots counted from boats will occur at colony sites like the Barren Islands and Chiswell Islands because the colonies are much larger, in very exposed waters, have a poor history of censusing, and require counts from boats. Sample plots will be established on the basis of accessibility and visibility. 3)Land-based plots will be continued at the Semedi Islands because these colonies are too large for total counts, and land plots are feasible and have been used for over ten years. Sample plots were previously selected on the basis of accessibility. The Alaska Peninsula murre colonies will probably require a combination of the second and third application since some portions of the colonies are visible from land, but most aspects of the colony require boat counts.

Colonies will be recensused using the standard Service methodology for either land-based or air/boat-based counts of seabirds (Byrd 1989; Hatch in press; Irons et al. 1987; Nishimoto and Rice 1987). This will vary depending on the geography or topography of the four areas. This will mean a goal of at least three replicate counts of colonies or plots after eggs are laid between 1000 and 1600 hours. These three replicate counts are on three separate days. Plots and photographs (using 6x7 format cameras) will be set up and utilized for establishment of correction factors of total counts, comparisons with past plots, and plots for evaluation of future recovery or change. Survey units will be subcolonies for cliff nesters and islands for other species. As described, land-based plots are best, but these are probably feasible mostly in the Semidis and at some sites in Prince William Sound and the Alaska Peninsula. Aerial photographs are the next best method provided that the birds will hold on the cliffs and there is some correction or differential factor determined using either land or boat counts. Boat-based plots, while least desirable, will be necessary at many sites because it is the only option available. During boat censuses, seas must be less than three feet and rain should not be more than a light drizzle. At least 3 observers including skiff operator will make the counts by binoculars from the largest skiff available, something no smaller than a 17-25 foot boat.

B. Citations

Byrd, G.V. 1989. Seabirds in the Pribilof Islands, Alaska: trends and monitoring methods. M. S. thesis, Univ. of Idaho, Moscow, Idaho, 96pp.

Garton, E.O. 1988. A statistical evaluation of seabird monitoring programs at three sites on the Alaska Maritime National Wildlife Refuge. Univ. of Idaho, Moscow, Idaho. Unpubl. Rept. from contract with the refuge, 15pp.

Hatch, S.A. in press. Attendance of common and thick-billed murres at breeding sites: implications for population monitoring. J. Wildl. Mgmt.

Hatch, S.A. and M.A. Hatch. 1988. Colony attendance and population monitoring of black-legged kittiwakes on the Semedi Islands, Alaska. Condor 90:613-620.

Irons, D.B., D.R. Nysewander, and J.L. Trapp. 1987. Changes in colony size and reproductive success of black-legged kittiwakes in Prince William Sound, Alaska, 1972-1986. U. S. Dept. Interior, Fish and Wildl. Serv., Anchorage, Alaska, Unpubl. Rept. 37pp.

King, J.G. and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. Pp. 227-239 in J.C. Bartonek and D.N. Nettleship eds. Conservation of marine birds of northern North America. U. S. Fish and Wildl. Serv., Washington D.C. 319pp.

Nishimoto, M. and B.Rice. 1987. A re-survey of seabirds and marine mammals along the south coast of the Kenai Peninsula, Alaska during the summer of 1986. U. S. Fish and Wild. Serv., Alaska Maritime National Wildl. Refuge, Homer, Alaska. Unpubl. Rept. 79 pages.

Sowls, A.L., S.A. Hatch, and C.J. Lensink. 1978. Catalog of Alaskan seabird colonies. U. S. Fish and Wildl. Serv., Biol. Services Prog. FWS/OBS 78/78.

C. Standard Operating Procedure Requirements

The standard census and colony monitoring methods employed by the U. S. Fish and Wildlife Service will be used (Byrd 1989; Irons et al. 1987). See the methods section for a brief discussion of these.

D. Equipment Protocol

Not applicable.

E. Quality Assurance and Control Plans

To ensure standard censusing procedures are followed. All crew members will participate in trial surveys prior to initial censusing and standard forms will be used to record data.

F. Histopathology

None

G. Information Required From Other Investigators

Information on the distribution and persistence of oil will will provided by the suite of Air/Water and Coastal Habitat studies.

V. DATA ANALYSIS

A. Tests

The standard procedures and assumptions used by the U. S. Fish and Wildlife Service on colonies in the Alaska Maritime National Wildlife Refuge are described by Garton 1988 and Byrd 1989. We will not reiterate all of these, but we mention several key assumptions: 1)Plots, by necessity, are not random and selection is based on accessibility; hence this study makes the assumption that counts within plots are representative of the way the counts varied on the entire colony. 2)Counts of plots or colonies from boats are very difficult for large colonies and replications of counts by several observers on the same day and different days illustrate the need to minimize variation. This means that these counts are a form of indices, but this study assumes that changes in these indices represent the changes occurring in the colony.

The standard procedures mentioned prefer to compare trends between years using numerous replicate counts where all plots are censused each count day and these counts are replicated on successive days. Within year replication is useful to test for annual variation, but annual variation is anticipated even without the influence of a factor such as an oil spill. Hence the important question is whether the 1989 response is outside (an outlier) compared to anticipated annual variation without oiling. If past data are not available and weather, unusual phenology, or some other factor limit the ability to repeat earlier census efforts, then small sample sizes may preclude the effective testing of distributional assumptions required for hypothesis testing.

B. Analytical Methods

The most straightforward analysis of counts is a simple average of daily counts when all plots are surveyed each count day (Hatch and Hatch 1988; Hatch in press). The standard method that is used is to calculate a confidence interval for the estimate so as to evaluate the precision of an estimate in a particular year. Garton (1988) recommends calculating 90% confidence intervals. A t-test can be performed to test the hypothesis that the 89 index value is a single random sample from the same population as that sampled by historical yearly index values. In situations where there are not replicate counts to compare between years, the intention is to compare a past single count with the replicate counts taken this year of either a plot, a subcolony, or a colony and see if that count falls within the normal variation expected from the counts conducted this year. If several colonies are in each category (oiled and unoiled), then we will test for interaction between time (pre- and post-oiling) and status (oiled and unoiled). Techniques appropriate for repeated measures data should be applied.

C. Products

The products listed below will be produced by this study. In addition, all colony data will be entered into the Services' Seabird Colony Catalog Database.

1. Map of colony locations
2. Tables of species composition and abundance for each colony
3. Report summarizing colony census data

VI. SCHEDULES AND PLANNING

A. Data Submission Schedule

Begin colony census: June 20 (if phenology normal)
Complete colony census: August 1 (if phenology normal)
All field camps closed: August 15
Complete report: December 23
Submit report: December 23

B. Special Reports

None

C. Visual Data

Plots are photographed with large format cameras. These will be stored at the Alaska Maritime National Wildlife Refuge and the Service's file system in Anchorage, depending upon the future needs for them.

D. Sample and Data Archival

Data from this study will be archived in the Services' Seabird Colony Catalog Database. All data forms and log books will be placed in the Service's oil spill file system in Anchorage.

E. Management Plan

This study will be managed by a Principal Investigator, who will work under the general guidance of the Fish and Wildlife Service's Marine Bird and Shorebird Oil Spill Damage Assessment Study Coordinator (Marine Bird and Shorebird Coordinator) and Migratory Bird Oil Spill Study Coordinator or their designees. The Marine Bird and Shorebird Coordinator is responsible for acheiving maximum coordination with all other marine bird oil spill studies during the planning, implementing and reporting phases of the studies. The Principal Investigator is responsible for either coordinating the collection of, or generating field data, and for the timely reporting of the data in draft and final reports.

Principal Investigator - David Nysewander
Oil Spill Damage Assessment
Coordinator - Kenton D. Wohl
Migratory Bird Oil Spill Damage Assessment
Coordinator - Robert Leedy

F. Logistics

To complete the proposed study will require use of a 25-foot vessel and support from a larger vessel and field camps. The Fish and Wildlife Service's two 65-foot vessels, MV Curlew and Surfbird, will be used to support this study in Prince William Sound and Gulf of Alaska.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries		
PI Nysewander .80 FTE	$ 50,000	
Other Permanent Staff	$ 50,000	
Vacant Temporaries	$ 90,000	
Subtotal		$190,000
Travel		$ 15,000
Contract		$ 20,000
Supplies		$ 20,000
Equipment(includes costs associated with M/V Surfbird and Kenai Ranger		$195,000
TOTAL		$440,000

B. Personnel

See VII. C.

C. Qualifications

1. Principal Investigator - David Nysewander

Dave Nysewander received his B.S. from the University of Michigan and Principia College in 1965 and his M.S. in wildlife biology from the University of Washington in 1977. From 1973 to 1975 he worked in Washington State on colony censuses and reproductive biology of marine and shore birds. He joined the U.S. Fish and Wildlife Service in Alaska in 1975. Between 1975 and 1989 he has held several positions with the Service: 1) from 1975 to 1980 he served as biologist and camp leader on pelagic and colony studies, specializing on Gulf of Alaska sites associated with the Offshore Continental Shelf Evaluation and Assessment Project in the Service's Office of Biological Services/Coastal Ecosystems; 2) from 1980 to 1986 he served with the Marine Bird Management Project in Alaska as wildlife biologist and later as acting project leader, specializing in distribution, colony census, and productivity of marine birds and mammals in Prince William Sound, southeastern Alaska, Kodiak Island, Cook Inlet, and eastern Aleutian Islands; 3) from 1986 to 1989 he served with the Alaska Maritime National Wildlife Refuge primarily as a supervisory wildlife biologist, whose work has dealt with colony censuses and monitoring, reproductive biology, and distribution of marine birds along with management concerns like eradication of introduced predators and reintroduction of endangered species.

Title:	Assessing the Effects of the Exxon Valdez Oil Spill on Bald Eagles
Study ID Number:	Bird Study Number 4
Principal Investigator:	Philip F. Schempf
Lead Agency:	U.S. Fish and Wildlife Service
Cooperating Agencies:	Alaska Dept. of Fish and Game, U.S. Dept. of Interior, U.S. Forest Service, Alaska Dept. of Natural Resources
Cost Of Proposal:	$445,000
Dates Of Plan:	March 1989 through February 1990

Principal Investigator: Philip F. Schempf Date: 10/20/89

Migratory Bird Oil Spill Damage Assessment Coordinator: Robert R. Leedy Date: 10/20/89

Biometrician: David C. Bowden Date: 10/20/89

Address: U. S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907) 786-3444

II. INTRODUCTION

The area affected by the Exxon Valdez oil spill provides year-round habitat for approximately 5000 adult bald eagles and seasonal habitat for an additional estimated 2500 immatures. An unknown number of bald eagles from breeding areas in south-central Alaska probably also winter in the Sound.

Bald eagles are closely associated with intertidal habitats that have been heavily impacted by the Exxon Valdez oil spill. Nearly all nests in the spill area occur within 100 meters of the beach and eagles commonly forage in intertidal habitats on fish and marine invertebrates. Eagles that breed elsewhere, but spend winters in the spill area will also use the impacted intertidal habitats for foraging.

Contamination of these intertidal habitats may result in serious impacts to bald eagles. Effects may include direct mortality of adults and immatures from ingestion of oil-contaminated food or as a result of preening oil from feathers. Eagles that become heavily soiled or entrapped in oil may die. Mortality of embryos can occur when eggs are contaminated with oil carried to the nests on the plumage of the adults. Decreases in the abundance of prey such as herring, eulachon, salmon, or marine invertebrates may increase the vulnerability of eagles to starvation, or disease induced by weakened physical condition. Significant losses of breeding adults, eggs, nestlings and non-breeding eagles are expected.

This study is designed to document the magnitude and duration of these impacts and determine if these impacts are a result of oil contamination. Estimates for the number of eagles occupying the spill area after the spill will be compared with historical data to identify changes in the population. Occupancy and reproduction surveys will be conducted to determine productivity and to document differences in production between oil-affected and non-oiled areas. Nestling and adult bald eagles from oiled and non-oiled areas will be radio-tagged and monitored to estimate survival rates, distribution, and determine causes of mortality.

Because eagles mature slowly and are long lived, impacts to the population may not be readily apparent. Furthermore, the long term impacts of oil contamination on bald eagles are unknown. For these reasons, we recommend that this study be continued for at least 5 years to document recovery or decline in eagle populations. In this proposal, we address a one year study from March 1989 through February 1990. However, we also note the advantages and types of data that can be obtained by a longer term (5-year) study of bald eagles.

III. OBJECTIVES:

1. Estimate numbers of resident and wintering bald eagles such that the estimate is within 10% of the actual size 95% of the time; determine whether changes in population size have occurred in the oil-impacted areas since 1982 and test whether the change in number of eagles in oil-impacted areas is different than changes in non-oiled areas.

2. To test the hypothesis that productivity of bald eagles is the same in oiled and non-oiled areas (a = 0.05).

3. To test the hypothesis that survival rates are the same for bald eagles in oiled and non-oiled areas (a = 0.05).

4. Determine toxic and sublethal effects of oiling on eagles and eggs.

5. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS

A. Sampling Methods.

Population surveys (Objective 1). Surveys of randomly selected plots will be conducted from Malaspina Glacier to Cape Elizabeth in early May, following methodology discussed in Hodges et al. (1984). All shorelines in each selected plot will be flown at an altitude of about 200 feet and an airspeed of 90-100 knots using fixed-wing aircraft. Eagles will be classified as either white-headed or immature. "White-headed" eagles will include sexually mature adults and near-adults that have predominately white heads. This survey will not directly estimate the number of immatures, therefore we will assume that our ability to detect all age classes is equal for birds in flight, and a ratio of adults to immatures observed flying will be used to estimate the number of immatures.

This survey should be conducted annually for the next 5 years to assess population trends following the spill. The intensity of the survey would be increased to tighten the confidence interval to +/-10%. A similar survey of a subsample of plots within Prince William Sound would be attempted each February to estimate the size of the wintering population.

Productivity surveys (Objective 2). Two surveys to determine productivity will be conducted in the oil spill area and in the Copper River Basin, an area used by eagles that may winter in the oil spill area. The first aerial survey will be flown during mid-May to estimate the number of adults that attempt to breed, whereas the second survey will be flown in mid-July to estimate the number of successful nests and the number of young produced. Surveys will be conducted from helicopter at an altitude of 80-200 feet at 40-60 kts. airspeed to determine nest status. During the initial survey, nests will be classified as empty, active (eggs or incubating adult observed), or not found (for nests found on previous surveys). The second survey will classify nests as empty, active, failed (previously active nest found empty or containing abandoned eggs or nestlings), or not found. The number of young observed in the nest will be recorded. Eaglets will be aged according to plumage characteristics (Bartolotti 1984, Carpenter in press). Data collected will include number of nests surveyed, number of nests occupied, number of nests that successfully produce young, and number of young produced (Postupalsky 1974).

Maps produced by the Alaska Department of Environmental Conservation that detail the extent and intensity of oiling within the spill area will be used to stratify beaches within 1/2 mile of bald eagle nest sites, an area representative of the home range of a bald eagle in coastal Alaska (USFWS, unpubl. data). The length of shoreline within the "home range" will be measured and segments classified as heavily, moderately, lightly or unoiled. An oiling index will calculated for each nest "home range" that reflects the proportion of the shoreline in each of the oiling categories weighted by the degree of oiling using the following equation:

$$\text{Sum of: } \frac{\text{Length of shoreline oiling within home range by oiling intensity}}{\text{Total length of shoreline in home range}} \times \text{Intensity Rating} = \text{Oiling Index}$$

Shorelines will be given an intensity rating of 1.0, 0.67, 0.33 and 0, for heavy, moderate, light and unoiled beaches, respectively. These numerical rankings will be used to reclassify each "home range" into one of the four qualitative oiling classes. Analysis of variance will be used to detect significant differences among strata for nest occupancy and productivity parameter averages. Data on productivity from the Copper River Basin will be compared with data from coastal areas. Productivity data from southeastern Alaska will also be used for comparative purposes.

Two visits during the breeding season will not allow an accurate assessment of the timing or causes of nesting failure. We propose to conduct intensive, weekly nesting surveys within a limited study area for 3 years. Nests that fail would be climbed to collect dead eggs or nestlings and to identify the cause of failure. Intensive work would allow a more accurate interpretation of the results of extensive surveys by identifying the timing and causes of mortality.

Survival Studies (Objective 3): During the winter, food resources for eagles are at the lowest availability of the year and eagles are presumably under the greatest nutritional stress. Mortality due to inadequate food will most likely occur during the winter period. Furthermore, some contaminants stored in fat tissues are mobilized during periods of nutritional stress. To estimate survival rates, 60 eagles (15 adults and 15 nestlings each from oiled and non-oiled areas) will be tagged with radio transmitters. Weekly aerial flights will be made to relocate the transmitters using standard telemetry techniques (Gilmer et al. 1981) and to document eagle numbers, distribution and mortality within the study area. Dead eagles will be retrieved and necropsied to determine the cause of death. Survival rates will be estimated using the Kaplan-Meier (1958) procedure (Pollock et al. 1989). Survival functions will be tested for significant differences between eagles marked in oiled and in unoiled areas, and between age classes.

Eagles can be marked each year to provide comparative survival data among cohorts. Additional bald eagles can be marked in a remote breeding location to provide comparative data. Long term monitoring would allow calculation of seasonal and annual survival rates and a better interpretation of the long term effects of oil contamination on bald eagle populations.

Toxic and Sublethal Effects of Oiling (Objective 4): All eagles found dead will be collected and necropsied to substantiate the cause of death, to note the extent of oiling and to look for ingested oil or other signs of oil contamination. Tissue samples from the collected specimens will be analyzed for contaminants. All histopathology work will be accomplished through a qualified contractor (e.g., U. S. Fish and Wildlife Service National Wildlife Health Laboratory). All samples collected in the field will be properly labelled and chain of custody procedures followed.

Unhatched eggs collected from failed nests will be examined for oil contamination of eggshells, egg contents, and the presence and development of embryos. Addled eggs will be collected using aluminum foil rinsed with acetone and hexane to avoid contamination by hydrocarbons.

Blood samples from free flying birds will be collected and analyzed to determine concentrations of hydrocarbons and other contaminants associated with oil contamination. Approximately equal numbers of bald eagles will be sampled from oiled and nonoiled areas. Blood samples will also be analyzed for standard blood chemistry profiles, which will help identify sublethal impacts. Blood chemistry of eagles will be compared between oiled areas and non-oiled areas, and tested (2-sample t-test, a = 0.05) for significant differences.

Remains of prey items will be collected when visits are made to nest sites and other areas where eagles have fed. Samples will be analyzed for the presence of hydrocarbons, and the incidence of oil contamination on prey items will be recorded and expressed as a minimum frequency of occurrence among food samples.

Alternative Methods for Restoration (Objective 5). Actions to offset loss of production or individuals incurred as a result of the oil spill will be suggested. Consideration will be given to the expected efficiency of each alternative.

B. Refer to Citations section at end of proposal.

C. Standard Operating Procedure

See Appendix A for Standard Operating Procedure for collection and handling of bald eagle blood samples. Appendix C gives standard procedures for processing bald eagle eggs.
For other SOPs, refer to Methods section for each objective.

D. Equipment Protocol

Centrifuge -- must be a multi-speed centrifuge designed to obtain quantitative micro-hematocrits from whole blood, and obtain serum or plasma specimens from whole blood. Maintenance and service procedures for the TRIAC Model 0200 centrifuge are included in Appendix B.

E. Quality Assurance and Control Plans

We will follow the Quality Assurance and Control Plans as outlined in the Damage Assessment Studies for the Exxon Valdez Oil Spill. Refer to Appendix A for Standard Operating Procedure for collection of bald eagle blood samples. All blood sampling will be done in the presence of Study Leader or Survey Crew Leader to ensure consistency and proper technique.

F. Histopathology

We will follow all procedures for collecting and preserving specimens for histopathological analyses as outlined in Appendix 6: Avian Sampling Procedures (in Appendix A: State/Federal Damage Assessment Plan, Analytical Chemistry, Quality Assurance/Quality Control). Histopathological work will be contracted through the U.S. Fish and Wildlife Service National Wildlife Health Laboratory.

G. Information Required from Other Investigators

We will require data and maps from the Alaska Department of Conservation which illustrate the extent and degree of oiling on shorelines in Prince William Sound. We will also require information from the U. S. Forest Service (Chugach National Forest) on bald eagle productivity in the Copper River Basin.

V. DATA ANALYSIS

Objective 1 (Population Surveys): Analytical Methods and Tests: Surveys will be conducted using a random plot design, as discussed in Hodges et al. (1984). This survey technique will allow estimation of the number of adult eagles and number of occupied nests that is comparable with the last survey of Prince William Sound in 1982. We will try to obtain a confidence interval of +/- 10%. We assume that no major changes in habitat quality or quantity that may affect the breeding population have occurred since 1982, other than the Exxon Valdez oil spill. We will test (2-sample t-test, a = 0.05) the hypotheses that: 1) the number of adult bald eagles in the entire survey area in 1989 is the same as the number of adult bald eagles in 1982; 2) the number of adult bald eagles within the oil-impacted area is the same for 1982 and 1989; 3) the change in numbers of adult eagles in the oiled areas is the same as the change in numbers in non-oiled areas, from 1982 to 1989.

We plan to use a parametric two-sample t-test [Steel and Torrie, 19XX] which does not require equal variances to test the above hypotheses. Assumptions necessary for valid application of the t-test will be checked (e.g., test for normality). If assumptions are violated, we will use either an appropriate transformation or an equivalent nonparametric test.

Products: Tables will be used to display summarized data for eagle censuses and surveys.

Objective 2 (Productivity Surveys): Analytical Methods and Tests: We will obtain data on production from all known nests within the study area (i.e., a census). Production data will be expressed as 0 or 1 for successful or unsuccessful, and expressed as the number of young produced per active nest. Our selection of sampling areas will allow comparison of productivity between oiled areas and distant breeding areas not affected by the spill (i.e., Copper River Delta or eastern Prince William Sound), and among areas with varying intensities of oiling. Measures of production or failure rates within the oil-affected portion of Prince William Sound will be directly comparable because this is a complete census of the study area. If a difference in production or failure rates exists, we will be able to estimate the amount of "lost" production in the oiled areas, based on the proportional amount of each treatment class (e.g., heavy, moderate, light, or no oiling).

We will test the hypothesis that there is no difference in the observed production among treatment groups compared with what would be expected if nests were assigned randomly to each of the treatment groups. For this, we will use a nonparametric permatation test.

The equation used to determine the oiling index takes into account both the extent and intensity of oiling within the home range of eagles. The equation assumes that the home range of breeding adult bald eagles is about 1 square mile. This assumption is based on unpublished data for similar areas in Alaska. We also assume that maps by ADEC that depict oiling intensities in Prince William Sound are reasonably accurate.

Products: Bald eagle nest locations will be entered into a GIS system using ARCINFO software, and maps of all nest locations will be generated for Prince William Sound and other areas surveyed. Overlays that show shoreline oiling will be produced. Data will be summarized in tables or figures.

Objective 3 (Survival): Analytical Methods and Tests: We assume that all eagles in the study area have an equal chance of being captured. We assume that the transmitters have a negligable effect on the eagles behavior and do not influence the birds chances of survival. We will attempt to relocate eagles at weekly intervals, and use the week as the smallest period of exposure. Survival data will be analyzed using the methods of Kaplan and Meier (1958), which accommodate infrequent visitation (i.e., relocations) of birds, and censoring of lost birds. We believe this is an appropriate method because we expect eagles to move from the study area where they cannot be relocated during every survey. Furthermore, the Kaplan-Meier method does not assume constant survivorship during the period of observation. We will use a Z-test (Bart and Robson 1982) to test for significant differences in survival rates between eagles marked in oiled areas and eagles marked in unoiled areas. This Z-test requires the use of a transformation on the survival rate and standard error to normalize its distribution and allow use of a Z statistic to test for differences in survival rates. We assume that adult bald eagles will use a relatively discreet area (i.e., home range), but we will be able to substantiate that assumption based on relocations of individual radio-marked eagles.

Products: Data will be summarized in tables.

Objective 4 (Toxic and sublethal effects): Analytical Methods and Tests: We will attempt to collect all addled eggs and dead chicks from nests. All eggs will be handled using aluminum foil to avoid contact with skin oils that may contaminant samples for hydrocarbon analyses. Eggs will be processed according to procedures in Appendix C. Blood samples will be collected from all eagles captured (see Appendix A). We assume that all eagles have an equal chance of being caught. We will test for significant differences in levels of contaminants and blood characteristics between bald eagles from oiled and non-oiled areas using a 2-sample t-test (a = 0.05). Assumptions necessary for valid application of the t-test will be checked (e.g., test for normality). If assumptions are violated, we will use either an appropriate transformation or an equivalent nonparametric test.

Remains of prey items will be analyzed for the presence of hydrocarbons. The incidence of oil contamination in prey remains will provide supportive evidence for exposure (i.e., consumption, physical contact) of eagles to oil.

Products: Data will be summarized in tables and figures.

VI. SCHEDULES AND PLANNING

Note: Much of the data will not be available or analyzed by the proposed report deadlines because of the timing of activities (e.g., surveys, telemetry) and long time required for analysis of samples.

A. Data Submission Schedule

Activity	Timetable
Spring population surveys	May 1989
-status and initial results	December 21, 1989
Winter population surveys	February 1990
-status and initial results	Will be provided as appendix to final report

Extensive nesting surveys	
Occupancy Surveys	April and May 1989
-status and initial results	December 21, 1989
Productivity Surveys	July/August, 1989
-status and initial results	December 21, 1989
Radio-mark nestlings	July to August, 1989
Radio-mark adults	September to October, 1989
-status and initial results	December 21, 1989
Monitor radio-marked eagles	Weekly, 1989-90
-status and initial results	December 21, 1989 January 24, 1990
-final status and results	Will be provided as appendix to final report
Collect prey remains	As available, 1989-90
-submit for analysis	December, 1989
-status and initial results	December 21, 1989
-final status and results	January 24, 1990
Collect addled eggs	May to July, 1989
-submit for analysis	December, 1989
-status and initial results	December 21, 1989
-final status and results	Will be included as appendix to final report
Collect specimens	As available, 1989
-submit for analysis	As received, 1989
-status and initial results	December 21, 1989
-final status and results	Will be included as appendix to final report
Collect blood samples	September to October, 1989
-submit for analysis	December, 1989
-status and initial results	December 21, 1989
-final status and results	Will be provided as appendix to final report

Final Status and Initial Results Report January 24, 1990

B. Special Reports

Results of this study may be published in appropriate scientific journals under the approval of the Trustees.

C. Visual Data

Maps depicting bald eagle nest sites in the areas surveyed will be generated through use of a GIS system. Maps may be produced as printed products or stored as computer files.

D. Sample and Data Archival

All samples that will be analyzed for contaminants will be routed through Mr. Everett Robinson-Wilson, Contaminants Coordinator for Region 7, in Anchorage, Alaska. Samples will be stored in a secure, appropriate (e.g., freezer, refrigerator) location at field station office in Cordova prior to shipment. Unused portions of samples, or samples returned from the laboratory after analysis, will be archived at the direction of the Contaminants Coordinator for Region 7. Chain of custody procedures will be followed.

All data, study plans, SOPs, summaries, reports, correspondence, publications, or other products will be stored in the Juneau office of U.S. Fish and Wildlife Service.

E. Management Plan

Primary Investigator: Philip F. Schempf
Raptor Management Studies
U. S. Fish and Wildlife Service
P. O. Box 021287
Juneau, AK 99802

Project administration and supervision of project.

Wildlife Biologist: Tim Bowman
U. S. Fish and Wildlife Service
P. O. Box 768
Cordova, AK 99574

Serves as survey crew leader for all field activities. Supervises one biological technician and several seasonal technicians and tree climbers.

Biological Technician: Vacant

Serves as primary assistant to Wildlife Biologist, and assists with all field activities.

F. Logistics

The central headquarters for field activities will be in Cordova, due to the availability of flight services, greater number of days allowing aerial surveys, and more central location to the study area. One wildlife biologist and one biological technician will be stationed there full-time for the duration of the study. Two seasonal biological technicians will be employed during the summer field season. Two skilled tree climbers will be employed during the nesting season to recover dead eggs or nestlings and to assist in marking nestlings.

Budget

ITEM	1989
Salaries	78
Travel	20
Contracts	283
Commodities	30.5
Equipment	33.5
Totals:	445

PROJECTED EXPENDITURE BREAKDOWN -- March 1989 to February 1990

Salaries:

Position	
Project Leader	30
Wildlife Biologist	18
Biological Technician	10
Seasonal Biologists (2)	10
Tree Climbers (2)	10
TOTAL	78

Travel:	20

Contracts:

Fixed wing aircraft ($260/hr x 300 hrs)	75
Helicopter ($500/hr x 260 hrs)	130
Vessel (M/V Surfbird)	20
Office rental	4
Administrative support	1
Sample analyses	30
Necropsies	3
Vehicle rental	10
Miscellaneous	10
TOTAL	283

Commodities:

Food and supplies	5
Sampling equipment (trapping supplies, blood collection)	2
Radio transmitters ($175/transmitter x 100/yr)	17.5
Radio-telemetry supplies	2.5
Miscellaneous	3.5
TOTAL	30.5

Equipment:

Blood collection equip.	10
Computer software	5
2 VHF radios	1.5
4 ICOM transceivers	3.5
2 ATS receivers	5
Misc. telemetry equip.	5
Aircraft 2-way radio	1
4 Binoculars	1.5
2 cameras	1
TOTAL	33.5

Personnel:

Position	Incumbent	FTEs
Project Leader	Phil Schempf	1
Wildlife Biologist	Tim Bowman	1
Biological Technician	Vacant	1
2 Seasonal Biological Technicians	Vacant	1
2 Tree Climbers	Vacant	0.5

Qualifications of Project Leader:

Philip F. Schempf

Bachelor of Science, University of Minnesota, St. Paul, 1971
Masters of Science, University of California, Berkeley, 1977
15 years of experience as a professional biologist with the Federal government. 9 years of experience working with birds of prey as a project leader for the U.S. Fish and Wildlife Service in Alaska.

CITATIONS

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Postupalsky, S. 1974. Raptor reproductive success: some problems with terminology.

Steel, and Torrie.

APPENDIX A

Protocol for Collection and Storage of Blood Samples from Bald Eagles

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Philip F. Schempf
U.S. Fish and Wildlife Service
Juneau, Alaska 99802
(907) 586-7243

Procedure

a) Disinfect area around brachial vein using an alcohol swab. Draw 10 cc blood from the brachial (ulnar) vein into a sterile heparinized 10 cc syringe through a 21-23 gauge needle.

b) Make 4 blood smears with the blood from the needle (NOTE: the blood in the needle is NON-HEPARINIZED, this is important because heparin interferes with staining). With the needle still attached to the syringe, dot one drop of blood on each of four alcohol-cleaned slides and make blood smears. These slides should be air dired then fixed in absolute methanol and stored in microscope slide boxes.

c) Immediately after the drops of blood are placed on the slides (before smearing or concurrent with someone else smearing) the syringe should be gently rotated to ensure that the heparin is properly mixed with the blood to prevent clotting.

d) Blood from the syringe must next be used to fill four hematocrit tubes. Place the needle of the syringe into the tubes and fill gently, then seal the ends with clay (Crit-Seal).

e) Transfer 3 1/2 cc of the remaining blood into a 10 cc heparinized, green-top vial for centrifugation (routine procedures of 2500 rpm for 5 minutes). After centrifugation, pipette 1.5 cc of plasma into a red-top clot tube for use in clinical chemistry analysis. Put this sample on ice immediately and freeze as soon as possible. Discard the tube and remaining dark portion of blood.

f) Transfer any remaining whole blood in the syringe to a 10 cc red-top vial (to be analyzed for metals). Freeze this sample.

g) Spin the 4 hematocrit tubes in the centrifuge for 3 minutes at MHCT setting. After centrifugation, put 2 tubes into each of two 10 cc heparinized (red-top) vials and refrigerate.

h) Using a non-heparinized 2 1/2 cc Glaspak syringe, draw 2 1/2 cc of blood from the brachial vein in either wing. Transfer this blood to a glass vial that has been previously cleaned with acetone and hexane to remove any hydrocarbons. Freeze this sample.

i) Using a permanent marker, label all vials, slides, and slide holders with the last 5 digits of the band number on the standard U. S. Fish and Wildlife Service aluminum band attached to each bald eagle, followed by a letter designating the type of sample, as follows: W = whole blood, H = sample for hydrocarbons, S = serum, C = Hematocrit tubes, X = slides. Sample containers that have paper labels attached should also be taped with transparent tape to secure the label.

NOTE: freeze all vials in a horizontal position to prevent breakage when blood expands.

j) Complete all chain of custody forms and seal sample containers with evidence tape.

k) Record on standard capture forms: total volume of whole blood collected, types of samples obtained and the volume of each type of sample.

l) All samples should be shipped or delivered by hand to:

U.S. Fish and Wildlife Service
ATTN: Everett Robinson-Wilson
1011 E. Tudor Road
Anchorage, Alaska 99503

Mr. Robinson-Wilson's phone number is (907) 786-3493.

Appendix B

Maintenance and Service of Clay Adams TRIAC Centrifuge Model 0200

MAINTENANCE AND SERVICE

Service and maintenance that can be performed in the laboratory are described below. *All other service to the TRIAC Centrifuge should be performed by an authorized Clay Adams service center.*

A. Lubrication

The sealed ball bearings of the TRIAC Centrifuge motor do not require lubrication.

B. Inspection/Replacement of Motor Brushes

The motor brushes in the TRIAC Centrifuge should be inspected for wear (length) every six months. Brushes should be replaced when they are less than ¼" long. One extra pair of motor brushes is enclosed within the base housing attached to the power cord. Order only genuine Clay Adams replacement brushes (See Appendix B—Spare Parts and Accessories).

> **CAUTION**
>
> **Disconnect power cord from wall receptacle before disassembling the TRIAC Centrifuge.**

To inspect and/or replace brushes, proceed as follows:

a. Remove line cord from outlet.

b. Remove centrifuge head by removing notched retaining nut from motor shaft using spanner wrench supplied with centrifuge. Close and tightly latch centrifuge lid.

c. Turn the centrifuge upside down.

d. Referring to the exploded view in Figure 12 (Page 10), remove the two screws (A) holding the two rear rubber feet (Item 4) and washers, and screw (B) and washer in the front vibration isolator.

e. Carefully lift off the bottom plate and attached motor assembly.

f. Using a screwdriver, remove the two brush caps (C) on either side of the centrifuge motor.

g. Remove the spring and brush assembly (Item 1) from the motor.

NOTE: Brush Orientation—if brushes are still usable, i.e., more than ¼" long, replace them AS YOU FOUND THEM.

h. To replace brushes or install new ones, insert the spring and brush assembly into the motor. IT IS IMPORTANT THAT THE CURVED FRONT SURFACE OF THE BRUSH IS ORIENTED TO MATCH THE CURVED SURFACE OF THE MOTOR HOUSING BEFORE INSERTION. Replace brush caps and screw down tightly. Re-install bottom plate and replace rubber feet and plate screws.

i. Re-install centrifuge head.

NOTE: Always run-in new brushes. Proper performance may not occur until after several hours of operation with the centrifuge head re-installed.

C. Replacement of MHCT Tube Gaskets

Tube gaskets are located at the outer end of each PRE-CAL Tube Compartment. After prolonged use, gaskets may become punctured at regions in contact with the PRE-CAL Tubes. When this occurs, replace with the extra gaskets supplied with the centrifuge. Additional gaskets (Cat. No. 0200-617-000) may be ordered from Clay Adams. (See Appendix B—Spare Parts and Accessories.)

D. Speed Check

Centrifuge speeds in each of the three operating modes may be periodically checked with an accurate tachometer, such as an ADAMS Photo-Electric Tachometer, Model 5205. Mechanical tachometers that contact the motor spindle should not be used. When performing the speed checks, follow the manufacturer's directions. IMPORTANT: BEFORE CHECKING SPEED IN THE MHCT MODE, BE SURE THE TRUNNIONS ARE REMOVED.

E. Cleaning

It is recommended that interior and exterior surfaces of the TRIAC Centrifuge bowl, head, head cover and trunnions be wiped occasionally with a damp cloth. A mild detergent may be used to remove stains. Keeping these parts clean will prolong the life of the centrifuge. The transparent cover of the centrifuge is made of a shatter-proof polycarbonate resin, resistant to a wide range of laboratory chemicals. It is recommended, however, that the cover be kept clean and that spillage be wiped off as soon as possible. A mild detergent should be used. DO NOT USE CARBON TETRACHLORIDE or CHLOROFORM. Other chemicals, such as aromatic hydrocarbons (benzene, toluene, xylene, turpentine, gasoline, acetone) and strong alkalies (sodium and ammonium hydroxide), can damage the cover.

Appendix C

Protocol for Processing Bald Eagle Eggs for Contaminant Analyses

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Philip F. Schempf
U.S. Fish and Wildlife Service
Juneau, Alaska 99802
(907) 586-7243

Procedure

a. Clean all equipment (foil, tweezers, scalpel, drill bits) by rinsing with acetone to remove water, then with hexane to remove hydrocarbons.

b. Label all I-Chem jars with the sample ID number using a permanent marker; weigh each jar to the nearest 0.01 g; set aside.

c. Unwrap egg to the last layer of foil surrounding egg; weigh the egg <u>in</u> the foil, then transfer to another piece of foil and weigh the foil. <u>Note: Do not touch egg at any time and do not touch the surface of the foil used to wrap egg. This will contaminant egg with skin oils.</u>

d. Using Vernier calipers, measure egg length, and measure the egg width at 3 places around the area of largest diameter. (Use the average of the 3 width measurements).

e. Set the egg (still in foil) big end up into the open end of a small I-Chem jar to support it while working on egg.

f. Using a Dremmel rotary tool and fine circular bit, carefully drill a nickel sized cap off the big end of the egg. Remove the cap with tweezers and place cap in large I-Chem jar.

g. Pour contents of egg into a small I-Chem jar.

h. Note development of embryo, if any (e.g., amount of development [no development, 1/2 developed, ready to hatch], eyes or limbs present or absent, coloration and consistency of egg).

i. Drill out a dime-sized portion of shell at the middle of the egg for thickness measurements. Put section into small manilla envelope, and label envelope with sample ID number.

j. Put remaining eggshell into big I-Chem jar.

k. Cap, then weigh both I-Chem jars. Subtract jar weights to get weight of contents.

l. Freeze samples.

m. Record the following information on data sheets:
   - Sample site
   - Whole egg ID #
   - Contents ID #
   - Shell ID #
   - Whole egg weight (g)
   - Contents weight (g)
   - Shell weight (g)
   - Egg Length (mm)
   - Egg Width (mm)
   - Volume (calculated)
   - Sample jar weight - contents
   - Sample jar weight - shell
   - Comments - development, etc.

STATE-FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT

DETAILED STUDY PLAN, APRIL 1989-FEBRUARY 1990

Project Title: Impact Assessment of the Exxon Valdez Oil Spill On Peale's Peregrine Falcons

Study ID Number: Bird Study Number 5

Lead Agency: U.S. Fish & Wildlife Service

Cooperating Agency: Alaska Department of Fish and Game (ADF&G)

Project Leader: Jeffrey H. Hughes, Wildlife Biologist III (ADF&G)

Cost of Proposal: $43,500

Date Submitted: 23 October 1989

	Signature	Date
Principal Investigator	Jeffrey H. Hughes	22 Oct 89
Supervisor (ADF&G)	Donald W. Calkins	Oct 22, 1989
OSIAR Senior Biometrician		
OSIAR Project Manager		
OSIAR Director		

Introduction

Three subspecies of peregrine falcon occur in Alaska. The American peregrine falcon (Falco peregrinus anatum) inhabits the boreal forest region of the State and is classified as endangered on both Federal and State endangered species lists. The Arctic peregrine falcon (F.p. tundrius) occurs in tundra regions of northern Alaska and is also classified on both State and Federal endangered species lists. The third subspecies, commonly referred to as Peale's peregrine falcon (F.p. pealei), is not classified as endangered or threatened. Peale's falcons occur along the southern coast of Alaska from the Aleutian Islands through southeastern Alaska. The goal of this project is to determine whether the Exxon Valdez oil spill (EVOS) has had, or will have, a measurable impact on Peale's peregrine falcons in Prince William Sound, coastal Kenai Peninsula, and adjacent areas.

Peale's falcon populations in Alaska have been estimated at between 500-600 pairs (Schempf 1989, Ambrose pers. comm.). An estimated 40-60 pairs inhabit Prince William Sound and coastal Kenai Peninsula (Janik & Schempf 1985), and another 20-30 pairs occur in the Kodiak Archipelago, upper Alaska Peninsula, and Cook Inlet area, for a total of 60-90 pairs in coastal habitat affected by EVOS.

Alcids, small gulls, and petrels are prime peregrine prey species that became oiled as a result of EVOS and may be taken by falcons. Oil transferred to peregrine falcons could affect individuals and the population through: 1) Coating of feathers and the resulting loss of insulation and flight capabilities; 2) Reduced reproduction due to ingestion of hydrocarbons and trace-metals that affect the breeding physiology of adults; 3) Reduced reproduction due to transfer of oil from feathers of incubating adults to eggs; 4) Mortality of individuals due to toxicity; and 5) Reduced reproduction due to reduced prey population levels.

This project will provide information on the number of nest sites occupied by Peale's falcons and their productivity. These data, in combination with historical data for this area will provide a basis to evaluate whether changes occurred in the distribution, abundance, and productivity of falcons. Examination of secondary wing feathers taken from adults and young, along with prey remains and eggs collected from occupied eyries will provide evidence of whether crude oil was ingested or absorbed by falcons. Analysis of wing feathers and prey remains collected several months after the oil spill will provide information on the bioaccumulation of trace-metals from crude oil, in marine and terrestrial food chains.

OBJECTIVES:

1. To test the hypothesis ($\alpha = 0.05$) that nest site occupancy and productivity are lower in the project area as a result of EVOS than other populations.

2. To test the hypothesis that the quantities of vanadium and nickel in peregrine feathers are the same for birds nesting in oiled and non-oiled areas.

3. To count and identify prey remains collected at eyries in oiled and non-oiled areas.

4. To test the hypothesis ($\alpha = 0.05$) that pesticide contamination of egg clutches in the project area are less than contamination levels reported in scientific literature as causing reproductive failures in peregrine falcons.

5. To identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

METHODS

Project Area: The project area will include the mainland shore and islands of Prince William Sound from Cape Hinchinbrook along the southern coast of the Kenai Peninsula through Kachemak Bay, the Alaska Peninsula from Kamishak Bay to Wide Bay, and the Kodiak Archipelago.

Survey Design: Two surveys of the project area will be conducted. Guidelines for peregrine falcon surveys to standardize survey techniques, terminology, and data collection are enumerated in Protocol A. The initial survey, to determine presence or absence of peregrines at coastal bluffs and to collect fresh egg samples for contaminant analysis, will take place in early and mid-May. A helicopter will be used for the surveys and to provide access to potential nesting habitat. At sites with large concentrations of cliff nesting seabirds, the helicopter will land far enough away from bluffs to minimize disturbance. Observers will approach on foot to survey potential nesting habitat.

The latter survey, in late June and early July, will embrace the same area but focus on the sites which were determined to be occupied by peregrine falcons during the initial survey. Nests will be located by observers on the ground and then reached by standard climbing techniques to collect feather samples and to band nestlings. Adults will be trapped near nests to take feathers, while feather samples from young will be collected at eyries. Prey remains and addled or broken eggs will be collected at nest sites. During both surveys, investigators will document oil on falcons and look for bands on adults to learn where they were banded. If the birds were not previously banded, they will be banded with standard aluminum bands.

Twenty-five prey remains will be examined for hydrocarbon contamination. If prey remains are treated as a binomial random variable, the probability of encountering at least one prey remain contaminated with hydrocarbons can be calculated based on the Binomial Distribution (Mendenhall et al. 1981). Assuming 25 prey remains are collected and 10 percent of these prey remains contain hydrocarbon residues, we are 92 percent certain of collecting at least one hydrocarbon contaminated specimen. Samples collected for hydrocarbon analysis will be handled according to Protocol B. Chain-of-custody will be maintained for all samples and they will be stored in a secure facility at ADF&G in Anchorage until they can be sent to an approved laboratory for analysis.

Feathers grown by adult and nestling peregrine falcons should contain trace-elements in an array of concentrations unique to the local ecosystem (Parrish et al. 1983). High levels of nickel and vanadium have been associated with North Slope crude oil and these trace-metals are bioaccumulated in marine and terrestrial food chains (Minerals Management Service 1988). Predators at the top of food chains, such as the peregrine falcon, may encounter toxic levels of trace-metals because these elements are concentrated with each step up the food chain. Toxic quantities of trace-metals have been implicated in population declines of peregrines and other raptors (Newton 1989). Elevated levels of nickel in the diet will produce physiological effects similar to lead or mercury poisoning such as central nervous system disorders and reduced reproductive success (Williams, pers. comm.). Traces of these metals can be measured efficiently in birds feathers by instrumental neutron-activation analysis (INAA) (Wainerdi & DuBeau 1963). Feather samples from peregrines not influenced by the oil spill from other regions of the state will serve as controls.

Approximately 30 feather samples will be collected for trace-metal analysis. The distal 1 cm of the fifth secondary remige will be collected from adult and nestling peregrines for INAA as described by Parrish et al. (1983). Feather samples will be labeled and preserved in accordance with Protocol C. Chain-of-custody will be maintained for all samples and they will be stored in a secure facility at ADF&G in Anchorage until they can be sent to an approved laboratory for INAA.

The decline of peregrine populations in North America during the 1950's through the early 1970's was linked to organchlorine pesticides (Hickey 1969). Nelson & Myres (1976) reported substantial levels of biocides in Peale's falcons in coastal

British Columbia and suggested the depressed reproductive success up to hatching on Langara Island was largely due to the efects of pollutants. Since trace-metals may affect reproduction in peregrines, similarly to organochlorine pesticides, a pesticide monitoring program would help identify which factors are involved if reporduction is impacted. Thus collection of fresh eggs is necessary for pesticide analysis.

Historically, about 35 eyries are thought to be occupied each year in the project area. The decision to collect 10 eggs is an attempt to achieve an adequate sample without significantly impacting productivity. Based upon a hypergeometric distribution (Mendenhall et al. 1981), and assuming a population of 35 clutches, a sample of 10 clutches, and a contamination rate of 20 percent, we are 90 percent confident of observing at least one contaminated clutch. Eggs will be collected as described by Ambrose et al. (1986) and in accordance with Protocol C. Chain-of- custody will be maintained for all samples and they will be stored in a secure facility at ADF&G in Anchorage until they can be sent to an approved laboratory for chemical analysis as described by Cromartie et al. (1975) and Kaiser et al. (1980).

DATA ANALYSIS

Objective 1 involves a comparison of site occupancy and productivity in the project area among other peregrine populations. Separate but similar analysis of variance (ANOVA) (Snedecor & Cochran 1980) with the appropriate linear contrasts will be used to test the following:

a) there is a difference among populations in unoiled areas;

b) that the project area has lower values than the unoiled areas.

If historical values do not differ among unoiled populations a significant test statistic for the above hypothesis would indicate that the difference was caused by the oil spill.

The null hypothesis is that eyrie occupancy in the project area in 1989 is greater than or equal to eyrie occupancy reported in the literature. The alternative hypothesis is that eyrie occupancy in 1989 in the project area is less than eyrie occupancy reported in the historical literature.

The null hypothesis for the second part of Objective 1 is that Peale's peregrine productivity in 1989 in the project area is greater than or equal to Peale's peregrine productivity reported in the literature. The alternative hypothesis is that Peale's peregrine productivity in 1989 in the project area is less than Peale's peregrine productivity reported in the literature.

ANOVA coupled with the appropriate linear contrasts will be used to test the above hypotheses (Snedecor & Cochran, 1980). The assumptions for ANOVA are:

1) The samples are ramdom and independent;
2) The distribution of the different means is normal; and
3) The variances of the samples are equal.

A Q-Q plot (Hoaglin et al. 1985) of the raw data will determine if the data is approximately normal, in which case the Central Limit Theorum will insure assumption 2 is met. If assumption 2 is not met, a non-parametric test will be employed (Conover 1980). Bartlett's statistic will be used to test assumption 3 and transformation employed, if necessary, to meet this assumption.

Objective 2 involves a 2 sample T-test (Snedecor & Cochran 1980) to determine if trace-metal concentrations are lower in the project area than outside the project area. The null hypothesis is that nickel and vanadium concentrations in peregrine feathers from the project area in 1989 is less than or equal to nickel and vanadium concentrations in peregrine feathers from elsewhere in Alaska in 1989. The alternative hypothesis is that nickel and vanadium concentrations in peregrine feathers from the project area in 1989 were greater than nickel and vanadium concentrations in peregrine feathers from elsewhere in Alaska in 1989.

In Objective 3, if hydrocarbon prey remains are observed, an estimate of the proportion of contaminated prey remains and 95 percent confidence intervals will be estimated. The confidence intervals require that the proportion be normally distributed. If necessary, transformations will be used to meet this assumption (Snedecor & Cochran 1980).

The null hypothesis contained in Objective 4 states that levels of pesticide contamination of peregrine eggs collected in the project area in 1989 are greater than or equal to the levels of pesticide contamination of peregrine eggs reported in literature as causing reproductive failures (Peakall et al. 1975). The alternative hypothesis states that levels of pesticide contamination of peregrine eggs collected in the project area in 1989 are less than the reported levels of pesticide contamination of peregrine eggs associated with reproductive failures. A one-tailed, one sample T-test (Snedecor & Cochran 1980) will be used to test the hypothesis in Objective 4. This test assumes the sample was randomly collected and the mean has a normal distribution. If necessary, either a transformation will be used to meet the Normality Assumption or the Wilcoxon Signed Ranks test (Conover 1980) employed to test this hypothesis.

BUDGET

A line item breakdown of costs from April 1989 through February 1990 is as follows:

Line Item	Amount
100 Personnel	$ 9.0
200 Travel & per diem	1.5
300 Services	30.0
400 Commodities	1.5
500 Equipment	1.5
TOTAL	$43.5

Line Item 100 - Personnel

Person	Grade	Cost/Month	Mo.	Subtotal
J. Hughes PCN 7028	WB III	4.5	2	9.0

TOTAL Line 100 9.0

Line Item 200 - Travel & Per Diem

Field Travel (Homer, Seward, & Valdez)	1.0	
Travel & Per diem - Juneau	0.5	
Total Line 200		1.5

Line Item 300 - Services

Aircraft Charter 200/hr x 10 hours	2.0	
Helicopter Charter 500/hr x 50 hours	25.0	
Air Freight and Postage	1.0	
Telephone	1.0	
Equipment Repair	1.0	
Total Line 300		30.0

<u>Line Item 400 - Commodities</u>		
Food and Supplies	0.5	
Jet B Fuel	1.0	
Total Line 400		1.5
<u>Line Item 500 - Equipment</u>		
Climbing Gear	1.0	
Safety Equipment	0.5	
Total Line 500		<u>1.5</u>
Total Budget		43.5

Qualifications: Jeff Hughes is the project leader for Bird Study Number 5. Jeff has an undergraduate degree in zoology and has completed graduate studies in wildlife management and silviculture. He was employed for 12 years as a wildlife biologist for the U.S. Forest Service in Idaho, Alaska, and Oregon. Jeff has spent the past 8 years working for the Alaska Department of Fish and Game in the Nongame Wildlife Program. He has conducted several studies in Alaska involving raptors, including ospreys, bald eagles, peregrine falcons, and other birds of prey. These projects involved aerial and ground nest surveys, raptor trapping, banding, and detailed time/activity investigations. He has published several refereed manuscripts as well as numerous popular articles on raptors.

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Personal Communications

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Williams, D. Quantum Medicine, Eagle River, Alaska.

Protocol A. Standard Methodology for Peregrine Falcon Surveys, May 1989.

In order to minimize disturbance to nesting peregrine falcons and in order to standardize survey techniques, terminology and data collection, the U.S. Fish and Wildlife Service, Endangered Species Office in Fairbanks, has adopted the following guidelines for peregrine falcon surveys.

1. All investigators must obtain pre-survey authorization (permit) from the U.S. Fish and Wildlife Service, Endangered Species Office in Fairbanks. Only individuals who have demonstrated (through experience) the ability to work effectively with peregrine falcons will be authorized.

2. Unless nest site visits are specifically authorized by the U.S. Fish and Wildlife Service, investigators must approach nest sites no closer than is essential to accomplish survey objectives. To avoid egg and nestling mortality or abandonment by adults, disturbance which cause adult birds to leave the nest must be of short duration.

3. The use of explosives, firearms, or other loud audio devices to flush birds from known or potential nest sites is prohibited.

4. Unless alternate methods are agreed upon by the U.S. Fish and Wildlife Service, two visits will be made to each nesting territory. The first visit will occur as soon as possible after the assumed date of clutch completion, and the second visit will occur when the nestlings are at least 3 weeks of age (50% of fledgling age).

5. All investigators must complete a "Raptor Observation and Nest Record Card (February 1989)" (Enclosure 1) for each nesting territory visited. A map with locations of nesting territories visited must be submitted with the cards. Completed cards, maps, and banding schedules (if any) must be submitted to the U.S. Fish and Wildlife Service, Endangered Species Office in Fairbanks, by November 1 of the year of the survey.

Nesting Territory Status Terminology

1. UNOCCUPIED: A nesting territory where no bird showing an affinity for the territory during the breeding season was observed (investigators must spend a minimum of 6 hours at the territory during the incubation period to make this determination).

2. OCCUPANCY UNKNOWN: A nesting territory where no bird

showing an affinity for the territory during the breeding season was observed but investigators spent less than 6 hours at the territory during the incubation period.

3. OCCUPIED - NON-BREEDING: A nesting territory where one or two birds showing an affinity for the nesting territory during the breeding season were observed but no eggs were laid (note: this category involves proving no eggs were laid, therefore only those nests that were frequently observed can be assigned to this category.

4. OCCUPIED - BREEDING: An occupied nesting territory where eggs were laid (evidence includes young in the nest, eggs, or eggshells in the nest, or adults seen incubating) but where final breeding success was not determined.

5. OCCUPIED - UNSUCCESSFUL BREEDING: An occupied nesting territory where breeding was attempted but where no young reached 80% of fledging age, for any reason (for example, eggs destroyed or otherwise lost, eggs failed to hatch, or young hatched but died prior to fledging).

6. OCCUPIED - SUCCESSFUL BREEDING: An occupied nesting territory where one or more young reached 80% of its fledging age.

7. OCCUPIED - BREEDING STATUS UNKNOWN: An occupied nesting territory where breeding or non-breeding could not be determined.

DEFINITIONS:

BREEDING TERRITORY: The area within which courtship, copulation, nesting and food seeking usually occur.

NESTING TERRITORY: An area that contains, or historically contained, one or more nests (or scrapes) within the home range of a pair of mated birds, and where no more than one pair has ever bred at one time.

NEST SITE: The actual site of the nest or scrape. More than one nest stie may be present with the territory of a pair of birds but used in different years.

FLEDGED YOUNG: Young that have reached 80% of their respective fledging age (age at first flight) or more.

ALTERNATE NEST: An unoccupied nest site within the nesting territory of one pair of birds.

Enclosure 1. Alaska Raptor Observation Card (Feb. 1989).

Front:

RAPTOR OBSERVATION RECORD CARD (FEB 1989)

OBSERVER NAME AND ADDRESS:	MAP NAME:
	1:250 # - 1:63 # - NEST.TERR. # - SITE # - YEAR
SPECIFIC AREA (DESCRIBE):	OTHER NO. (e.g. Agency No.):
	UTM-N or LATITUDE:
	UTM-E or LONGITUDE:

SPECIES (COM NAME OR AOU ABBREV.):

DATE	TIME	SUR MET	NO. ADS	NO. SUB	NO. EGGS	NO. NESTL	AGE NESTL	NO. FLG	ACTIVITIES
					E A	E A	E A		
					E A	E A	E A		
					E A	E A	E A		
					E A	E A	E A		
SEASON SUMMARY	TOTAL:								

SURVEY METHOD:
1. FOOT
2. VEHICLE
3. BOAT
4. PLANE
5. HELICOPTER
6. INCIDENTAL OBS.

ACTIVITY / BEHAVIOR (May Be More Than One)
1. PERCHED
2. FLYING
3. HUNTING/FORAGING
4. FEEDING ADULT
5. TERR. DEFENSE
6. VOCALIZING
7. BODY CARE
8. COURTSHIP
9. NEST BUILDING
10. INCUBATING
11. BROODING
12. FEEDING YOUNG
13. COPULATING
14. OTHER:

OFFICIAL NEST STATUS

NOTES, MAP, OR PHOTO ATTACHED? 1. YES 2. NO

REMARKS (Moult In Adult Pair, Prey In Nest/Eyrie, Etc.):

Back:

RAPTOR NEST/EYRIE RECORD CARD (FEB 1989)

TREE NEST-SPECIES:
1. LIVE TREE
2. SNAG
3. NEST BOX/PLATFORM
4. ARTIFICIAL
5. CAVITY IN TREE
6. OTHER

TREE HEIGHT (M): E A

TREE DIAMETER (CM): E A

HEIGHT OF NEST IN TREE (M): E A

DOMINANT HABITAT TYPES (up to three within .5 km of nest)
1. CLIFF
2. UNVEGETATED GROUND
3. WET MEADOW
4. DWARF SHRUB MEADOW (tundra dominated by grasses or sedges)
5. GRASS MEADOW
6. DWARF SHRUB MAT (dwarf shrubs <0.4 M high)
7. LOW SHRUB THICKET (shrubs 0.5 - 1.1 M high)
8. MED. SHRUB THICKET (shrubs 1.2 - 2.4 M high)
9. TALL SHRUB THICKET (shrubs 2.5 - 5.0 M high)
10. DECIDUOUS FOREST
11. CONIFEROUS FOREST
12. MIXED DECIDUOUS-CONIFER FOREST
13. SCATTERED WOODLAND AND DWARF FOREST
14. ARTIFICIAL HABITAT
15. OTHER
16. MARINE (dist. km) E A
17. RIPARIAN (dist. km): E A
18. LACUSTRINE(LAKE) (dist. km): E A
19. RIVER / STREAM (dist. km): E A
20. OTHER PERRENIAL WATER (dist. km): E A

FOR CLIFF NESTS - ABOVE CLIFF:
(habitat types) BELOW CLIFF:

GROUND NEST - SITUATION:
1. LEDGE ON CLIFF
2. STICKNEST ON CLIFF
3. CAVITY (POTHOLE) ON CLIFF
4. OPEN HILLSIDE
5. LEVEL GROUND
6. OTHER

CLIFF ROCK TYPE: 1. SED 2. IGN 3. MET

SPEC. FORMATION:

CLIFF HEIGHT (M): E A

CLIFF LENGTH (KM): E A

HEIGHT OF NEST ON CLIFF (M): E A

ELEVATION OF NEST ABOVE SEA LEVEL (FT):

ASPECT OF SLOPE:

ASPECT OF NEST:

NEST CONDITION: 1. GOOD 2. POOR 3. REMNANT ONLY

NEST ACCESSIBILITY (to ground predators): 1. EASY 2. MOD. DIFFICULT 3. VERY DIFFICULT

DISTANCE TO HUMAN ACTIVITY (KM): E A

HUMAN ACTIVITY VISIBLE FROM NEST? 1. YES 2. NO

TYPE(S) OF HUMAN ACTIVITY:
1. TRAIL
2. ROAD
3. BOATING
4. AIRCRAFT
5. BUILDING(S)
6. AGRICULTURE
7. CONSTRUCTION
8. RESEARCH
9. MINING
10. OIL / GAS
11. LOGGING
12. OTHER:

CIRCLE ANY THAT APPLY:
1. PHOTO OF CLIFF TAKEN
2. PHOTO OF EYRIE TAKEN
3. EYRIE DESCRIP. ATTACHED
4. PREY REMAINS COLL.
5. EGG(S) COLLECTED
6. EGG SHELLS COLLECTED
7. WHITEWASH AT EYRIE
8. OTHER WHITEWASH ON CLIFF
9. OVERHANG AT EYRIE
10. AFTERNOON SHADING?: a. YES b. NO c. UNKNOWN

BANDING AND BAND RECOVERY INFORMATION

AGE	SEX	AVISE NO. - COLOR / LEG	BAND CODE - COLOR / LEG

Protocol B. Methodology for collecting samples for toxicology.

Toxicological Analysis

Samples taken under this protocol must be collected with care since the slightest amount of contamination may result in erroneous results. EXTREME CARE MUST BE TAKEN TO AVOID HYDROCARBON CONTAMINATION. THESE SAMPLES MUST NOT COME IN CONTACT WITH ANY PLASTIC OR OTHER PETROLEUM DERIVED PRODUCTS!

Samples collected for this protocol should be placed in clean glass jars. Use new ICHEM jars if possible. If new ICHEM jars are not available, thoroughly wash jars with clean water, rinse them with reagent grade methylene chloride, and allow them to dry. Methylene chloride is toxic and should be handled in a hood or used out of doors. Do not breathe the fumes! If methylene chloride is not available, rinse jars with another organic solvent (acetone or hexane). Jar lids should be lined with teflon. If jars are not available, samples may be tightly wrapped in aluminum foil. Samples of bile and milk should be put in amber-colored jars with teflon lids. Samples of whole blood should be put in gray-topped vacutainers or ICHEM jars.

Samples should be handled only with knives and forceps that have been cleaned with acetone, hexane, or methylene chloride. Rinse instruments with acetone and hexane after each sample. Be sure that samples do not come in contact with rubber or surgical gloves. Gloves without talc are preferred. Whenever possible, take the sample from the center of the organ, avoiding possible contaminating material. Tissue samples should be about 2x2x1 cm. Fluid samples should be 5-10 cc. If adequate material is available take triplicate samples and package each separately.

Sample information should be put on the outside of the jar on a cloth or paper label. Permanent marking pens or pencil work better than ballpoint pens. Information on the label must include <u>species</u>, <u>sex</u>, <u>date sampled</u>, <u>location found</u>, and <u>location sampled</u>. Additional information could include time and location of death and condition of carcass. Cool the sample immediately, and freeze as soon as possible (-20 degrees F if possible).

<u>Bile</u>, <u>liver</u>, <u>blubber</u>, and <u>lung</u> are the highest priority to sample. Other samples that should be taken, if they are available and time and supplies permit, include: kidney, brain, heart, skin, skeletal muscle, blood, and milk. If they are prey or other items in the stomach take sample of those and clearly label them as such.

Protocol C. Analytical chemistry collection and handling of samples.

1. Sample Identification and Labelling

A tag or label identifying the sample must be completed and attached to each sample. Waterproof (indelible) marker must be used on the tag or label. The minimum information to be included on the tag are the sample identification number, the location of the collection site, the date of collection and signature of the collector (who, what, where, and when). This information and any other pertinent data such as the common and scientific names of the organism collected, the tissue collected and any remarks are recorded in the logbook.

The location of the sampling site is determined with the aid of USGS grid maps, NOAA charts or navigational systems such as LORAN C.

2. Sampling Equipment and Sample Containers

All sample containers must be either organic-free (solvent-rinsed) glass or organic-free (solvent-rinsed) aluminum foil. Lids for the glass containers must be lined with either teflon or solvent-rinsed aluminum foil.

Sample collection and storage devices are cleaned by washing with soap and hot water, rinsed extensively with clean water and then rinsed with either methylene chloride or acetone followed by pentane or hexane and allowed to dry before use.

The solvents (methylene chloride, acetone, pentane and hexane) used for cleaning sample collection and storage devices must be of appropriate quality for trace organic residue analysis and be stored in glass or Teflon containers, not plastic.

New glass jars or unused aluminum foil do not need to be washed with soap and water. They must however, be solvent-rinsed as described above before use.

The dull side of the aluminum foil should be the side that is solvent-rinsed. Pre-cleaned squares may be stored with the clean sides folded together.

All equipment that comes in contact with the sample must be solvent-rinsed before contacting each sample. Equipment should be washed with soap and hot water between sampling locations.

3. Sampling Procedures

The method of collection must not contaminate the samples. Do not touch or collect any sample with your bare hands.

Tissue samples to be analyzed for petroleum hydrocarbons should be freshly killed or recently dead.

Whole organisms may be stored in solvent-rinsed glass jars or wrapped in solvent-rinsed aluminum foil.

Bird eggs and feathers are wrapped in solvent-rinsed aluminum foil and transported by any convenient means that will prevent breakage. Eggs should be opened or refrigerated as soon as possible. Eggs are opened by cutting them with a solvent-rinsed scalpel or by piercing the air cell end and pouring/pulling the contents out. Avoid including pieces of egg shell with the contents or touching the contents with your hands. Total weight, volume (measured or calculated), length, width and contents weight must be recorded for each egg.

4. <u>Sample Preservation and Holding Time</u>

Samples must be kept cool, i.e. on ice.

Frozen samples must be kept frozen, at -20 degrees C or less, until extracted or prepared for analysis. Repeated freezing and thawing of samples can destroy the integrity of the samples resulting in questionable data or the loss of data.

Table 1. Schedule of Activities from April 1989 through December 1989.

Activity	1989	Personnel*
Nest occupancy surveys	Apr-Jul	JH, BD, JF, JM, RS, TS
Collect 10 fresh eggs	Apr-May	JH
Trap adults to collect feather samples	Apr-May	JH, TS
Resurvey nest sites & collect feather samples from young	July	JH
Collect prey remains	Aug	JH, TS
Data analysis surveys	Oct-Dec	JH
Data analysis specimens	Dec	JH
Reporting	Dec	JH

*Letters refer to initials of personnel listed in Table 2.

Table 2: Personnel involved in Bird Study Number 5.

Name	Affiliation	Responsibilities
Skip Ambrose	USFWS	Assist with project design & review, assist with field work
Earl Becker	ADF&G	Advise on bio-metrical procedures
Peter Bente	USFWS	Assist with project design, review, & field work
Bob Dittrick	consultant	Assist with project design & field work
James Frazier	NAFA	Assist with field work
Jeff Hughes	ADF&G	Project leader; field work including aerial surveys, collecting, data analysis, & reporting
Bob Leedy	USFWS	Provide lead agency review & coordination
Jon Mousel	AFA	Assist with field work
Phil Schempf	USFWS	Provide lead agency review & coordination; assist with project design
Rick Sinnott	ADF&G	Assist with field work
Ted Swem	BSU	Assist with project design & field work

Title:	Assessment of injury to Marbled Murrelets at sites along the Kenai Peninsula and Prince William Sound
Study ID Number:	Bird Study Number 6
Principal Investigator:	Kathy Kuletz
Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$115,700
Date of Plan:	March 1989 through February 1990

Principal Investigator: Kathryn J. Kuletz Date: 10-20-89

Marine and Shorebird Oil Spill Damage Assessment Coordinator: Robert L. Leedy (for Kent Wohl) Date: 10/20/89

Migratory Bird Oil Spill Damage Assessment Study Coordinator: Robert L. Leedy Date: 10/20/89

Biometrician David C Bowden Date: 10/20/89

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1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907)-786-3444

II. INTRODUCTION

As small diving seabirds which frequent nearshore areas, marbled murrelets (Brachyramphus marmoratus) have one of the highest oil vulnerability indexes of any seabird (King and Sanger 1979). Alaska represents a significant portion of this species' breeding population (Mendenhall 1988), and the area affected by the Exxon Valdez oil spill has a high population of marbled murrelets (Dwyer et al. 1975). This species is of particular concern because it is on the U.S. Fish and Wildlife Service's Candidate List of Threatened and Endangered species.

Estimates of the Prince William Sound murrelet population range from 103,000 (Dwyer et al. 1975) to 250,000 (Isleib and Kessel 1973) summer residents. Reliable population estimates or identified breeding sites of murrelets are difficult to obtain, because of the species' wide distribution and secretive nesting habits. Thus, injury to marbled murrelets can only be ascertained by at-sea censusing at sites with historic data, or collection of adults for evidence of contamination.

This study will estimate local at-sea densities of murrelets during the summer months at sites with historic data, in order to test for a potential reduction in the adult population subsequent to the Exxon Valdez oil spill. Long-term injury to breeding potential will be estimated by quantifying breeding activity and testing adults for contamination with petroleum hydrocarbons by analysis of tissue samples.

The increased human presence in Prince William Sound in 1989 may be an important factor effecting murrelet densities or activity patterns, which will need to be distinguished from an actual decline in population. The data collected will enable analysis of murrelet densities in bays relative to human activity, including traffic on-beach, by boat and low flying aircraft.

It is possible to monitor local murrelet populations using methodologies recently developed for censusing marbled murrelets (Carter 1984, Paton and Ralph 1988, Paton et al. 1989, Kuletz 1989). In Alaska, detailed historic data is available for Naked Island (Oakley and Kuletz 1979, Kuletz unpubl. data), St. Matthews Bay / Olsen Bay in Port Gravina (Irons, unpubl. data) and Kachemak Bay (Erickson 1976, Kuletz 1989). Single censuses are available for areas of Prince William Sound (Hogan and Murk 1982, Irons 1988) and the south side of the Kenai Peninsula (Bailey 1977, Nishimoto and Rice 1987).

III. OBJECTIVES

The stated objectives in this plan differ slightly from those given in the Public Review Draft (August, 1989). Objective A in the August plan has been split into objectives A and B for the detailed study plan.

A. To test the hypothesis that at sites with historic data, the mean densities of marbled murrelets following the Exxon Valdez oil spill are not significantly different from their respective mean densities in prior years.

B. To estimate the local murrelet at-sea densities of selected oiled and unoiled sites of Prince William Sound and the Kenai Peninsula (with 95% confidence level), to serve as baseline data for studies on the recovery of local populations of murrelets affected by the oil spill.

C. To provide a quantifiable index of breeding activity at sites with known breeding populations of marbled murrelets, at both oiled and unoiled sites.

D. To test for differences in exposure to petroleum hydrocarbons for adult marbled murrelets in oiled and unoiled sites by collecting adult birds for tissue samples.

E. To identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS

A. Sampling Methods

Objective A: Testing for differences in murrelet densities

At-sea censusing of murrelets

Areas of marbled murrelet at-sea summer concentrations are usually consistent (Carter 1984, Kuletz 1989). This study will estimate murrelet at-sea density in 1989 for areas which were censused prior to the oil spill. Three of the study sites have data from replicate censuses prior to the oil spill: 1) Naked Island, 2) Kachemak Bay, 3) St. Matthews and Olsen Bay, Port Gravina.

The 1989 censuses to determine at-sea densities will follow methods outlined in Kuletz 1989. The basic method will be observation from small boats on established transects or sections of shoreline. Approximately 15-20 Km of transects will be done at each study site to minimize variance from small-scale movement of murrelets. To insure peak murrelet numbers and reduce variability, primary censuses will be conducted between 0600 and 0900 hours. The two observers will record murrelets on the water out to 250 m from the boat, using data forms. Any adaptations specific to this study are explained below.

Pilot studies targeting murrelets in Alaska have shown day-to-day variability in densities resulting in a coefficient of variation ranging from 16% to 54%, (Kuletz 1988, Irons, unpubl. data). The number of replicate transects (sample size) will depend on the on-site variability in murrelet numbers. Assuming an average of 30% CV, a minimum sample size of four, and preferably up to eight, replicate transects will be required at each site. These censuses should be conducted on consecutive days or as close as possible, to reduce seasonal effects on murrelet attendance. As a control for 1989 seasonal changes in attendance, a more intensive effort will be conducted on Naked Island, where field crews will attempt a minimum of eight replicates each for early and late season censusing periods.

Variability among census days can be significantly reduced by conducting censuses between approximately 7 June to 7 July (Kuletz et al. 1988). However, Kachemak Bay had the highest murrelet densities in late July. At least two sites will be censused in late July to early August to determine if this pattern is consistent among sites. If so, late summer censuses may be used to obtain maximum estimates of the total murrelet population.

Effects of weather and viewing platform

Historic data were obtained by a variety of methods and observers, in addition to variable weather conditions. The small size and scattered distribution of murrelets are likely to increase the impact these factors have on derived density estimates. Data on environmental conditions will be collected, and exist in most historic data, to test for effects on murrelet density or detectability. In 1989, this study will attempt to derive a correction factor for viewing platform as well, by testing for significant differences in at-sea murrelet observations taken from a 25 ft. vessel and a 12 ft. inflatable raft. At least six paired transects will be conducted by both boats, within 2 hours of each other, on the same day.

Adjustment for difference in visibility rates will be made if differences are found to be significant. Comparisons among years will be made using standardized or adjusted counts to minimize procedural effects on counts.

Effect of human disturbance and accuracy of boat transects

At-sea murrelet densities derived from surveys conducted by boat, although convenient and used most frequently, have not been tested against an independent census method. Murrelet numbers may be significantly underestimated by boat surveys, due to the murrelet's small size and avoidance behavior (Dwyer et al. 1975, Sealy and Carter 1984, Kuletz, pers. obs.)

To test the null hypothesis that there is no difference in density estimates between different methods, murrelet counts will be done from land-based observation sites viewing the same areas traversed by boat. At least 10 of the on-land counts will be paired with concurrent boat counts, with the on-land observer making counts prior to, during and after the boat transit. On-land counts will follow the standard operating procedures outlined in Kuletz 1989, with site-specific adaptations to be outlined in a standard operating procedure.

Objective B: Baseline data on population estimates

Testing for long-term significant differences in murrelet population trends in heavily oiled and unoiled areas will require more study sites. In addition to the three study sites with detailed historic data, other areas of Prince William Sound and the lower Kenai Peninsula have qualitative or single-census records of murrelet densities. This study will expand on and quantify this data base to more accurately define the murrelet population for future monitoring of changes in the population. The at-sea censusing methods described above will be used, with on-land counts included at Naked Island and Eaglek Bay.

Based on the availability of historic data and degree of oiling, the following study sites were chosen: 1) Ingot Island to Herring Bay on Knight Island, heavily oiled. 2) West side of Naked Island, moderate to lightly oiled. 3) Kachemak Bay, "weathered" oil appearing periodically. 4) Eaglek Bay, an unoiled site north of Naked Island. 5) St. Matthews and Olsen Bay in Port Gravina, an unoiled area in eastern Prince William Sound.

Two census crews, of 2-3 personnel each, will rotate among the sites such that census days are clustered as close as possible at any one site, and each site is censused at least four times during the period of mid June to mid July.

Objective C: Quantifying breeding activity

Because of the marbled murrelet's unique nesting requirements and threatened nesting habitat, methods are being developed to detect general nesting distribution and provide an index of mean activity level (or "detection index"). The latter is being tested for use as an indication of the size of the local nesting population, for year-to-year trend analysis.

This study will follow methods described by Paton et al. (1989) and Nelson (1988), with some modification for intensive survey of wilderness areas without road or trail access. In general, audio and visual records are made from set points of murrelets making overland flights, from 30 min prior to and 1 hour after sunrise. Murrelets exchange incubation duties or feed their chicks at this time, flying from feeding grounds at sea to their nests in the trees (Varoujean et al. 1988).

Paton et al. (1989) concluded that three replicate watches (clustered by date if possible) were sufficient to determine if nesting pairs are active in a given area, and to derive an average "detection level". At selected sites (to be decided on location, depending on access, viewing area and appropriate weather conditions), three dawn surveys will be conducted on separate mornings, spaced as close together as possible, during the nestling phase (approximately mid June to mid July). There are qualitative historic records available, and appropriate watch sites chosen, for two locations on Naked Island and one location in Kachemak Bay.

The occurrence of juvenile murrelets on the water (beginning in early July) will also be considered as evidence that breeding was attempted, as well as provide chronological data for comparison among years. The ratio of juvenile to adult murrelets observed on the water during transects will be used as a relative index of year-to-year breeding success.

Objective D: Testing for exposure to petroleum hydrocarbons

Petroleum hydrocarbon analysis will confirm exposure to the presumed cause of impact. This will be important in determination of injury to marbled murrelets since little information can be obtained on loss of reproductive viability.

Birds will be collected at three sites: near Ingot Island (heavily oiled), Naked Island (light to moderately oiled) and Eaglek Bay (unoiled). Ten birds will be taken from each site, following procedures outlined in the State/Federal Damage Assessment Plan, Technical Services Study Number 1.

Objective E: Identifying strategies for restoration

The results from studies done by the Coastal Habitat and Fish/Shellfish study teams will be integrated with the results of this study to identify areas where marbled murrelet populations are at immediate and long-term risk. Where murrelet populations indicate a decline from previous studies, but the marine habitat and prey source do not suggest chronic contamination, protection of murrelet nesting areas may suffice to enable restoration of the population. Important nesting areas can be identified using methods described in objective C of this study.

In areas of coastal or prey contamination, restoration of affected murrelet populations will depend on recommendations by the appropriate study teams as well as protection of murrelet nesting habitat. In addition to the above, the effects of human disturbance, as determined by this study under Objective A, will help to define acceptable levels of human activity near murrelet populations of particular sensitivity.

B. Citations

Literature cited in reference to methods are listed in section VIII.

C. Standard Operating Procedure Requirements

Standard Operating Procedures are described in section VII.

D. Equipment Protocol

Not applicable.

E. Quality Assurance and Control Plans

Field personnel will be trained in the data collection techniques by the Principal Investigator. Transect data will be recorded on data forms. All tissue samples for petroleum hydrocarbon contaminants will be collected and analyzed according to the procedures outlined in the State/Federal Damage Assessment Plan, Analytical Chemistry Quality Assurance/Quality Control.

F. Histopathology

Not applicable

G. Information Required From Other Investigators

Data on the degree of oiling at selected study sites will be required from the Coastal Habitat Study, the Air/Water Studies, and the Technical Services Study Number 3.

Results of this study will be integrated with those of Bird Studies 1 and 2 to provide estimates of overall mortality of marbled murrelets, and (by inference) of other birds with similar distributions and feeding behavior. These results will support determination of damages to recreational and intrinsic values under Economic Uses Studies 5 and 7.

V. Data Analysis

A. Tests

Tests for differences in murrelet at-sea densities between study sites, current and historic data, and between viewing platforms are described in section VII.

B. Analytical Methods

Objective A:

Historical data will be standardized and entered into the Paradox3 data system to be current with 1989 and subsequent data. Transect counts will be corrected for or stratified by viewing platform, habitat, season (early, mid or late summer), time of day, weather and tide conditions.

Standardized counts will be used to obtain a yearly index for historical data. Another test will be made to determine if the post-oiling year index value is significantly different from the historical annual index. This test will be performed if at least 3 years of historical data are available. Otherwise, tests among years will be based on error derived from within year replications.

Objective B:

At-sea densities derived by different methods will be tested for significant differences using t-test or equivalent nonparametric procedures as needed. Paired observations will be analyzed by paired t-test and/or Wilcoxon signed rank tests. Results will indicate if a correction factor needs to be applied to the boat transect counts to derive a population estimate. Effects of environmental conditions on viewing and/or murrelet presence will be tested using multivariate techniques. Variance in densities among days for each study site will serve to define future sample sizes.

Objective C:

No statistical tests are applicable at this time.

Objective D:

Differences in level of petroleum hydrocarbons in tissue samples between birds from oiled and unoiled sites will be tested using two sample t-tests allowing for unequal variances. Distribution free (nonparametric) procedures will be used as needed. A log transformation may be applied to normalize data before t-tests are performed.

Objective E:

No statistical tests are applicable at this time.

C. Products

1. Map of transects and on-land observation stations.
2. Maps of distribution and abundance of murrelets within study sites.
3. Tables of murrelet densities and estimated population derived from boat transects and on-land observations.
4. Table of over-land detections for murrelets at each observation station.
5. Graphs showing murrelet density as a function of environmental, seasonal and diel factors.
6. Graphs showing murrelet densities pre and post oil spill at sites with historic data.
7. Report synthesizing the results of this study.

VI. SCHEDULES AND PLANNING

A. Data Submission Schedule

Begin field work	June 1989
Complete field work	August 1989
Complete draft report	December 21, 1989

B. Special Reports

None

C. Visual Data

None

D. Sample and Data Archival

Adult murrelets collected for tissue samples will be deposited in the custody of Everett Robinson-Willson, USFWS, Anchorage, Alaska. Copies of the field data sheets and notebooks will be archived in the Service's oil spill file system at the Marine and Coastal Bird Project, Anchorage, Alaska.

E. Management Plan

This study will be managed by the Principal Investigator, who will work under the general guidance of the USFWS Marine Bird and Shorebird Oil Spill Study Coordinator (Marine Bird and Shorebird Coordinator) and Migratory Bird Oil Spill Study Coordinator or their designees. The Marine Bird and Shorebird Coordinator is responsible for acheiving maximum coordination with all other marine bird oil spill studies during the planning, implementing and reporting phases of the studies. The Principal Investigator will be responsible for coordinating the collection of field data, analysis of data and completing draft and final reports.

F. Logistics

Field surveys in Prince William Sound will be done from a 25 ft. vessel operated by the field crew, with inshore censuses at some locations conducted from an inflatable raft. The main field camp will be located in Cabin Bay on Naked Island. A secondary camp will be established at Agayuute Bay, Eaglek Bay. The 25 ft. vessel will be used for overnight stays at other sites. Logistical support, including camp transport, gasoline and food, will be provided by the MV Curlew. Surveys in Kachemak Bay will be operated from the Alaska Maritime National Wildlife Refuge in Homer, using the Refuge's 25 ft. Boston Whaler.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries

P.I.- Kuletz	.90FTE	$33,000	
Vacant Temporaries	.60FTE	12,700	
Subtotal			$55,700
Travel/Per Diem			$10,000
Contracts			0
Supplies			20,000
Equipment			40,000
Total			$115,700

B. Personnel

See VII.A.

C. Qualifications

1. Principal Investigator- Kathy Kuletz

Kathy Kuletz received her Master's degree from the University of California, Irvine, in 1983. From 1978 to 1981 she established baseline data for the seabirds and marine mammals of Naked and neighboring islands for the U.S. Fish and Wildlife Service. During this time, as principal investigator, she completed research for her thesis on the foraging ecology and reproductive success of pigeon guillemots. Her experience with marbled murrelets, the most abundant bird at Naked Island, led to her 1988 study of this species in Kachemak Bay for the Alaska Maritime National Wildlife Refuge.

Ms. Kuletz was involved in several fisheries projects in Alaska with the U.S. Fish and Wildlife Service in the late 1970's. In 1980 she conducted shipboard surveys of seabirds in the Bering Sea as part of the PROBES projects. In the 1980's she worked for Dames and Moore consulting on aerial surveys for waterfowl and for LGL Alaska Research Associates studying tundra birds at Prudhoe Bay.

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IX. OTHER INFORMATION

None.

Title: Assessment of Injury to Waterbirds from the Exxon Valdex Oil Spill: Effects of Petroleum Hydrocarbon on Fork-tailed Storm-Petrel Reproductive Success

Study ID Number: Bird Study Number 7

Principal Investigator: Mike Nishimoto

Lead Agency: U.S. Fish and Wildlife Service

Cost of Proposal: $135,000

Date of Plan: March 1989 through February 1990

Principal Investigator: Michael F. Nishimoto Date: 10/23/89

Marine & Shorebird Oil Spill Damage Assessment Coordinator: Kenton D. Wohl Date: 10-20-89

Migratory Bird Oil Damage Assessment Study Coordinator: Robert K. Leedy Date: 10/20/89

Biometrician: David C. Bowden Date: 10/20/89

Address: U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907) 786-3444

II. INTRODUCTION

Manual (1980) estimated the population of fork-tailed storm-petrels at 65,000 pairs at East Amatuli Island compared to 75,000 pairs for all of the Barren Islands. It is the largest seabird colony affected by the Exxon Valdez oil spill. Storm-petrels are the only plankton feeding seabird that can be easily monitored in areas affected by this oil spill. It serves as an indicator species for the lower food chain and may be used to identify secondary impacts that affect higher food chain organisms.

The fork-tailed storm-petrels at East Amatuli Island have been monitored from 1976 to 1988 making it one of the longest studied storm-petrel colonies in Alaska. Petrels have been studied, in part, to provide baseline data on them and other seabird populations due to the development of outer continental shelf oil and gas lease units in lower Cook Inlet and the increasing potential for oil spills.

III. OBJECTIVES

This revision of the original study proposal deletes the assessment of breeding adult foraging efficiency and chick physiological condition that was previously included under Objective "B". When this study was originally proposed, we had intended to contract that portion of the study to researchers who specialize in bird physiology. However, time was too short to contract the work and the Service did not have the expertise to accomplish that work. However, should the study continue beyond 1989, data will be collected on adult and chick condition. In future years, we also propose to measure rainfall since chick mortalities may also be attributed to flooded burrows (Objective "E").

A. Test if reproductive success of storm-petrels is lower than in pre-spill years.

B. Assess the impact of crude-oil exposure on storm-petrel reproduction by comparing the relationships between exposure, adult condition, chick condition and nesting success.

C. Count the number of adults that have been contaminated externally or internally by oil.

D. Determine persistence of crude oil in the marine environment by comparing hydrocarbon contamination of stomach oils with pre-spill data to detect temporal changes in exposure and sublethal effects.

E. Compare rainfall and and reproductive success with data collected in previous years.

F. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS

A. Sampling Methods

Objectives A and B:

Methods to collect storm-petrel productivity data will follow standard Fish and Wildlife Service procedures outlined in Nishimoto et al. (1988) and Nishimoto et al. (1989). We will search and determine the burrow contents at eight fork-tailed storm-petrel study sites in late June to mid-July and again during late August to early September (while checking prefledging chicks). Approximately 650 burrows will be sampled. Active burrows will include all burrows with eggs or chicks. The number of prefledging chicks will be determined by searching all burrows (marked earlier in the season) during late August to early September.

Objective C and D:

To determine external oiling, all petrels encountered during burrow searches and along the beach at Amatuli Cove will be checked for oiled plumage. The number of petrels examined and number oiled at each site will be recorded. Any adult or chick carcass will be collected. Furthermore, records of oiled petrels from receiving centers at Valdez, Seward, Homer and Kodiak will be used to supplement oiled petrel data collected at East Amatuli Island.

To determine internal contamination by crude oil and to determine the persistence of crude oil in the northern gulf, stomach oils will be collected at each study site from incubating storm-petrels and stored in 20 ml vials with teflon lined caps. Sample size at each site will be proportional to the number of marked burrows. This procedure is consistent with the method developed by Boersma (1986). Fresh eggs will also be collected from late June to mid-July and abandoned eggs will be collected during late August to early September. Eggs, and carcasses of chicks and adults will be wrapped in cleaned aluminum foil and stored in a waterproof case.

Objective E.

Should this study continue beyond 1989, rainfall mesurements will be taken. Boersma et al. (1980) reported that the most noticeable effect of bad weather was reflected in chick mortality at wet burrows.

Objective F.

The literature will be reviewed for measures that could be used to restore storm-petrel populations. We will also analyze reproductive success data from nestboxes that have been used at East Amatuli Island.

B. Citations

Methods to collect fork-tailed storm-petrel reproductive success data will follow methods used by Nishimoto et al. (1988) and Nishimoto et al. (1989). Stomach oils will be collected according to procedures developed by Boersma (1986).

C. Standard Operating Procedure Requirements

See Section IV. A. and B.

D. Equipment Protocol

Not applicable

E. Quality Assurance and Control Plans

To insure that project design and procedures are followed: 1) the project leader will train all personnel for the respective duties, 2) one person at each field camp will be responsible for maintaining consistent data collection, 3) standardized forms will be used for data collection, 4) data forms will be checked at the end of each day to insure the integrity of the data. Sample collection, labelling, and chain-of-custody will be done in accordance with the Quality Assurance and Control Plans in Appendix A of the Guidelines For Preparing Detailed Study Plans For the State/Federal Natural Resource Damage Assessment and Restoration Plan.

F. Histopathology

Not applicable

G. Information Required From Other Investigators

Results of hydrocarbon analyses on adults, chicks, eggs and stomach oils will be needed to tie reproductive failure to the spill. Findings from Bird Study 14 (Effects on Migratory Birds of Exposure to North Slope Crude Oil) would be used to interpret the results of the hydrocarbon analyses. Dead bird data from receiving stations will supplement data collected at East Amatuli Island and may support findings in the study. Data collected under the Outer Continental Shelf Environmental Assessment Program (1976-79) and subsequent studies (1980-84), in the custody of the University of Washington, would help our analyses. However, except for the OCEAP reports, these data and details of methodologies used in those studies are unavailable. Access to these data would require a contract with the University of Washington.

V. DATA ANALYSIS

A. Tests

This study assumes that storm-petrels within the subcolonies will be representative of the way the petrel population would respond to environmental conditions at sea. Furthermore, due to the asynchronous breeding phenology of storm-petrels, it would be difficult to completely account for all active burrows and prefledging chicks by short trips to East Amatuli Island. However, since much of the previous data were collected in a similar manner our data would be directly comparable. In 1985, only previously active burrows were checked for chicks, whereas, all burrows were checked during our second visit since 1987. Data on the previously active burrows were recorded separately and can be extracted from our database to standardize comparisons.

B. Analytical Methods

To see if the percent of active burrows, the number of prefledging chicks/active burrow and percent contaminated stomach oils are outlier relative to historical data, t-tests will be performed to test the hypothesis that the 1989 index value is a single random sample from the same population as that sampled by historical yearly index values.

C. Products

Maps will be produced depicting the storm-petrel subcolonies and marked burrow sites within each subcolony. Tables will be prepared comparing percent active burrows and number of prefledging chicks/active burrow from 1985 to 1989. A table of our database will be included in an appendix.

VI. SCHEDULES AND PLANNING

A. Data Submission Schedule (1989)

Check for active burrows: June 20 - July 20
Collect adults and chick carcasses: June 20 - July 20
Collect stomach oils and fresh eggs: June 20 - June 30
Submit stomach oils/egg samples: July 25
Check for prefledging chicks: August 20 - September 10
Collect abandoned eggs: August 20 - September 10
Submit egg samples: September 20
Complete data entry: September 30
Complete literature search: October 30
Complete hydrocarbon analyses: November 1.
Submit draft report: December 21

B. Special Reports

None

C. Visual Data

None

D. Sample and Data Archival

Copies of all field data and log books will be archived in the Fish and Wildlife Service oil spill file system in Anchorage and at the Alaska Maritime National Wildlife Refuge in Homer.

E. Management Plan

This study will be managed by Principal Investigator Mike Nishimoto. Nishimoto will work under the general guidance of the Fish and Wildlife Service's Marine Bird and Shorebird Oil Spill Coordinator and Migratory Bird Oil Spill Coordinator. The Marine Bird and Shorebird Coordinator is responsible for achieving maximum coordination with all other marine bird oil spill studies during the planning, implementing and reporting phases of the studies. The Principal Investigator will be responsible for either coordinating the collection of, or generating field data, and for the timely reporting of the data in draft and final reports.

Principal Investigator - Mike Nishimoto
Marine Bird and Shorebird oil Spill
Damage Assessment Coordinator - Kenton D. Wohl
Migratory Bird Oil Spill Damage Assessment
Coordinator - Robert Leedy

F. Logistics

To complete the proposed study will require the use of the Service's 65 - foot vessel MV Surfbird. The vessel will be used to transport field crews to East Amatuli Island. If the Surfbird is not available helicopters will be chartered.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries			
Co-PI	.80FTE	$40,000	
Vacant		20,000	
Subtotal			60,000
Travel			10,000
Contract			25,000
Supplies			20,000
Equipment			20,000
TOTAL			$135,000

B. Personnel

See VII.C.

C. Qualifications

1. Principal Investigator - Mike Nishimoto

Mike Nishimoto received his B.S. in Wildlife Science from New Mexico State University in 1970. He received his M.S. in Fisheries from the University of Washington in 1973.

Between 1974 and 1984, Mr. Nishimoto worked with the U.S. Fish and Wildlife Service assessing the impacts of economic development projects on coastal resources in Hawaii, U.S. territories in the Pacific and southcentral and southeast Alaska. Since 1984, Mr. Nishimoto has monitored seabird resources for the Alaska Maritime National Wildlife Refuge. He has studied storm petrels at East Amatuli from 1985 to 1988. Nishimoto also monitored both Leach's and fork-tailed storm-petrels at St. Lazaria Island. Besides his work on petrels, Nishimoto has monitored various other species of seabirds in Kachemak Bay, Chisik Island, Chiniak Bay, Middleton Island and the Pribilof Islands.

VIII. CITATIONS

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Manuwal, D.A. 1980. Breeding biology of seabirds on the Barren Islands, Alaska. Final Rep. Outer Continental Shelf Environmental Assessment Program. Boulder, CO.

Nishimoto, M. and B. Beringer. 1988. Status of fork-tailed storm-petrels at East Amatuli Island during the summer of 1987. Unpubl. Admin. Rep. Fish and Wildlife Service. Homer, AK.

Nishimoto, M. and K. O'Reilly. 1989. Status of the fork-tailed storm-petrel at East Amatuli Island during the summer of 1988. Unpubl. Admin. Rep. Fish and Wildlife Service. Homer, AK.

IX. OTHER INFORMATION

None.

APPENDIX A

QUALITY ASSURANCE/QLAILITY CONTROL STUDY PLAN

Study Name: Reproductive succes of fork-tailed storm-petrels

Study Leader: Mike Nishimoto Phone: 235-6546

Responsible Organization: U.S. Fish & Wildlife Service

Study Description and Purpose of Samples:

Monitor the number of active fork-tailed storm-petrel burrows from those marked in previous years; determine reproductive success. Also analyze stomach oils for hydrocarbons.

Part 1: Field QA/QC

Sample Collection

Sample Design:

The study will compare reproductive success of storm-petrels with historical data. Dead birds and addled eggs will be collected and analyzed for hydrocarbons. Hydrocarbon content of stomach oils will be compared with past data.

Sampling Location

East Amatuli Island

Sampling Methods

Probe burrows to determine nest contents during late incubation. Determine fledging success by checking burrows during late chick rearing stage. Collect addled eggs. Collect viable eggs from areas outside study colonies. Collect stomach oils. Also collect all dead petrels.

Field QA/QC

Sample sites will be located using marked burrows. All samples collected will be taken using a clean techniques as described in the Quality Assurance/Quality Control guidelines. A field blank will be taken after each 10 samples from the field.

Field Instrument Calibration

No field instruments will be used.

Number and Type of Samples Expected

Fresh eggs	12/yr
Addled eggs	12/yr
Stomach oils	50/yr
Dead birds	10/yr

Sample Shipping and Handling

Eggs will be wrapped in pre-cleaned aluminum foil and shipped to Homer on ice then transferred to a refrigerator. They will be held there until the end of the field season. Eggs will then be transported to Anchorage where they will be opened using clean techniques. Contents will be placed in pre-cleaned Ichem jars and transported on ice to Homer where they will be frozen at <-20 °C. Egg shells will be allowed to air dry for two weeks, then shell thickness measurements will be taken. Stomach oils will be collected with a stainless steel or glass funnel and washed down with dichloromethane into a 20 ml glass vial.. Samples would be transported on ice to a freezer in Homer. All bird samples will be wrapped in pre-cleaned aluminum foil marked with tags on the aluminum foil and placed in two plastic bags with a label on the outer bag. The birds will be placed on ice for transportation to Homer where they will be placed in a freezer.

Types of Analyses Required

Eggs: hydrocarbon scan as specified on page 12 of QA/QC guidelines

Liver: same as eggs

Stomach oils: hydrocarbon according to Boersma P.D. 1986. Ingestion of Petroleum by seabirds can serve as a monitor of water quality. Science 231: 373-375.

Data Reduction and Review Methods

The data will be put onto an electronic spreadsheet using Lotus 1-2-3. All data will be reviewed by the study leader and will be held in the U.S. Fish and Wildlife Service Regional Office. Analytical data will be provided in an electronic format. It will be reviewed by the QA/QC officer at the Patuxent Analytical Center facility before release and will be reviewed by the study team leader. A progress report will be provided to the management team by Feb. 1989.

Title:	Assessment of Injury to Waterbirds from the Exxon Valdez Oil Spill: Effects on the Reproductive Success of Black-legged Kittiwakes in Prince William Sound
Study ID Number:	Bird Study Number 8
Principal Investigator:	David Irons
Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$190,000
Date of Plan:	March 1989 through February 1990

Principal Investigator: ____________________ Date: 10/30/89

Marine & Shorebird Oil Spill Damage Assessment Coordinator: Kenton D. Wohl Date: 10-20-89

Migratory Bird Oil Spill Damage Assessment Study Coordinator: Robert R. Leedy Date: 10/20/89

Biometrician: David C Bowden Date: 10/20/89

Address: U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907) 786-3444

II. INTRODUCTION

The black-legged kittiwake (Rissa tridactyla) is one of the two primary seabird indicator species that are monitored throughout Alaska by the U.S. Fish and Wildlife Service. Kittiwakes represent surfacing feeding seabirds and murres represent diving seabirds. Kittiwakes and murres were chosen as indicator species because they are widespread and their population sizes and reproductive success can be quantified relatively easily. Kittiwakes are abundant in Prince William Sound and nest at 27 colonies (Sowls et al. 1978).

The size and reproductive success of the kittiwake colonies in Prince William Sound have been monitored sporadically from 1972 to 1983 and yearly from 1984 to 1988 (Sowls et al. 1978, Hogan and Irons 1988, Irons 1988). Of the 27 colonies 11 are in the area that was oiled and 16 are outside the oiled area.

Kittiwake reproductive success could be reduced as a result of the oil spill by several means. Adults could die of oil contamination (Bourne 1979, King and Sanger 1979). Contaminated adults may not lay eggs, incubate eggs, or feed chicks (Fry 1987). Adults with oil on their breast feathers may oil and thereby kill their eggs during incubation (Albers and Gay 1982, Fry 1987). Adults may feed contaminated prey to their chicks and thereby cause them to become deformed, grow slowly, or die (Butler and Lukasiewicz 1979, Peakall et al. 1982, Fry 1987).

The proposed study will test:

A. if reproductive success is the same at colonies in the oiled area and in the non-oiled area, as compared to pre-spill levels.

B. if adult kittiwakes have the same level of oil contamination, either internally or externally, at colonies in the oiled area as the colonies in the non-oiled area.

C. if unhatched eggs and prey delivered to chicks contain the same level of hydrocarbons at colonies in the oiled area as in the non-oiled area.

A concurrent kittiwake study in Prince William Sound may provide information on: 1) whether kittiwakes from colonies in the oiled area feed in the oiled area or fly to the non-oiled area to feed, 2) if the feeding rates are lower at colonies in the oiled area, and 3) if chicks grow slower at colonies in the oiled area than at colonies in the non-oiled area. The concurrent study will also test if populations of kittiwakes are lower in the oiled area than in the non-oiled area, compared to previous years.

III. OBJECTIVES

A. To test the null hypothesis that kittiwake reproductive success is the same at colonies in oiled areas and at colonies in non-oiled areas, as compared with pre-spill levels.

B. To test the null hypothesis that adult kittiwakes at colonies in the oiled areas have not been contaminated, either internally or externally, by oil more than adult kittiwakes at colonies in non-oiled areas, $\alpha = 0.05$.

C. To test the null hypothesis that unhatched eggs and prey delivered to kittiwake chicks do not contain more petroleum hydrocarbons at colonies in the oiled area as compared to colonies in the non-oiled area, $\alpha = 0.05$.

D. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS

A. Sampling Methods

Objective A:

Black-legged kittiwake reproductive success of each colony (i.e., the number of chicks fledged per number of nests built) will be determined using standard Fish and Wildlife techniques (Irons et al. 1987, Irons 1988). The number of nests at colonies will be counted in early to mid June as an index of reproductive effort. A nest will be defined as a site with new nesting material. The number of chicks will be counted in early to mid August, just before they fledge. All counts will be made from boats using binoculars. Nests and chicks will be counted three times to determine the variation inherent in counting.

Objective B:

External contamination from oil will be determined by visual observation of oil on feathers. Birds at colonies will be scanned and number of oiled and non-oiled birds will be recorded. There has been no pilot study or previous study done to allow us to determine the amount of variation in external contamination of kittiwakes from an oil spill.

Internal contamination will be determined by analyzing tissues (livers) for petroleum hydrocarbons. A total of twenty birds will be randomly collected at two colonies in the oiled area and twenty birds will be randomly collected at two colonies in the non-oiled area. Sample collection, labelling, and chain-of-custody will be done in accordance with the Quality Assurance and Control Plans in Appendix A of the Guidelines For Preparing Detailed Study Plans For The State/Federal Natural Resource Damage Assessment And Restoration Plan.

There has been no pilot study or previous study done to allow us to determine the amount of variation in the amount of petroleum hydrocarbons in kittiwakes after an oil spill. Twenty should be a sufficiently large sample size (Green 1979).

Objective C:

A total of twenty unhatched eggs and twenty food samples will be collected from two colonies within the oiled area and from two colonies outside the oiled area. Unhatched eggs and food samples will be randomly selected. Sample collection, labelling, and chain-of-custody will be done in accordance with the Quality Assurance and Control Plans in Appendix A of the Guidelines For Preparing Detailed Study Plans For The State/Federal Natural Resource Damage Assessment And Restoration Plan.

There has been no pilot study or previous study done to allow us to determine the amount of variation in the amount of petroleum hydrocarbons in eggs and food of kittiwakes after an oil spill. Twenty should be a sufficiently large sample size (Green 1979).

Objective D:

Potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury occurs will be identified.

B. Citations

Methods for estimating reproductive success of kittiwakes have been described in Irons et al. (1987) and Irons (1988).

C. Standard Operating Procedure Requirements

Reproductive success will be determined by using the standard Fish and Wildlife Service procedure described in Irons et al. (1987) and Irons (1988) (see attachments).

D. Quality Assurance and Control Plans

To insure that project design and procedures are followed: 1) the project leader will train all personnel for the respective duties, 2) one person at each field camp will be responsible for maintaining consistent data collection, 3) standardized forms will be used for data collection, 4) data forms will be checked at the end of each day to insure the integrity of the data. Sample collection, labelling, and chain-of custody will be done in accordance with the Quality Assurance and Control Plans in Appendix A of the Guidelines for Preparing Detailed Study Plans for the State/Federal Natural Resource Damage Assessment and Restoration Plan.

E. Histopathology

None.

G. Information Required From Other Investigators

None.

V. DATA ANALYSIS

A. Tests

Objective A:

Colonies within the oiled area are assumed to be equally affected by the oil spill. Colonies outside the oiled area are assumed to be unaffected by the oil spill.

To meet objective A the colonies will be censused not sampled, therefore there are no assumptions or conditions pertaining to sampling that must be met.

Objective B and Objective C:

Colonies within the oiled area are assumed to be equally affected by the oil spill. Colonies outside the oiled area are assumed to be unaffected by the oil spill.

Samples are assumed to be selected at random from normal populations with equal variances (Zar 1984). Normality will be tested using the Kolmogorov-Smirov procedure (Zar 1984).

B. Analytical Methods

Objective A:

Total reproductive success of kittiwake colonies in the oiled area will be compared to total reproductive success of kittiwake colonies outside the oiled area, in respect to reproductive success in previous years.

Objectives B and Objective C:

If the data are not normally distributed, they will be normalized by transformation, and ANOVA will be used (Zar 1984).

C. Products

The product of this study will be a narrative report with maps, figures, and tables.

VI. SCHEDULES & PLANNING

A. Data Submission Schedule

Fieldwork	June 1, 1989 to Aug. 30, 1989
Analyze data	Sept 1, 1989 to Dec. 1, 1990
Complete draft report	Dec. 21, 1990

B. Special Reports

None.

C. Visual data

None.

D. Sample and Data Archival

Samples and data will be archived in the Fish and Wildlife Service oil spill file system in Anchorage.

E. Management Plan

This study will be managed by a Principal Investigator, who will work under the general guidance of the Fish and Wildlife Service's Marine Bird and Shorebird Oil Spill Study Coordinator and Migratory Bird Oil Spill Study Coordinator or their designees. The Marine Bird and Shorebird Coordinator is responsible for achieving maximum coordination with all other marine bird oil spill studies during the planning, implementation, and reporting phases of studies. The Principal Investigator is responsible for either coordinating the collection of, or generating field data, and for the timely reporting of the data in draft and final reports. Specific personnel working on this project are listed below.

Principle Investigator	David Irons
Marine and Shorebird Oil Spill Coordinator	Kenton D. Wohl
Migratory Bird Oil Spill Damage Assessment Coordinator	Robert Leedy
Camp Leader	Carol Slothower
Camp Leader	Larry Barnes
Bio. Tech.	George Esslinger
Bio. Tech.	Brandon Bestelmeyer
Boat Operator	Greg McClellan
Boat Operator	Matt Stevenson

F. Logistics

Two field camps will be set up in Prince William Sound, one at Eleanor Island and one at Shoup Bay. Boston Whalers and zodiacs will be used to travel to and from the kittiwake colonies. The Eleanor camp will be supplied with food and fresh water by the MV Curlew. The Shoup Bay camp will supply themselves from Valdez.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries

PI - Irons	.80 FTE	$ 40,000
Vacant Temporaries	2.0 FTE	$ 22,000
Subtotal		$ 62,000
Travel		$ 6,000
Contract		$ 4,000
Supplies		$ 25,000
Equipment		$ 93,000
TOTAL		$190,000

B. Personnel

See VI. E.

C. Qualifications

Principal Investigator - David B. Irons

Degrees and Status:

1976 Bachelors of Science, Pennsylvania State University, State College, PA

1982 Masters of Science, Oregon State University, Corvallis, OR

Research Experience

1980-1982 Masters Research Project: Foraging Strategies of Glaucous-winged Gulls: influence of sea otter predation.

1983	U.S. Fish and Wildlife Service study: Hauling out and foraging behavior of walruses on St. Matthew Island, Alaska.
1984-1985	U.S. Fish and Wildlife Service study: Prince William Sound waterbird distribution in relation to habitat type.
1984-1985	U.S. Fish and Wildlife Service study: Prince William Sound sea otter distribution in relation to population growth and habitat type.
1984-1986	U.S. Fish and Wildlife Service study: Changes in breeding distribution and numbers of black-legged Kittiwakes in Prince William Sound, Alaska, 1972-1986.
1988-1989	U.S. Fish and Wildlife Service study/PhD. Dissertation: Factors limiting black-legged kittiwake reproductive success.

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Sowls, A.L., S.A. Hatch, and C.J. Lensink. 1978. Catalog of Alaskan seabird colonies. U.S. Fish and Wildl. Serv. Biol. Services Prog. FWS/OBS 78/78. Washington, D.C.

Zar, J.H. 1984. Biostatistical Analysis. Prentice-Hall, Inc. Englewood Cliffs, N.J.

IX. OTHER INFORMATION

None.

CHANGES IN COLONY SIZE, AND REPRODUCTIVE SUCCESS OF BLACK-LEGGED KITTIWAKES IN PRINCE WILLIAM SOUND, ALASKA, 1972-1986

by

David B. Irons[1], David R. Nysewander[2], and John L. Trapp[3]

Key words: Black-legged Kittiwakes
colony size
reproductive success
variation
Prince William Sound

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October 1987

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[3]Present Address: Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Washington, DC 20240

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ABSTRACT

Twenty-eight Black-legged Kittiwake colonies in Prince William Sound (PWS) were monitored from 1984-1986. The number of nests, number of birds at the colonies, and number of fledglings per nest were recorded. These data were compared to census data from 1972. Overall the number of breeding pairs in PWS decreased from 1972-1984 then increased from 1984-1986. However, there was great variation among colonies; 7 lost 7-80 percent of their nests and 5 grew from 200-1600 percent. The mean colony size in 1986 was 860 nesting pairs and ranged from 20 to 4,163. The mean number of chicks fledged per nest for all colonies was consistently about 0.30 for 1984-1986. However, as with the number of nests, the reproductive success was extremely variable among colonies; 15 colonies produced fewer than 0.1 young per nest, while 11 colonies varied from 0.17 to 0.92 young per nest. Some of the variation in both, changes in number of nests per colony and in number of young per nest, can be accounted for by dividing the colonies into two groups, glacier and island colonies. Glacier colonies were larger, fledged more young, and grew more than island colonies.

Data from PWS were compared to data from Middleton and Kodiak Islands. Population trends were dissimilar among these three areas in the Gulf of Alaska. This large variation in population changes within PWS colonies and among colonies in the Gulf of Alaska, which is presumably caused by differential food availability and/or predation pressure, is extremely important in developing a sound program for monitoring seabirds in Alaska.

Results from data collected by time-lapse cameras on attendance patterns indicated that the attendance pattern at successful nests was consistent, having only one bird present most of the time. Attendance patterns at failed nests and roost sites were less consistent, having two or no birds present more often than successful nests. If the observed attendance patterns are consistent among colonies and years they could be used to determine an index of reproductive success.

INTRODUCTION

The responsibility to monitor marine bird populations was placed on the Fish and Wildlife Service (FWS) by the Fish and Wildlife Act of 1956 and the Marine Protection, Research, and Sanctuaries Act of 1972. The Black-legged Kittiwake (Rissa tridactyla) is one of the key seabird species monitored in Alaska because is it widespread and relatively easy to monitor. Kittiwake populations have been censused the past 14 years at 19 locations throughout Alaska by the FWS, the Minerals Management Service, and the University of Alaska, Fairbanks (Hatch 1987). Presently, there is information on population trends at 11 areas; kittiwake numbers have recently been declining at several of these sites (Byrd et al. 1985, Nysewander et al. 1986, Springer et al. 1986).

The potential impacts from present and near-future oil development, logging activities, fish hatchery development, and increased recreational use on the rich wildlife resources in Prince William Sound (PWS) are high and continue to rise. Kittiwakes are one of the most abundant and conspicuous breeding seabirds in PWS. Also, the large number of colonies (28) in a limited area creates a unique opportunity to compare population trends among colonies. Information on the degree of variation among colonies is needed to develop a stronger monitoring program. In the past few years monitoring of kittiwakes in PWS, and on Middleton Island and Kodiak Island has produced detailed information on seabird populations, in a large geographic area (Figure 1), that is unprecedented in Alaska. It is an excellent beginning to a better understanding of seabird population trends and the level of censusing that is needed to monitor them.

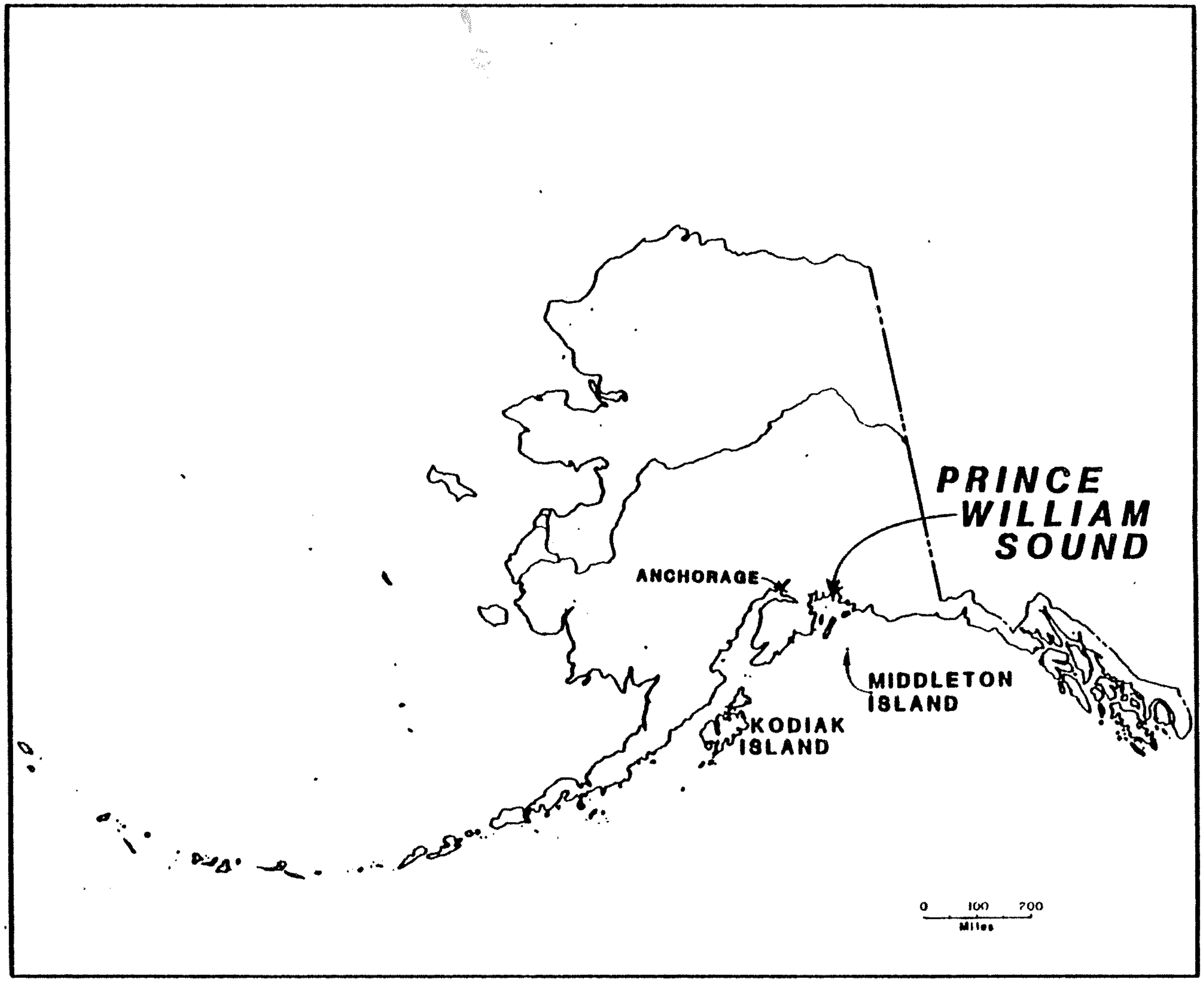

Figure 1. Map of Alaska showing the location and size of Prince William Sound and Middleton and Kodiak Islands.

In this study the population status and reproductive success of 28 Black-legged Kittiwake colonies were monitored in PWS from 1984 to 1986. These data were compared to survey results from 1972 (Sowls et al. 1978) to observe long-term changes and were compared to data from Middleton and Kodiak Islands to examine variation among locations.

STUDY AREA

PWS lies 100 kilometers southeast of Anchorage and is an unusual estuarine system due to the deep inland waters and shallow sill at the entrance. PWS is a relatively protected body of water composed of a myriad of habitat types resulting from a mixture of deep narrow fiords, shallow protected bays, and exposed shorelines with water of variable salinity. Thousands of marine mammals and several hundred thousand marine birds inhabit the waters of PWS (Isleib and Kessel 1973), yet there is relatively little shallow water to accommodate bottom feeding animals such as diving waterbirds and sea otters (*Enhydra lutris*).

METHODS

All kittiwake colonies in PWS were surveyed annually from 1984-1986. Data from a previous census (Sowls et al. 1978) were used for comparison. Surveys were conducted from small boats using binoculars on days with good viewing conditions. In mid-June, during the height of incubation, the number of nests and birds at colonies were counted. A nest was described as a substantial structure with fresh material with one or both adults in attendance. Only adult birds that were on the nesting cliffs when the counts were made were included; birds on large roosts (greater than 10 birds) were not counted. In early August, just before fledging occurred, the number of chicks on the nests was counted. Our index to reproductive success was the number of fledglings per nesting attempt.

Colonies were divided into plots to decrease errors in counting. Boundaries were chosen to correspond with natural features such as cracks in the cliff face or strips of vegetation. Plots were photographed to aid in depicting boundaries. Most plots had between 50 and 200 nests but ranged from one to over 600.

Three people counted each plot simultaneously; if counts varied by more than five percent the plot was recounted. The number of nests times two was assumed to be the number of breeding birds.

Colonies were classified as glacier or island colonies, depending on their location. Glacier colonies were 10 m - 5 km from glaciers in fiords where glaciers had receded, thereby exposing nesting habitat on the cliffs of the mainland or on islands in the middle of the fiord. Island colonies were on small islets throughout PWS 30 km or more from glaciers.

Another part of this study was recording the attendance patterns of adult birds at colonies. Data were collected at two colonies with time-lapse cameras. Pictures were taken at eight-minute intervals from dawn-to-dusk throughout the summer.

Each colony was divided into four categories: sites with chicks, sites with incubating birds, sites in which the nest failed, and sites that had no nest but were used for roosting by one or two birds.

Data on attendance patterns were collected by recording a 0, 1, or 2, corresponding to the number of adult birds at each site, for each photograph. The data were expressed as the percent of time 0, 1, or 2 birds were present at sites. Data were analyzed to depict daily and seasonal activity patterns.

RESULTS

Population trends and status

The total number of kittiwakes nesting in PWS increased 20 percent from 1972-1986. There are no data from 1973-1984, but over the 12 year span the number of breeding pairs decreased. Sharp rises occurred from 1984-1986 (Table 1).

In 1972 there were 26 kittiwake colonies in PWS. By 1986, 6 sites had been abandoned and 8 new sites were initiated, bringing the total to 28 colonies. The mean colony size in 1986 was 860 nesting pairs with a range of 20 to 4,163 (Appendix 1).

The change in the number of nests from 1972-1986 varied tremendously among colonies. Aside from the 6 colonies that were abandoned, 7 others decreased from 6 to 80 percent. Eleven colonies increased 5 to 1600 percent (Figure 2).

Table 1. Number of nests and percent change in number of nests at glacier and island Black-legged Kittiwake colonies in 1972, 1984, 1985, and 1986 in Prince William Sound, Alaska. For definitions of colony types, see text.

	Number of nests in				Percent change in number of nests from		
	1972	1984	1985	1986	1972 to 1984	1972 to 1986	1984 to 1986
Glacier Colonies	8892	8604	11385	14593	-3	+64	+70
Island Colonies	8349	4003	5357	6051	-52	-28	+51
All Colonies	17241	12607	16742	20644	-27	+20	+64

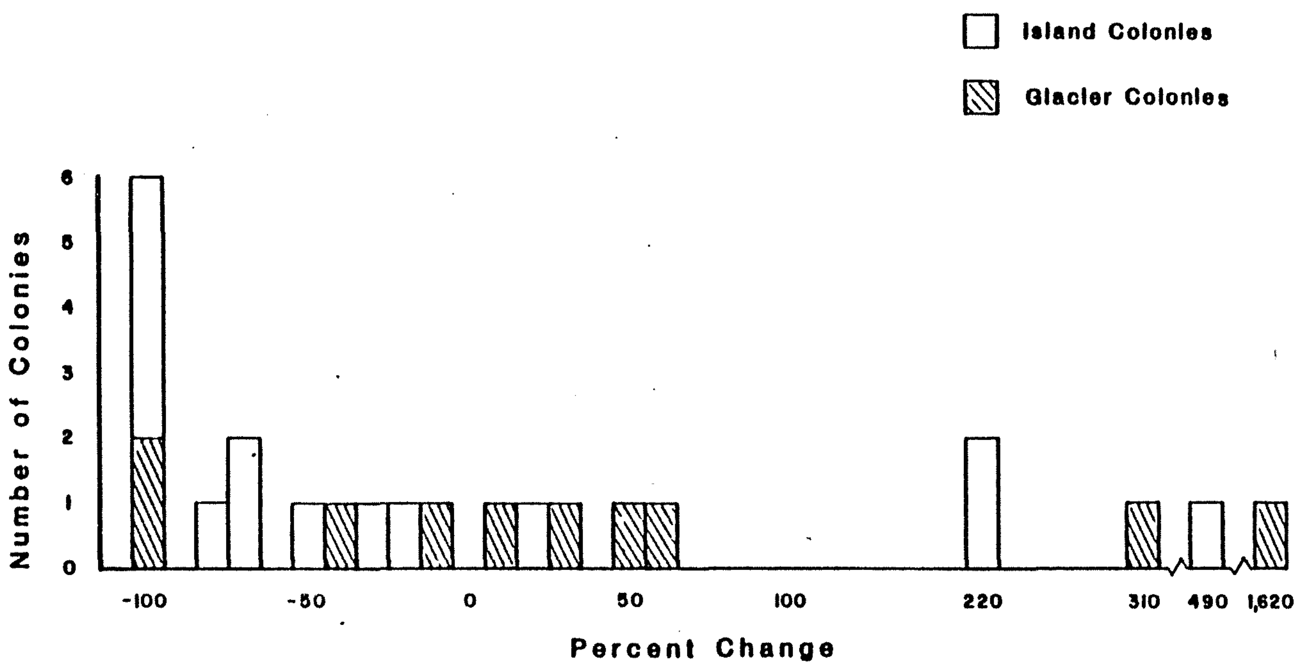

Figure 2. Percent change in colony size (based on number of nests) from 1972-1986 for 24 Black-legged Kittiwake colonies in Prince William Sound, Alaska.

By dividing the kittiwake colonies in PWS into two groups, glacier and island colonies, some of the variation may be explained. In 1972 the number of breeding birds were evenly divided between glacier colonies and island colonies; by 1984 the number nesting on islands was reduced by half, while the glacier colonies remained stable. During the next two years both groups increased sharply resulting in overall change (1972-1986) of a 65 percent increase at glacier colonies and a 28 percent decrease at island colonies. In 1986, the glacier colonies averaged four times larger than island colonies (Appendix I & II).

Reproductive success

The mean number of chicks fledged per nest for all colonies in PWS during 1984-1986 was consistently around 0.30 (Table 2). Although the reproductive rate was consistent among these three years, the total number of young fledged per year more than doubled because of the rise in the number of breeding birds (Table 2).

As with the change in colony size, the number of chicks per nest was also highly variable. Combined data from 1984-1986 demonstrated that 15 colonies produced 0.1 or fewer fledglings per nest, while 11 colonies varied from 0.17 to 0.92 in reproductive success (Figure 3). The total number of fledglings was no less variable. In 1986, 16 colonies produced fewer than 100 young per colony, while two colonies yielded a total of 4,318, 76 percent of the young in PWS (Figure 4).

Table 2. Total number of Black-legged Kittiwake fledglings and number of fledglings per nest for glacier and island colonies in 1984, 1985, and 1986 in Prince William Sound, Alaska.

	Number of chicks fledged			Number of fledglings per nest		
	1984	1985	1986	1984	1985	1986
Glacier Colonies	2235[a]	4015	5524	0.40[a]	0.35	0.38
Island Colonies	640[b]	152	729	0.17[b]	0.03	0.12
All Colonies	2875[ab]	4167	6253	0.31[ab]	0.25	0.30

[a]Data from 4 of the 9 colonies were not collected.
[b]Data from 7 of the 18 colonies were not collected.

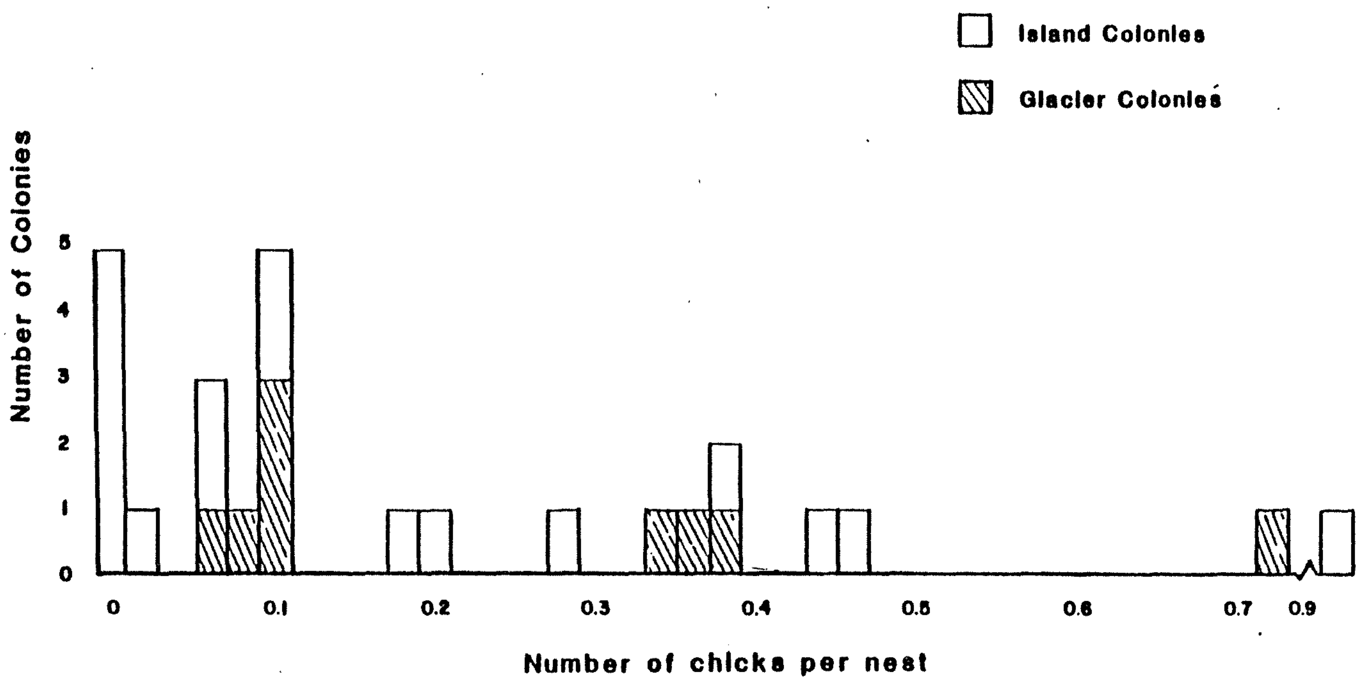

Figure 3. Number of chicks fledged per nest at 26 Black-legged Kittiwake colonies in Prince William Sound, Alaska. Data are unweighted means for 1,2, or 3 years.

Figure 4. Number of chicks fledged per colony in 1986 at 26 Black-legged Kittiwake colonies in Prince William Sound, Alaska.

Again some of the variation can be accounted for by looking at glacier and island colonies. Reproductive success was 2 to 12 times higher at glacier colonies than at island colonies and glacier colonies fledged most of the young in PWS (Table 2).

Attendance patterns of adult birds at colonies

Preliminary analysis of attendance patterns showed significant differences among successful nesters, failed nesters, and roosting birds during the incubation-nestling period (Table 3). Sites with incubating birds and sites with chicks were never without adults during daylight hours. One bird was present 98 percent and 97 percent of the time at incubating sites and sites with chicks, respectively. Two birds were present the remaining 2 percent and 3 percent of the daylight hours at sites with incubating birds and chicks (Table 3). Adult attendance at failed sites and roost sites was more variable with one bird present 80 percent and 57 percent of the time, two birds present 14 percent and 32 percent of the time and zero birds present 6 percent and 11 percent of the time, respectively (Table 3).

Attendance patterns were broken down by time of day to examine diurnal patterns. Adult attendance at sites with incubating birds and chicks was consistent. Behavior at roost sites and failed sites demonstrated the most variability in the afternoon (Figures 5-7). Long-term activity patterns were analyzed by comparing days. Again, attendance at sites with chicks and incubating birds showed little variation. Numbers of birds at failed sites and roosting birds were somewhat variable the first four days of observation, then became more stable (Figures 8-10).

Table 3. Percent of time that 0, 1, and 2 birds were at roosts, failed nests, nests with incubating birds, and nests with chicks. Data are from 1507 observations over 9 days during the incubation and nestling period.

# BIRDS PRESENT	ROOSTS (n=2)	FAILED (n=6)	INCUBATING (n=8)	CHICKS n=8
0	10.8	6.0	0	0
1	57.2	80.2	97.8	96.6
2	31.9	13.8	2.2	3.4
# BIRDS/ 100 sites	121.0	107.8	103.4	102.2

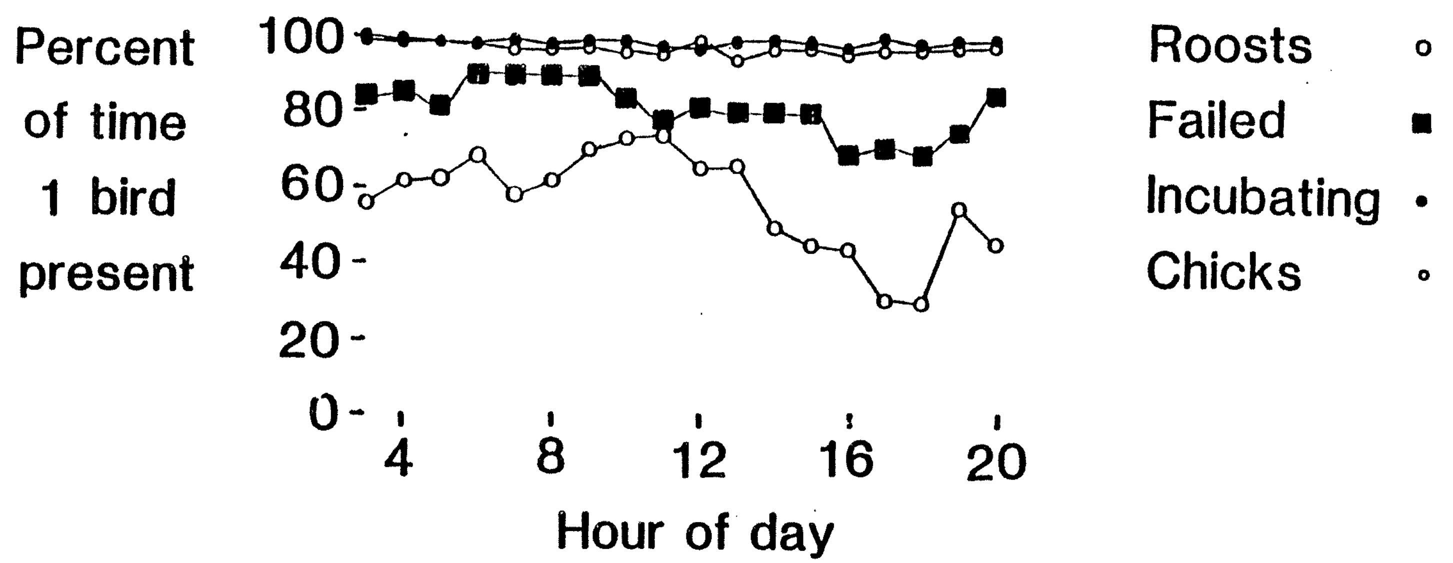

Figure 5. Percent of time 1 bird was present at roost sites, failed nests, nests with incubating birds, and nests with chicks for each hour of the day.

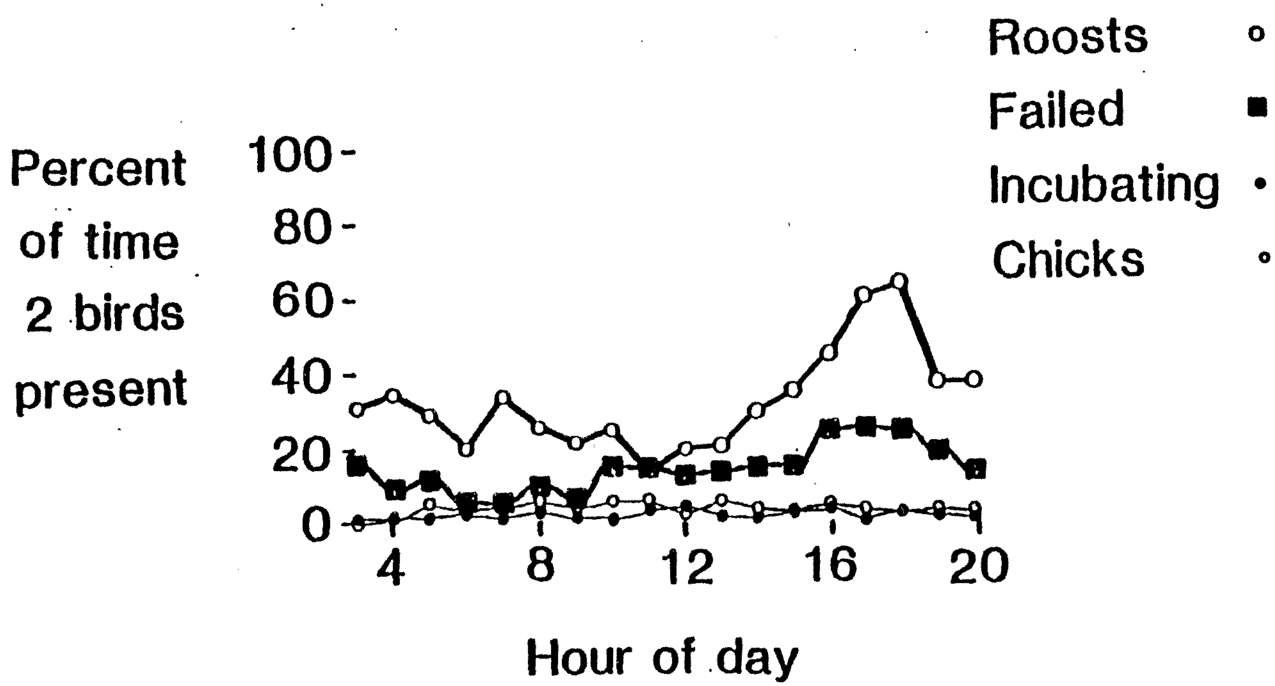

Figure 6. Percent of time 2 birds were present at roost sites, failed nests, nests with incubating birds, and nests with chicks for each hour of the day.

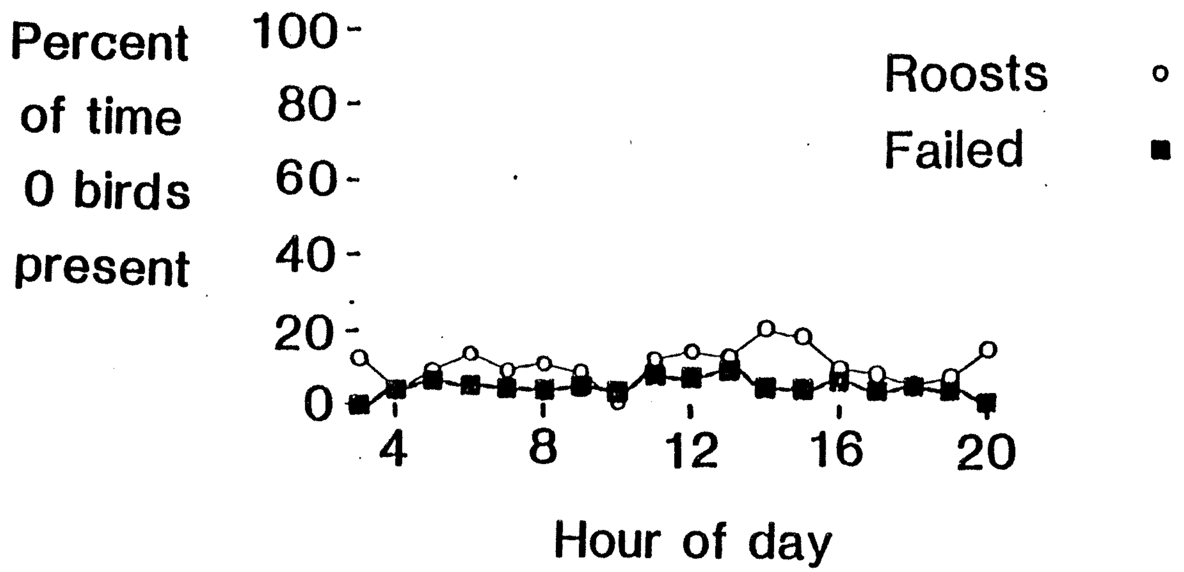

Figure 7. Percent of time 0 birds were present at roost sites and failed nests for each hour of the day. Nests with incubating birds and nests with chicks were never without adults.

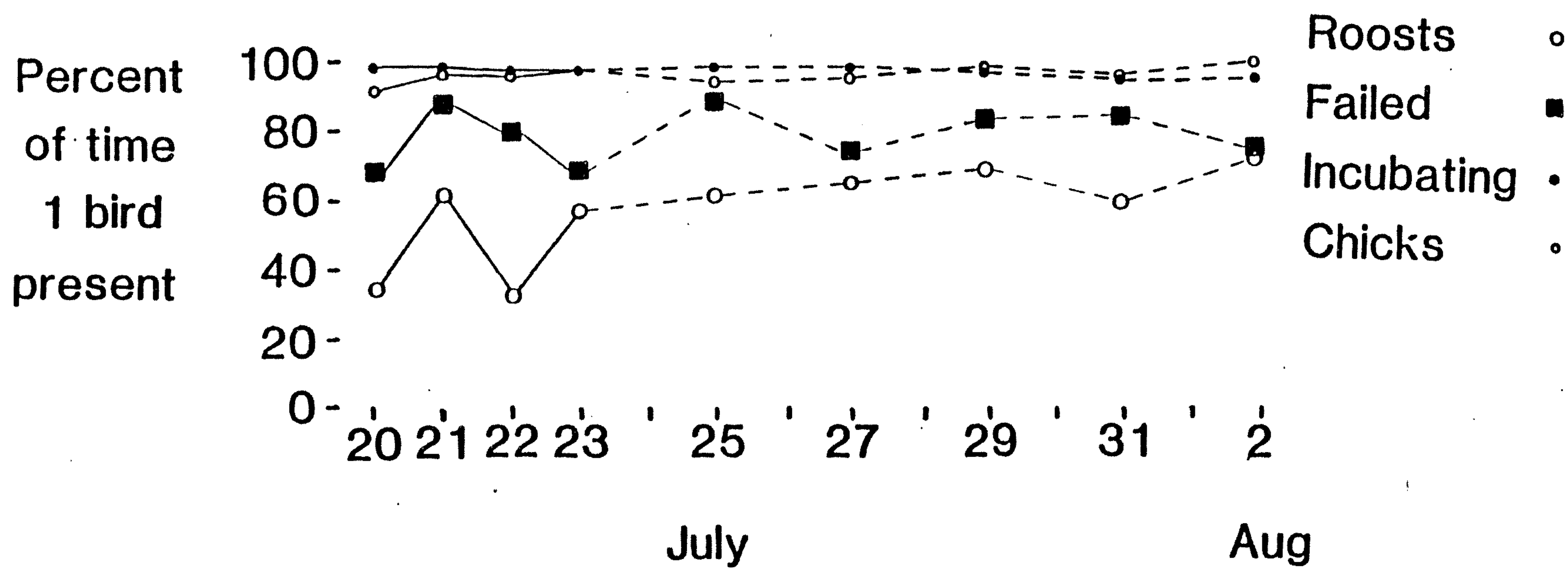

Figure 8. Percent of time 1 bird was present at roost sites, failed nests, nests with incubating birds, and nests with chicks during 9 days of observation.

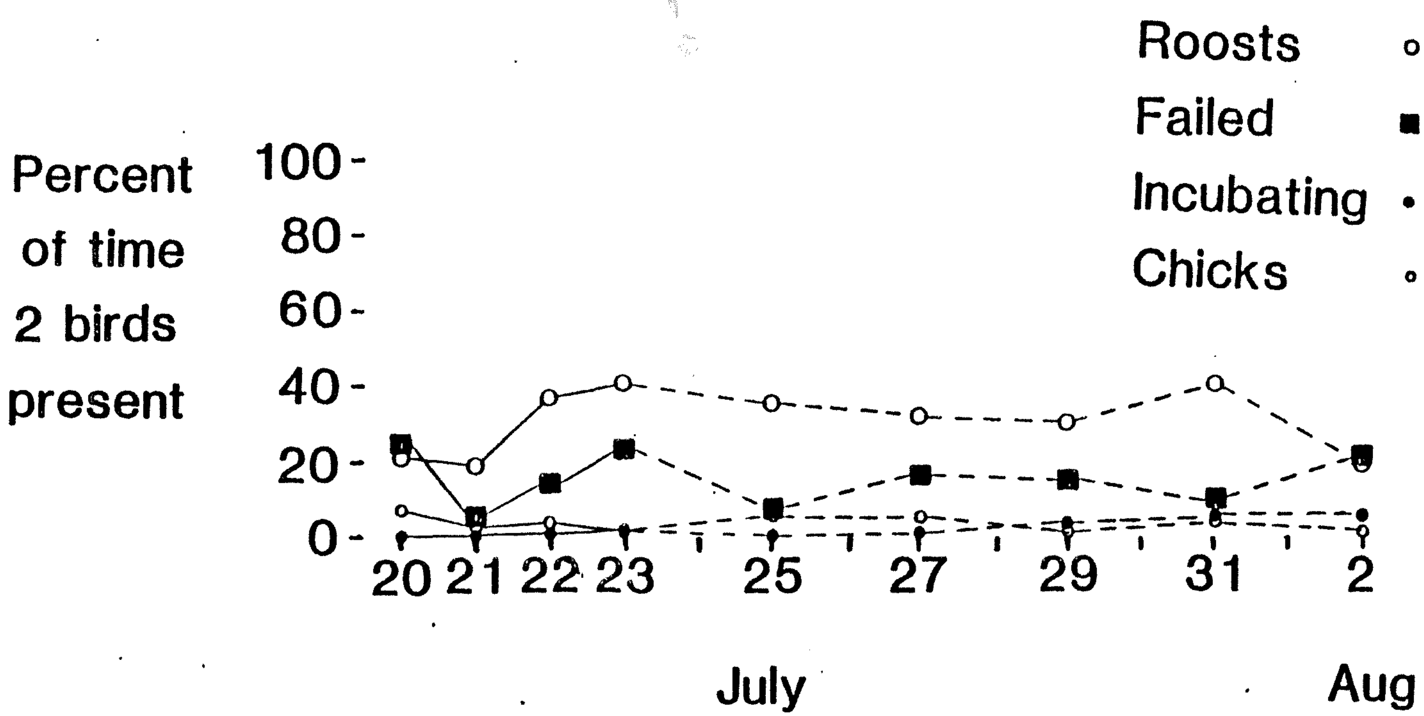

Figure 9. Percent of time 2 birds were present at roost sites, failed nests, nests with incubating birds, and nests with chicks during 9 days of observation.

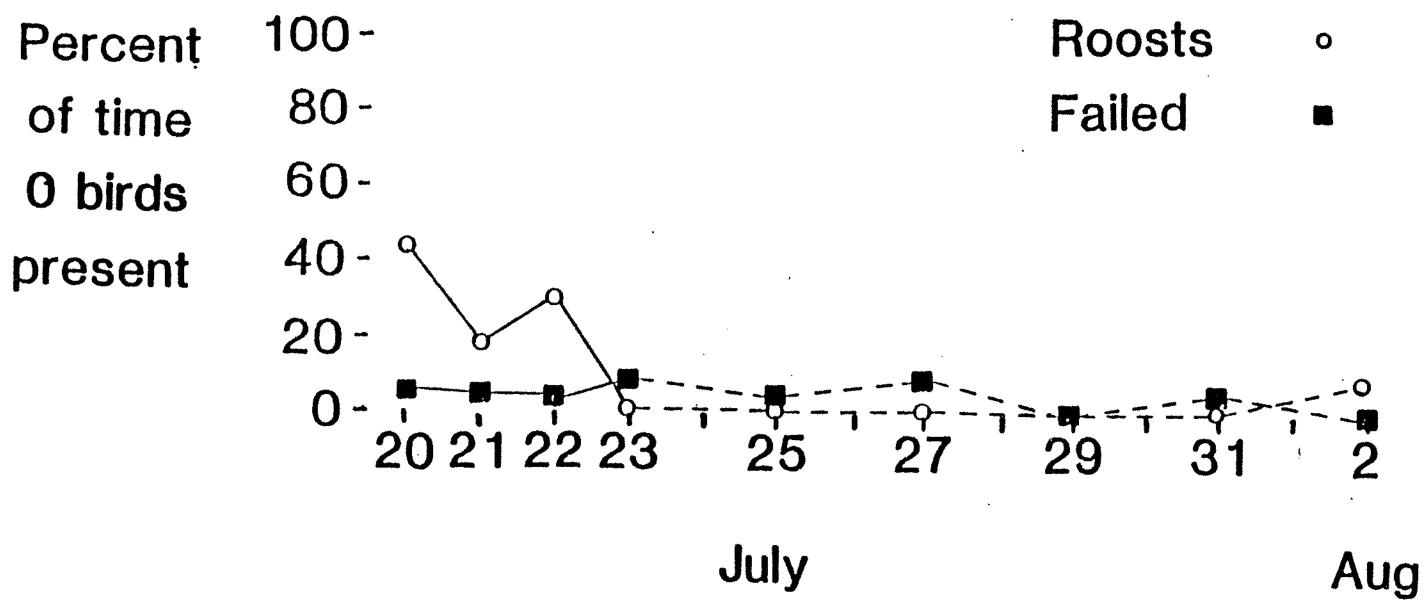

Figure 10. Percent of time 0 birds were present at roost sites and failed nests during 9 days of observation. Nests with incubating birds and nests with chicks were never without adults.

We observed one case of egg mortality. At 1 p.m. on July 23 a bird stopped incubating and left a single egg unattended. Upon returning it incubated for a few hours but not again. Two points can be made about the activity patterns of the pair. First, the activity pattern showed a definite change when incubation stopped. Second, although the bird(s) quit incubating they maintained a high rate of attendance (Figure 11).

Ratio of number of adult birds to nests

From 1984-1986 the total number of nests increased 64 percent, but the total number of birds on the colonies increased only 17 percent. Another way of looking at this is that the ratio of the number of birds to nests decreased from 2.00 to 1.68 to 1.43 from 1984-1986 (Appendix 1). This trend was variable among colonies, but most large colonies conformed.

DISCUSSION

Population Trends

The number of kittiwake nests in PWS decreased 27 percent from 1972-1984, then increased in 1985 and 1986 causing the overall change from 1972-1986 to be a 20 percent increase. To try to understand whether this was a widespread pattern we can compare PWS data to other locations in the Gulf of Alaska.

Kittiwake colonies on Middleton and Kodiak Islands have been monitored frequently since the mid-1970's. Middleton Island lies 80 km seaward from

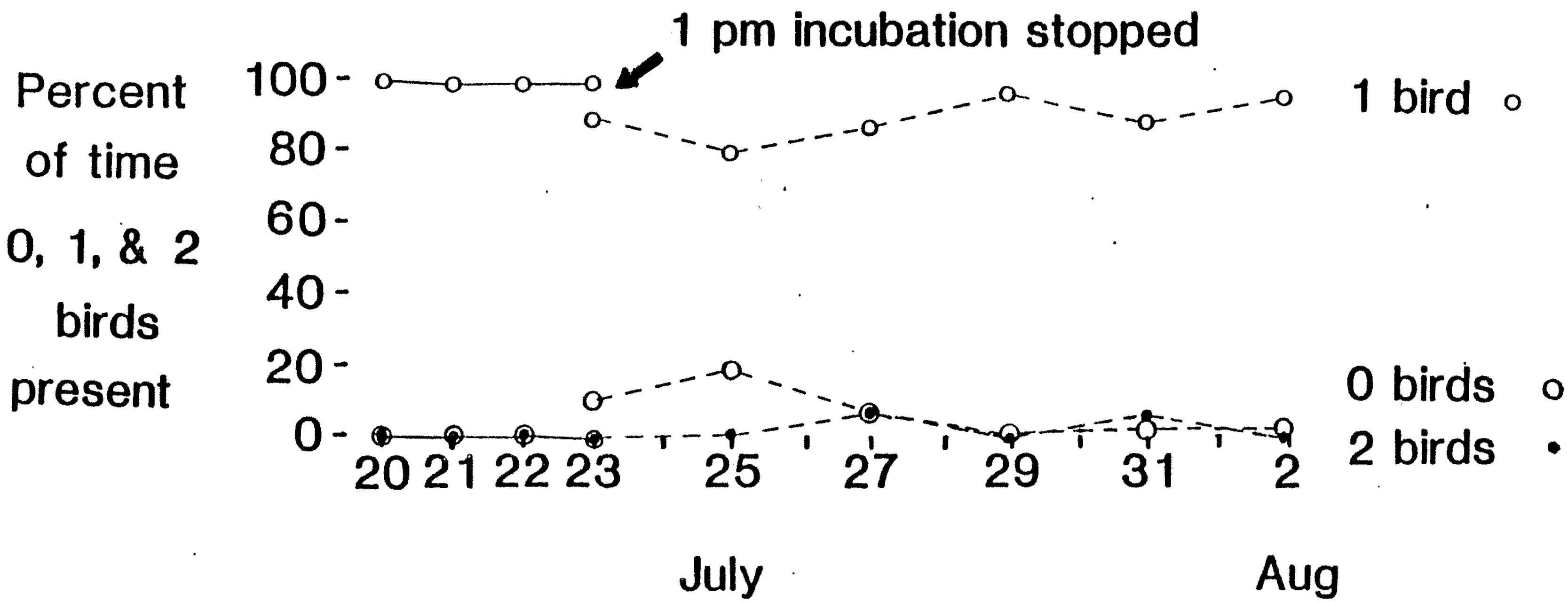

Figure 11. Percent of time 0, 1, and 2 birds were present at a nest in which the birds stopped incubating.

PWS (Figure 1) and is home to the second largest kittiwake colony in Alaska. Kodiak Island is about 300 km southwest of PWS and has 23 kittiwake colonies within a 15 km radius in Chiniak Bay, near the town of Kodiak on the east side of the island. The number of nests at Middleton Island rose and fell several times from 1974-1986 (Nysewander et al. 1986) while the number of nests at Kodiak Island increased steadily over that period (Nysewander unpublished data).

Comparisons of the number of kittiwake nests between PWS, Middleton and Kodiak Islands from the mid-1970's to 1984 reveal differences in long-term trends (Table 4). PWS and Middleton Island colonies decreased while the number of nests at Kodiak doubled. From 1984 to 1985 the number of nests at Middleton Island continued to decrease while PWS colonies increased and Kodiak colonies leveled off. In 1986 colonies at all areas increased. It is clear from these data that changes in the number of nests at Black-legged Kittiwake colonies in the Gulf of Alaska are not consistent; yet it is unknown whether this is the rule or the exception in Alaska. However, we can make comparisons to colonies in the Atlantic.

Godo (1985) presented results from six colonies over 24 years in Norway. He too found much variation among colonies in the changes of number of nesting birds. Godo suggested that the variation was due to intercolonial movements, small colony size, and large predation pressure, but had no data to support his ideas. Barrett and Schei (1977) compared 45 colonies in North Norway over a five-year period and found that 21 increased in population, 11 decreased, 8 new sites were established and 3 were re-established, and apparently 2 were abandoned.

Table 4. Number of nests and percent changes in number of nests at Black-legged Kittiwake colonies in Prince William Sound, Middleton Island, and Kodiak Island from 1972 to 1986.

	Number of nests in						Percent change in number of nests from		
	1972	1974	1975	1984	1985	1986	1972, 1974, or 1975 to 1984	1984 to 1985	1985 to 1986
Prince William Sound[a]	17,241	--	--	12,607	16,742	20,644	-27	+33	+23
Middleton Island[b]	--	72,471	--	66,263	49,977	61,960	- 9	-25	+24
Kodiak Island[cd]	--	--	3,445	7,188	7,125	8,438	+109	- 1	+18
Totals	--	--	--	86,058	73,844	91,042	- 8	-14	+23

[a]Includes data from all 28 colonies in Prince William Sound.
[b]Data from Nysewander et al. 1986 and A.L. Sowls, unpublished data.
[c]Data from D.R. Nysewander, unpublished data.
[d]Includes data from 22 colonies in Chiniak Bay but does not include Cape Chiniak colony.

Kittiwake colonies in the British Isles have been censused every 10 years for decades. Until 1969, most colonies increased in size and new colonies were formed, but by 1979, many colonies had begun to decrease. Five regions (e.g. East Coast of England, West Coast of Scotland, see Coulson 1983) decreased from 3-56 percent and three regions increased from 32-81 percent. However, within the decreasing regions some colonies continued to increase and within the increasing regions some colonies continued to decrease (Coulson 1983). These data demonstrate large variation in changes in sizes of kittiwake colonies within and among regions in the British Isles.

The literature indicates that in the Atlantic Ocean there is much variation in changes of colony size among colonies of relatively close proximity. We are beginning to see this phenomenon in Alaska. If variation among adjacent colonies is widespread in Alaska, then perhaps the only suitable method to monitor kittiwakes is to census all or at least most colonies in the areas of question.

Reproductive Success

Some of the among colony variation in PWS colonies data can be accounted for by suggesting that glacier colonies are different from island colonies in that areas adjacent to the glacier colonies have either more food, less predation, or both. We have no data to support this hypothesis, but there are reports of kittiwakes foraging at the face of glaciers in Glacier Bay National Park (Heacox 1983, Jettmar 1984), in Norway (Hartley and Fisher 1936, Stott 1936, Mehlum 1984), and PWS (Irons pers. obs.). Presumably, they forage there because of the presence of a rich food source.

Reproductive success of kittiwakes from different locations in the Gulf of Alaska was compared (Table 5). Colonies at Middleton and Kodiak Islands were remarkably similar during the five years for which data were available from both islands. Colonies in PWS were quite different and more consistent among years than Middleton or Kodiak Islands.

The similarities between colonies on Middleton and Kodiak Islands suggest that factors affecting reproductive success were similar at the two areas; however, there are no data to support or refute this idea. The cause for low productivity at colonies on Middleton and Kodiak Islands during 1985 and 1986 is not known, but intense predation by Glaucous-winged Gulls (Larus glaucescens) on Middleton was observed in 1985 by Bonfield (1986) and D.R. Nysewander (pers. comm.) observed much disturbance by bald eagles (Haliaeetus leulocephalus) at Kodiak in 1986.

If productivity at colonies on Middleton and Kodiak Islands has been correlated for the past several years, then it seems incongruous that the number of nests at Kodiak colonies has doubled while the colony on Middleton has decreased. Regardless of whether the increase at the Kodiak colonies resulted from recruitment of young from those colonies or from immigration, the most plausible explanation for the difference in colony changes is that there was unused nesting habitat at Kodiak while there was no unused nesting habitat at Middleton. This is supported by photographs that show barren earthen hillsides, which were used for nesting at Middleton Island, are being turned into grassy slopes as vegetation encroaches (A.L. Sowls unpubl. data).

Table 5. Number of fledglings per nest for Black-legged Kittiwake colonies in Prince William Sound, Middleton Island and Kodiak Island from 1978 to 1986.

	Number of fledglings per nest in				
	1978	1983	1984	1985	1986
Prince William Sound	--	--	0.31	0.25	0.30
Middleton Island[a]	0.16	0.03	0.68	0.04	0.05
Kodiak Island[b]	0.16	0.00	0.42[c]	<0.01	<0.01

[a]Data from Nysewander et al. 1986 and A.L. Sowls, unpublished data.
[b]Data from D.R. Nysewander, unpublished data.
[c]Data collected from only one colony.

In Alaska, data on seabird populations have only recently been collected that allow trends or lack of them to be recognized. However, in the British Isles there is long-term data available for some species, including the Black-legged Kittiwake. Coulson (1983) reported that the kittiwake population had increased from the beginning of this century at a rate of between 3 and 4 percent per annum until 1969. However, by 1979 the trend had reversed and there were widespread declines at many of the colonies. Coulson (1983) suggested that the long-term increase resulted from reduced predation by man and that the subsequent decline was in response to food shortages.

Attendance Patterns

Our preliminary results of attendance patterns indicate more consistency than others have reported (Biderman and Drury 1978, Hatch 1978). We also found that most of the daily and seasonal variation during the incubation-nestling period was due to failed nesters and roosting birds. Therefore, we suggest that much of the variation recorded by others was from failed breeders, nonbreeders, and/or mates of successful breeders. Galbraith's data (1983) support this idea in that he found that only one adult of a successful breeding pair stayed around the colony during the nestling period. If further analysis shows that this pattern is consistent, then high variation would indicate "poor" years and low variation would indicate "good" years. Our results also pointed out that there may be differences between successful breeders and failed breeders in the percent of time that two birds are present at the nest site. If this is a consistent difference, then we may be able to determine the percent of successful and failed breeders simply by counting a colony and recording the number of birds per nest.

A confounding factor that affects kittiwake monitoring is the year-to-year variation in the number of nests (e.g., see Nysewander et al. 1986). Hatch (in prep.) and data from this study demonstrate that the number of birds at colonies is more constant among years than the number of nests. For example, the Passage Canal colony doubled in "size" (number of nests) in two years, however, the number of birds on the cliffs remained constant (Appendix 1). Had we been counting only the number of nests, which is a common method of monitoring in Alaska (Nysewander et al. 1986) and Britain (Coulson 1983), we would have concluded that the colony had doubled in size while the number of birds did not change. One can argue that the breeding population doubled in two years and it may have; however, given the colony size in 1972, it is likely that in 1984 and 1985 some experienced birds simply did not breed because of an environmental stress and they resumed breeding in 1986.

The decrease of number of birds per nest from 1984-1986 at PWS colonies may have resulted from either there being fewer nonbreeders (roosting birds) or fewer failed breeders in the later years (Table 3). We have two lines of evidence that suggest the change in number of birds per nest resulted from fewer nonbreeders rather than fewer failed breeders. First, the observed change is too large to be accounted for by a decrease in the number of failed breeders alone (Table 3). Second, the number of chicks fledged per nest was highest in 1984 indicating that there were fewest failed breeders in 1984.

The unanswered question is whether the increase in breeders resulted from first-time breeders or from experienced breeders that chose not to breed for one or two years. Coulson and Thomas (1984) showed that first-time breeders are less successful than experienced breeders, so if large numbers of first year breeders were present we would expect a decrease in reproductive success, yet the data do not support this (Table 1). Therefore, it is likely that experienced breeders chose not to breed in 1984 and 1985, which does not support Coulson and Thomas's (1984) findings that intermittent breeding in the British Isles was uncommon and lasted only one year.

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Appendix I

Comparisons of numbers of Black-legged Kittiwake nests and birds at glacier colonies in Prince William Sound, Alaska, in 1972, 1984, 1985, and 1986.

Colony	Number of nests in				Percent change in number of nests					Number of birds per colony in			Number of birds per nest in		
	1972	1984	1985	1986	1972 to 1984	1972 to 1985	1972 to 1986	1984 to 1985	1985 to 1986	1984	1985	1986	1984	1985	1986
Blackstone Glacier	990	994	1318	1261	+1	+33	+27	+32	-4	1640	1787	1643	1.65	1.36	1.30
Chenega Glacier	370	743	(796)[b]	(1160)[b]	+101	+215	+313	+7	+46	1263	(1258)[c]	(1566)[c]	1.70	-	
Coxe Glacier	0	660	965	1020	+[d]	+[d]	+[d]	+46	+6	1200	1429	1256	1.82	1.48	1.23
Harriman Fiord	54	0	-	-	-[a]	-[a]	-[a]	-	-	0	-	-	-	-	-
Icy Bay	2350	1803	(1655)[b]	2219	-23	-30	-6	-8	+34	2506	(2615)[c]	2733	1.39	-	1.23
North Icy Bay	550	197	358	860	-64	-35	+55	+92	+140	382	607	1436	1.93	1.69	1.67
Passage Canal	2780	2075	3077	4163	-25	+11	+50	+48	+35	5635	5468	5721	2.72	1.78	1.37
Shoup Glacier	190	1480	2518	3084	+679	+1225	+1623	+70	+22	2805	3718	4255	1.89	1.48	1.38
Surprise Glacier	514	0	-	-	-[a]	-[a]	-[a]	-	-	0	-	-	-	-	-
Tiger Glacier	280	228	(224)[b]	294	-19	-20	+5	-2	+31	304	(354)[c]	391	1.33	-	1.33
Yale Glacier	814	424	474	532	-48	-42	-35	+11	+12	742	726	756	1.75	1.53	1.42
Totals	8892	8604	11385	14593	-3%	+28%	+64%	+49%	+28%	16477	17962	19757	1.92	1.58	1.35

[a]Colony was abandoned.
[b]Number of nests was estimated from counts in August.
[c]Number of birds was estimated by multiplying the mean number of birds per nest for all glacier colonies by the number of nests at each colony.
[d]New colony was initiated since 1972 so percent increase cannot be calculated.

Appendix II

Comparisons of numbers of Black-legged Kittiwake nests and birds at island colonies in Prince William Sound, Alaska, in 1972, 1984, 1985, and 1986.

Colony	Number of nests in				Percent change in number of nests					Number of birds per colony in			Number of birds per nest in		
	1972	1984	1985	1986	1972 to 1984	1972 to 1985	1972 to 1986	1984 to 1985	1985 to 1986	1984	1985	1986	1984	1985	1986
Bay of Isles	173	59	40	48	-66	-75	-72	-32	+20	119	90	111	2.01	2.25	2.31
Boswell Rocks	4936	1754	2394	2369	-75	-52	-52	+34	-1	3130	3483	3156	1.78	1.45	1.33
Canoe Passage	47	0	-	-	-[d]	-	-	-	-	0	-	-	-	-	-
Clove Triangle	277	210	236	204	-24	-15	-26	+12	-14	473	494	370	2.25	2.09	1.81
Ellamar	0	-	43	27	-	+[b]	+[b]	-	-	-	-	43	-	-	1.59
Gravina Rocks	67	48	52	57	-28	-22	-15	+8	+10	143	86	142	2.98	1.65	2.49
Gull Island	0	-	4	20	-	+[b]	+[b]	-	+400	-	25	40	-	6.25	2.00
Hook Point	53	-	286	261	-	+540	+493	-	-9	-	613	745	-	2.14	2.85
Middle Green Island	183	55	31	52	-70	-83	-72	-34	+68	202	64	90	3.67	2.06	1.73
Naked Island	0	4	8	29	+[b]	+[b]	+	+50	+263	33	21	52	8.25	-	1.79
North Eaglet Island	0	58	91	79	+[b]	+[b]	+	+59	-13	167	153	218	2.88	1.68	2.76
North Green Island	205	0	-	-	-[d]	-	-	-	-	0	-	-	-	-	-
North Twin Bay	25	0	(0)[a]	-	-[d]	-	-	-	-	0	-	-	-	-	-
Pinnacle Rocks	700	88	119	137	-87	-83	-80	+35	+15	138	663	354	1.57	5.57	2.58
Point Elrington	0	8	(10)[a]	-	+[b]	+[b]	-	+25	-	28	(19)[c]	-	3.50	-	-
Porpoise Rocks	975	1259	1735	2196	+29	+78	+225	+38	+27	2970	3186	3385	2.36	1.84	1.54
Procession Rocks	0	15	(8)[a]	-	+[b]	+[b]	-	-47	-	66	(15)[c]	-	4.40	-	-
Seal Island	0	16	(20)[a]	32	+[b]	+[b]	+[b]	+25	+60	31	(38)[c]	69	1.94	-	2.16
Seal Rocks	275	25	-	-	-91	-	-	-	-	62	-	-	2.48	-	-
South Eaglek Bay	33	78	85	74	+136	+158	+224	+9	-13	133	175	165	1.70	2.06	2.23
South Green Island	20	0	a	-	-[d]	-	-	-	-	0	-	-	-	-	-
The Needle	380	326	238	466	-14	-37	+23	-27	+96	980	953	835	3.01	4.00	1.79
Wooded Island	780	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals[e]	8349	4003[f]	5357	6051	-52%	-36%	-28%	+34%	+13%	8675[f]	10099	9664	2.17	1.88	1.60

[a]Number of nests was estimated from counts in August.
[b]New colony was initiated since 1972 so percent of increase cannot be calculated.
[c]Number of birds were estimated by multiplying the mean number of birds per nest for all island colonies by the number of nests at each colony.
[d]Colony was abandoned.
[e]Totals do not include Wooded Island colony.
[f]Total does not include Hook Point colony.

Appendix III

Comparisons of numbers of Black-legged Kittiwake chicks at glacier colonies in Prince William Sound, Alaska, in 1984, 1985, and 1986.

Colony	Number of chicks per colony in 1984	1985	1986	Number of chicks per nest in 1984	1985	1986
Blackstone Glacier	209	474	467	0.21	0.36	0.37
Chenega Glacier	-	0	199	-	0.00	0.17
Coxe Glacier	165	0	19	0.25	0.00	0.02
Harriman Fiord[a]	-	-	-	-	-	-
Icy Bay	-	0	288	-	0.00	0.13
North Icy Bay	-	147	206	-	0.41	0.24
Passage Canal	1639	2523	2373	0.79	0.82	0.57
Shoup Glacier	222	781	1945	0.15	0.31	0.63
Surprise Glacier[a]	-	-	-	-	-	-
Tiger Glacier	-	0	53	-	0.00	0.18
Yale Glacier	0	90	0	0.00	0.19	0.00
Totals	2235[b]	4015	5524	0.40[b]	0.35	0.38

[a]Colony was abandoned since 1972.
[b]Data from four of the nine colonies are missing.

Appendix IV

Comparisons of numbers of Black-legged Kittiwake chicks at island colonies in Prince William Sound, Alaska, in 1984, 1985, and 1986.

Colony	Number of chicks per colony in 1984	1985	1986	Number of chicks per nest in 1984	1985	1986
Bay of Isles	0	0	3	0.00	0.00	0.06
Boswell Rocks	53	0	403	0.03	0.00	0.17
Canoe Passage	-	-	-	-	-	-
Clove Triangle	90	36	0	0.43	0.15	0.00
Ellamar	-	-	2	-	0.02	0.07
Gravina Rocks	-	0	0	-	0.00	0.00
Gull Island	-	6	7	-	1.50	0.35
Hook Point	-	3	29	-	0.01	0.11
Middle Green Island	0	0	0	0.00	0.00	0.00
Naked Island	-	3	15	-	0.38	0.51
North Eaglet Island	23	28	48	0.40	0.31	0.61
North Green Island	-	-	-	-	-	-
North Twin Bay	-	0	-	-	0.00	-
Pinnacle Rocks	-	0	0	-	0.00	0.00
Point Elrington	-	0	-	-	0.00	-
Porpoise Rocks	327	0	22	0.26	0.00	0.01
Procession Rocks	-	0	-	-	0.00	-
Seal Island	8	0	0	0.50	0.00	0.00
Seal Rocks	-	-	-	-	-	-
South Eaglek Bay	17	36	37	0.22	0.42	0.50
South Green Island	-	-	-	-	-	-
The Needle	122	40	163	0.32	0.17	0.35
Wooded Island	-	-	-	-	-	-
Totals	640	152	729	0.17	0.03	0.12

DRAFT

PRINCE WILLIAM SOUND BLACK-LEGGED KITTIWAKE POPULATIONS: STATUS AND TRENDS
- PROGRESS REPORT -

by

David B. Irons

Key words: Black-legged Kittiwakes
colony size
reproductive success
variation
Prince William Sound

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ABSTRACT

Twenty-six Black-legged Kittiwake colonies in Prince William Sound were monitored from 1984-1988. The number of nests, number of birds at the colonies, and number of fledglings per nest were recorded. These data were compared to census data from 1972. Overall the number of breeding pairs in Prince William Sound decreased from 1972-1984, increased from 1984-1986, decreased in 1987 and stablized in 1988. However, there was great variation among colonies; 7 lost more than one half of their breeding birds and four more than doubled in size. The mean colony size in 1988 was 732 nesting pairs and ranged from 17 to 3,596. The mean number of chicks fledged per nest for all colonies was consistently about 0.30 for 1984-1988. However, as with the number of nests, the reproductive success was extremely variable among colonies; for the five year period, 10 colonies produced fewer than 0.1 young per nest, while 10 colonies varied from 0.20 to 0.55 young per nest. Some of the variation in both, changes in number of nests per colony and in number of young per nest, can be accounted for by dividing the colonies into two groups, glacier and island colonies. Glacier colonies were larger, fledged more young, and grew more than island colonies.

Data from Prince William Sound were compared to data from Middleton and Kodiak Islands. Population trends among these three areas in the Gulf of Alaska were similar some years and different in other years. This large variation in population changes within PWS colonies and among colonies in the Gulf of Alaska, which is presumably caused by differential food availability and/or predation pressure, is extremely important in developing a sound program for monitoring seabirds in Alaska.

INTRODUCTION

The responsibility to monitor marine bird populations was placed on the Fish and Wildlife Service (Service) by the Fish and Wildlife Act of 1956. The Black-legged Kittiwake (Rissa tridactyla) is one of the key seabird species monitored in Alaska because is it widespread and relatively easy to monitor. Kittiwake populations have been censused the past 16 years at 19 locations throughout Alaska by the Service, the Minerals Management Service, and the University of Alaska, Fairbanks (Hatch 1987). Presently, there is information on population trends at 11 areas; kittiwake numbers have recently been declining at several of these sites (Byrd et al. 1985, Nysewander et al. 1986, Springer et al. 1986).

The potential impacts on seabirds from petroleum, commercial fisheries, and increased recreational use are high and continue to rise. To detect changes in seabird populations the Fish and Wildlife Service is developing a state-wide seabird monitoring program. Information on the variation in population changes and reproductive success among colonies throughout Alaska is needed to detect declining populations.

The objective of this study is to determine what level of monitoring is needed to determine general trends of population changes and reproductive success in large geographic areas. To accomplish this objective the population status and reproductive success of 26 Black-legged Kittiwake colonies were monitored in Prince William Sound. These data were compared to survey results from 1972

(Sowls et al. 1978) to observe long-term changes in colonies in the Sound and were compared to data from Middleton and Kodiak Islands to examine variation in reproductive success and populations changes among colonies in the Gulf of Alaska.

STUDY AREA

Prince William Sound lies 100 kilometers southeast of Anchorage and is an unusual estuarine system due to the deep inland waters and shallow sill at the ocean entrance. The Sound is a relatively protected body of water composed of a myriad of habitat types resulting from a mixture of deep narrow fiords, shallow protected bays, and exposed shorelines with water of variable salinity. Thousands of marine mammals and several hundred thousand marine birds inhabit the waters of Prince William Sound (Isleib and Kessel 1973), yet there is relatively little shallow water to accommodate bottom feeding animals such as diving waterbirds and sea otters (*Enhydra lutris*).

METHODS

All kittiwake colonies in Prince William Sound were surveyed annually from 1984 through 1988. Data from a 1972 census (Sowls et al. 1978) were used for comparison. Surveys were conducted from small boats using binoculars on days with good viewing conditions. In mid-June, during the height of incubation, the number of nests and birds at colonies were counted once. A nest was described as a substantial structure with fresh material and with one or both adults in attendance. Only adult birds that were on the nesting cliffs when the counts were made were included; birds on large roosts (greater than 10 birds) were not counted. In early August, just before fledging occurred, the number of chicks on the nests was counted. Our index to reproductive success was the number of fledglings per nesting attempt.

Colonies were divided into plots to decrease errors in counting. Boundaries were chosen to correspond with natural features such as cracks in the cliff face or strips of vegetation. Plots were photographed to aid in depicting boundaries. Most plots had between 50 and 200 nests but ranged from one to over 600.

From 1984 through 1986 three people counted each plot simultaneously; if counts varied by more than five percent the plot was recounted. In 1987 and 1988 only Irons censused the colonies. The number of nests times two was assumed to be the number of breeding birds.

Colonies were classified as "glacier" or "island" colonies, depending on their location. Glacier colonies were 10 m to 5 km from glaciers and were in fiords where glaciers had receded, thereby exposing nesting habitat on the cliffs of the mainland or on islands in the middle of the fiord. Island colonies were on small islets throughout the Sound 30 km or more from glaciers.

RESULTS

Population status and trends

In 1988, 24 of the 26 kittiwake colonies in Prince William Sound were censused. There was a total of 16,827 breeding pairs. The average colony size was 732 nesting pairs with a range of 17 to 3,596 (Tables 1 & 2).

The number of kittiwakes nesting in the Sound has varied from 1984 to 1988. The lowest count occurred in 1984 when 12,607 pairs nested, by 1986 the number of nests had increased 64% to 20,644, but then dropped to 15,489 in 1987 and remained stable through 1988 (Table 3).

Several colonies did not follow the overall year-to-year trend of changes in the Sound. When most colonies were increasing in 1985 and 1986, five colonies lost nests; when most colonies decreased in 1987, six colonies gained nests (Tables 1 & 2). These results suggest that factors controlling colony size are not uniform throughout Prince William Sound.

There were demographic differences between glacier colonies and island colonies. In 1972, the number of breeding birds was evenly divided between glacier colonies and island colonies; by 1984 the number nesting on islands was reduced by half, while the glacier colonies remained stable. During the next two years both groups increased sharply until 1986 and then dropped in 1987 resulting in overall change (1972 to 1988) of a 33 percent increase at

Table 1

Numbers of Black-legged Kittiwake nests at outer (less than 25 km from ocean) colonies in Prince William Sound, Alaska, in 1972 and 1984-1988.

Colony	Number of nests in					
	1972	1984	1985	1986	1987[a]	1988[a]
Boswell Rocks	4936	1754	2394	2369	1680	1624
Hook Point	53	-	286	261	57	194
Pinnacle Rocks	700	88	119	137	57	49
Porpoise Rocks	975	1259	1735	2196	1269	1999
Wooded Island	780	-	-	-	-	-
Totals[b]						

[a] Counts were made by Irons only.

[b]

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Table 2

Numbers of Black-legged Kittiwake nests at central (25 to 75 km from ocean) colonies in Prince William Sound, Alaska, in 1972 and 1984-1988.

Colony	Number of nests in					
	1972	1984	1985	1986	1987[a]	1988[a]
Bay of Isles	173	59	40	48	65	61
Canoe Passage[b]	47	0	-	-	-	-
Clove Triangle	277	210	274	204	176	267
Ellamar	0	-	43	27	21	17
Gravina Rocks	67	48	52	57	34	37
Gull Island	0	-	4	20	11	24
Middle Green Island	183	55	31	42	26	25
Naked Island	0	4	8	29	51	65
North Green Island[b]	205	0	-	-	-	-
North Twin Bay[b]	25	0	(0)[c]	-	-	-
Point Elrington[b]	0	8	(10)[c]	-	0	-
Procession Rocks[b]	0	15	(8)[c]	-	0	-
Seal Island	0	16	(20)[b]	32	22	17
Seal Rocks	275	25	-	-	-	-
South Green Island[b]	20	0	-	-	-	-
The Needle	380	326	238	466	262	369
Chenega Glacier	370	743	(796)[b]	(1160)[b]	663	762
Icy Bay	2350	1803	(1665)[b]	2219	1442	1110
North Icy Bay	550	197	358	860	667	880
Tiger Glacier	280	228	(224)[b]	294	177	-
Totals[d]						

[a] Counts were made by Irons only.
[b] Colony was abandoned after 1972.
[c] Number of nests eas estimated from counts in August.
[d] Totals do not included Wooded Island colony.

Table 3

Numbers of Black-legged Kittiwake nesta at inner (greater than 75 km from ocean) colonies in Prince William Sound, Alaska, in 1972 and 1984-1988.

Colony	Number of nests in					
	1972	1984	1985	1986	1987[a]	1988[a]
North Eaglet Island	0	58	91	79	119	131
South Eaglek Bay	33	78	85	74	84	104
Blackstone Glacier	990	994	1318	1261	1384	1271
Coxe Glacier	0	660	965	1020	114	378
Harriman Ford[c]	54	0[c]	–[c]	–[c]	–[c]	–[c]
Passage Canal	2780	2075	3077	4163	3274	3531
Shoup Glacier	190	1480	2518	3084	3354	3596
Surprise Glacier[c]	514	0[c]	–[c]	–[c]	–[c]	–[c]
Yale Glacier	814	424	474	532	480	316
Totals[d]						

[a] Counts were made by Irons only.
[b] Number of nests was estimated from counts in August.
[c] Colony was abandoned after 1972.
~~[d] Totals to not inleude Wooded Island colony.~~

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glacier colonies and a 40 percent decrease at island colonies (Table 3). In 1988, the glacier colonies averaged four times larger than island colonies.

There were several changes in colony sites from 1972 through 1988. In 1972 there were 26 colony sites, by 1988 there were still 26 colony sites; but during those 16 years eight new colonies had been formed and eight colonies had been abandoned, two of the new colonies were abandoned. Overall, six different sites were used in 1988 compared to 1972. Most of the colonies that were abandoned were small (i.e., less than 500 nests). All of the new colonies were small in 1988.

Reproductive success

The mean number of chicks fledged per nest for all colonies in Prince William Sound from 1984 through 1988 was consistently around 0.30 (Table 4). This is surprising given the year-to-year variation within individual colonies (Tables 5 & 6). For example, in 1984, the Passage Canal colony produced 0.79 chicks/nest and Shoup Glacier colony produced 0.21 chicks/nest; in 1987 production at Passage Canal colony dropped to 0.27 chicks/nest and Shoup Glacier colony increased to 0.75 chicks/nest.

Average reproductive success was also highly variable among colonies. Combined data from 1984 through 1988 demonstrated that 10 colonies produced 0.1 or fewer fledglings per nest, and 10 colonies varied from 0.20 to 0.55 in reproductive success. The total number of fledglings was no less variable.

Table 4

Numbers of Black-legged Kittiwake chicks at outer (less than 25 km from ocean) colonies in Prince William Sound, Alaska, in 1984-1988.

Colony	Number of chicks per colony in					Number of chicks per nest in				
	1984	1985	1986	1987[a]	1988[a]	1984	1985	1986	1987[a]	1988[a]
Boswell Rocks	55	0	403	0	0	0.03	0.00	0.17	0.00	0.00
Hook Point	-	3	29	0	0	-	0.01	0.11	0.00	0.00
Pinnacle Rocks	-	0	0	0	0	-	0.00	0.00	0.00	0.00
Porpoise Rocks	370	0	22	313	700	0.29	0.00	0.01	0.25	0.35
Wooded Island	-	-	-	-	-	-	-	-	-	-
Totals										

[a] Counts made by Irons only.

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Table 5

Numbers of Black-legged Kittiwake chiecks at central (25 to 75 km from ocean) colonies in Prince William Sound, Alaska, in 1984-1988.

Colony	Number of chicks per colony in 1984	1985	1986	1987[a]	1988[a]	Number of chicks per nest in 1984	1985	1986	1987[a]	1988[a]
Chenega Glacier	–	0	199	69	1	–	0.00	0.17	0.09	0.00
Icy Bay	–	0	288	404	0	–	0.00	0.13	0.28	0.00
North Icy Bay	–	147	206	241	346	–	0.41	0.24	0.36	0.39
Tiger Glacier	–	0	53	43	0	–	0.00	0.18	0.24	0.00
Bay of Isles	0	0	3	0	27	0.00	0.00	0.06	0.00	0.44
Canoe Passage[b]	–	–	–	–	–	–	–	–	–	–
Clove Triangle	90	41	0	106	140	0.43	0.15	0.00	0.60	0.52
Ellamar	–	–	2	0	0	–	0.02	0.07	0.00	0.00
Gravina Rocks	–	0	0	0	0	–	0.00	0.00	0.00	0.00
Gull Island	–	6	7	4	2	–	.85	0.35	0.36	0.08
Middle Green Island	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Naked Island	–	3	15	1	0	–	0.38	0.51	0.02	0.00
North Green Island[b]	–	–	–	–	–	–	–	–	–	–
North Twin Bay[b]	–	0	–	–	–	–	0.00	–	–	–
Point Elrington[b]	–	0	–	0	–	–	0.00	–	0.00	–
Procession Rocks[b]	–	0	–	–	–	–	0.00	–	–	–
Seal Island	8	0	0	0	0	0.50	0.00	0.00	0.00	0.00
Seal Rocks	–	–	–	–	–	–	–	–	–	–
South Green Island[b]	–	–	–	–	–	–	–	–	–	–
The Needle	122	40	163	120	3	0.32	0.17	0.35	0.45	0.01
Totals										

[a] Counts made by Irons only.
[b] Colony was abandoned after 1972

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Table 6

Numbers of Black-legged Kittiwake chicks at inner (greater than 75 km from ocean) colonies in Prince William Sound, Alaska, in 1984-1988.

Colony	Number of chicks per colony in 1984	1985	1986	1987[a]	1988[a]	Number of chicks per nest in 1984	1985	1986	1987[a]	1988[a]
Blackstone Glacier	209	474	467	444	469	0.21	0.36	0.37	0.32	0.37
Coxe Glacier	246	0	19	0	55	0.37	0.00	0.02	0.00	0.15
Harriman Fiord[b]	-	-	-	-	-	-	-	-	-	-
Passage Canal	1639	2523	2373	1033	1003	0.79	0.82	0.57	0.27	0.28
Shoup Glacier	307	781	1945	2499	2390	0.21	0.31	0.63	0.75	0.66
Surprise Glacier[b]	-	-	-	-	-	-	-	-	-	-
Yale Glacier	0	90	0	0	244	0.00	0.19	0.00	0.00	0.77
North Eaglet Island	28	28	48	19	82	0.48	0.31	0.61	0.16	0.63
South Eaglek Bay	22	36	37	26	65	0.28	0.42	0.50	0.31	0.63
Totals										

[a] Counts made by Irons only.
[b] Colony was abandoned after 1972.

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In the five year period, 17 colonies averaged fewer than 100 young per colony per year, while two colonies, Passage Canal and Shoup Glacier, yielded a total of 3,299 per year, 78 percent of the young in the Sound.

Again some of the variation can be accounted for by looking at glacier and island colonies. Reproductive success was 2 to 12 times higher at glacier colonies than at island colonies and glacier colonies fledged most of the young in the Sound (Table 4).

DISCUSSION

Population Trends

There has not been a clear trend of the number of kittiwakes nesting in Prince William Sound. They increased from 1984 to 1986 and decreased in 1987; individually, some colonies have increased throughout the period, some have decreased throughout the period, and others varied more erratically (Tables 1 & 2). More years of data are needed to determine if such variatione is normal.

Annual changes in size of kittiwake colonies have not been consistent within the Sound, which suggests that factors controlling colony size are not the same within Prince William Sound. Generally sizes of seabird colonies are thought to be determined by either availability of food or nesting habitat. However, in the Sound a third factor, predation, may effect colony size. At some colonies intense predation has been observed. The chief predators appear to be Bald Eagles (Haliaeetus leulocephalus), Peregrine Falcons (Falco peregrinus), Black-billed Magpies (Pica pica), Northwestern Crows (Corvus caurinus), and Common Ravens (Corvus corax).

The number of kittiwake nests in Prince William Sound decreased 27 percent from 1972 through 1984, increased in 1985 and 1986, decreased in 1987, and increased slightly in 1988. There was virtually no overall change from 1972 through 1988.

To gain insight as to whether this was a widespread pattern we can compare Prince William Sound data to those from other locations in the Gulf of Alaska. Kittiwake colonies on Middleton and Kodiak Islands have been monitored frequently since the mid-1970's. Middleton Island lies 80 km seaward from Prince William Sound (Figure 1) and is the site of the second largest kittiwake colony in Alaska. Kodiak Island is about 300 km southwest of the Sound and has 23 kittiwake colonies within a 15 km radius in Chiniak Bay, near the town of Kodiak on the northeast side of the island. The number of nests at Middleton Island rose and fell several times from 1974 to 1986 (Nysewander et al. 1986) while the number of nests at Kodiak Island increased steadily over that period (Nysewander unpublished data).

Comparisons of the number of kittiwake nests between Prince William Sound, Middleton and Kodiak Islands from the mid-1970's to 1988 reveal differences in the changes of number of nests among locations. Some years the changes in figure 1

number of nests were consistent among locations and in other years they were not (Figure 2), which may suggest that factors affecting the number of nests built are more widespread in some years than in other years.

Reproductive Success

Reproductive success was highly variable among colonies within Prince William Sound, yet the overall reproductive success for the Sound was consistent from year to year. Reasons for this are unknown, but a pattern such as this may result if there was a set amount of food and/or predation within Prince William Sound each year, but the amount of food and/or predation at each colony varied year to year.

Reproductive success of kittiwakes from different locations in the Gulf of Alaska was compared (Table 7). Reproductive success of colonies at Middleton and Kodiak Islands was remarkably similar during the seven years for which data were available from both islands. Reproductive success of colonies in Prince William Sound was quite different from colonies at Middleton or Kodiak Islands. It appears that factors that control reproductive success have similar effects on the colonies at Middleton and Kodiak Islands, but not on the colonies in Prince William Sound.

The cause for low productivity at colonies on Middleton and Kodiak Islands is not known, but intense predation by Glaucous-winged Gulls (Larus glaucescens) on Middleton was observed by Bonfield (1986), and D.R. Nysewander (pers. comm.) observed much disturbance by Bald Eagles at Kodiak in 1986.

figure 2

tab 7

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Title:	Assessment of Injury to Waterbirds from the Exxon Valdez Oil Spill: Effects on the Population and Breeding Success of Pigeon Guillemots in Prince William Sound
Study ID Number	Bird Study Number 9
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Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$109,500
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II. INTRODUCTION

This project will duplicate prior studies on the Pigeon Guillemot, a diving seabird, at Naked Island, Prince William Sound, to determine if the Exxon Valdez oil spill has injured the population or its long term reproductive viability. The Pigeon Guillemot, which feeds in nearshore waters and nests on rocky shorelines throughout the eastern North Pacific, nests in numerous small colonies in the area affected by the spill. Naked Island is located in the center of Prince William Sound 15 kilometers west of the oil tanker route, and its shorelines were the first to be hit by oil spilled from the Exxon Valdez.

In 1976, the U.S. Fish and Wildlife Service (USFWS) designated Naked Island as a baseline seabird study site due to its proximity to the tanker route. The USFWS commenced seabird nesting surveys of Naked Island and its neighbors--Peak, Storey, Smith and Little Smith islands--in 1976 (Lensink and Bartonek 1976) and 1977 (Sangster et al. 1978). They supported detailed studies of Pigeon Guillemots, found to be the most abundant colonial seabird in the area, between 1978 and 1981 (Oakley and Kuletz 1979, Eldridge and Kuletz 1980, Kuletz 1981, Oakley 1981, Kuletz 1983). Pigeon Guillemots were selected for detailed studies because of their abundance and because, as nearshore feeders, they could indicate conditions in the nearshore marine environment.

As a diving seabird, Pigeon Guillemots are highly vulnerable to oil (King and Sanger 1979). Oil spilled in the ocean has the potential to affect seabird populations by 1) directly killing adult birds, 2) reducing the number of nesting attempts by potential breeders due to physiological stress or poor foraging conditions, 3) reducing hatching success due to oil transfer from adults to their eggs, and 4) increasing chick mortality due to a decreased food supply or contaminated prey. Using the same methods used in the prior studies, this study will collect data on the distribution, abundance, breeding biology and feeding ecology of Pigeon Guillemots at Naked Island to determine if oil spilled from the Exxon Valdez had any of these effects on the guillemot population.

III. OBJECTIVES

The objectives of this study have been modified since the study was selected by the Trustee Council. Under the previous objectives, published in the August 1989 Public Review Draft of the State/Federal Natural Resource Damage Assessment Plan for the Exxon Valdez Oil Spill, the reproductive success and prey of guillemots in oiled and non-oiled areas were to be compared. Due to logistic constraints, guillemots could be studied at only one site. Because pre-spill data on guillemots were available for the Naked Island area, Naked Island was selected as the study site, and the objectives were changed to address the reproductive success and prey of guillemots at Naked Island before and after the spill. Because guillemot population data were available for Naked Island, two objectives addressing the effect of the spill on the guillemot population were added. The objective addressing guillemot prey was divided into separate objectives addressing 1) prey abundance and 2) prey type and foraging areas. The objectives addressing oil contamination and restoration were not changed.

Of the 14 bird studies included in the damage assessment plan, this study is the only one to examine the effect of the spill on the reproductive success of a diving seabird. This study may therefore yield information useful for assessing the impact of the spill on other divers including puffins, auklets and murres.

A. To test the hypothesis that the total number of Pigeon Guillemots attending colonies following the Exxon Valdez oil spill is not significantly different from the total number attending in prior years.

B. To test the hypothesis that the mean density of Pigeon Guillemots on the western side of Naked Island following the Exxon Valdez oil spill is not significantly different from the mean density on each transect in prior years.

C. To test the hypothesis that reproductive events, success and chick growth rates for Pigeon Guillemots at Naked Island following the Exxon Valdez oil spill are not significantly different from prior years.

D. To test the hypothesis that the abundance of guillemot prey following the Exxon Valdez oil spill was not significantly different from prior years.

E. To test the hypothesis that the prey fed to chicks and the foraging areas used for obtaining chick food by adult Pigeon Guillemots following the Exxon Valdez oil spill were not significantly different from the prey fed to chicks and the foraging areas used in prior years.

F. To identify potential alternative methods and strategies for restoration of lost use, populations or habitat where injury is identified.

G. Determine if petroleum hydrocarbons are present in adult pigeon guillemots, unhatched eggs, dead chicks or prey items in oiled areas.

IV. METHODS

This study will duplicate prior studies (see Section VIII. Citations) of the Pigeon Guillemot at Naked Island, and, to the extent possible, identical methods will be used. The methods to be used in gathering data on distribution and abundance, breeding biology, and foraging ecology in the year(s) following the Exxon Valdez oil spill are described below.

A. Sampling Methods

Objectives A and B: Distribution and Abundance

In the Naked Island group, Pigeon Guillemots breed in small colonies of 10 to 100 birds which are widely distributed. Maximum numbers of guillemots are present at colonies at high tides between 05:00 and 10:00 during late May and early June when the weather is good (Thoreson and Booth 1958, Drent 1965, Kuletz 1983, Nelson 1987). The number of guillemots summering in the Naked Island group will be determined by circumnavigating each island in a small boat between 50 and 100 m from shore when maximum numbers of guillemots are expected to be present and counting all guillemots. Using natural landmarks, the shorelines in the Naked Island group were divided into 70 sections, and the number of guillemots in each section will be recorded to determine the distribution of guillemots. Another census will be made in late July.

The number of Tufted Puffins, Horned Puffins and Parakeet Auklets present in each section of coast will also be recorded during guillemot censuses. These data will be forwarded to the investigators conducting Bird Study Number 3 which will census seabird colonies in the area affected by the spill.

The density (number per square kilometer) of Pigeon Guillemots in inshore waters on the western side of Naked Island will be determined by counting the number of guillemots on five transects established for this purpose in 1978. These data will be collected by the Marbled Murrelet project, and the timing and frequency of data collection on the transects will be dictated by the needs of that study.

Objective C: Breeding Biology

The parameters to be studied include: clutch size; breeding chronology; hatching success (percent of eggs laid that hatch); fledging success (percent of hatched eggs that fledge); breeding success (percent of eggs laid that fledge); chick growth; and fledging weight.

Reproductive data on guillemots from prior years were collected primarily from accessible and semi-accessible nests located at five colonies on the west side of Naked Island--Nomad, Thumb, Row, Hook II and Parakeet Point. The 80 nest sites at these colonies known from previous years will be checked during June, when guillemots lay their eggs, to determine their usage. Those nests found during the egg stage will be used for analysis of average clutch size, hatching success, breeding success, chick growth and fledging weight. Nests found after hatching will be used for analysis of chick growth and fledging weight.

Once nests are found, they will be visited to record the progress of each nesting effort. Pigeon Guillemots generally desert their nests if disturbed during the incubation stage, and nests will be checked infrequently until eggs have hatched. Once chicks are present, nests will be checked every third day. To the extent possible, nests will be checked when the tide is out to reduce disturbance to the colonies (Kuletz 1983).

Chick growth will be monitored by measuring weight, total culmen, diagonal tarsus, and wing chord and by noting plumage development. Weight will be measured with Pesola spring balance scales appropriate to the weight at each age (100 + 1 g; 300 + 5 g; 500 + 10 g; 1,000 + 25 g). Culmen, tarsus and wing chord will be measured with vernier calipers to the nearest millimeter. Five stages of plumage development for guillemot chicks have been identified (Oakley and Kuletz, unpubl. data), and the stage of each chick's plumage development will be recorded at each visit.

Pigeon Guillemots nest in natural crevices, many of which are inaccessible. Their nests are difficult (if not impossible) to find during the incubation stage. Nests can only be found by watching adults carrying fish to their chicks. Whether this study will generate breeding data suitable for statistical testing will depend upon the number of nests found, particularly, the number found during the egg stage. Although guillemots often use the same nest sites, only a few of the 80 nest sites known to the investigator may be used during 1989. If this is the case, the study will have to devote considerable time in 1989 to finding new nests, and further study will be required to obtain the data necessary to test hypotheses concerning breeding success.

Objectives D and E: Feeding Ecology

Guillemot feeding ecology will focus on the foods fed to chicks by adults and on the foraging areas used by adults feeding chicks. Diets of adult guillemots at Naked Island were studied previously. Guillemots feed their chicks single whole fish, and an experienced observer with a spotting scope in a blind can generally determine the type of fish being delivered (Slater and Slater 1972). Chick feeding observations, following methods developed by Kuletz (1983), will be used to determine the types of fish fed to chicks, the rate of food delivery, and the foraging areas used. The types of fish delivered to chicks will be determined by observations, collecting fishes found outside nests and by examining otoliths present in chick feces. The relative abundance of those fishes eaten by guillemots and trapable in minnow traps will be examined by setting minnow traps in known feeding areas.

Chick feeding watches will be made using binoculars and spotting scopes (15-45x) from blinds. Each watch will be 5 or 6 hours in duration. The time that each bird arrives at the colony with a fish will be noted, and the fish will be identified to the lowest possible taxon. The length of the fish relative to the length of the bird's bill will be estimated to 0.5 bill lengths. The nest to which each fish is delivered and the time of delivery will be noted. To determine the location of foraging areas, each bird leaving the colony after delivering a fish will be observed until it is out of view or it lands. The directions from which birds carrying fish arrive at the colony will also be noted.

Chick feeding watches will be made at the three colonies studied extensively by Kuletz (1983): Nomad, Thumb and Row. Other colonies may also be studied. Watches will be made at each colony about every five days throughout the nestling period. Because the tidal stage, time of day and weather may affect the feeding rate, an attempt will be made to conduct watches at all tides, times and weather conditions equally. For consistency with prior studies, this study will attempt to conduct at least 150 hours of chick food watches and observe at least 500 fish delivered to chicks.

Adult guillemots often drop fish during attempts to deliver to their chicks. Fish found outside nests will be identified and their weight and length measured.

Fish otoliths pass through the digestive tracts of chicks and can be recovered from the feces which accumulate in their nests. Chick feces will be collected from accessible nests, and the otoliths will be examined to determine the species of fish. This method can reveal the use of species not observed being fed to chicks and can indicate which species were fed to chicks raised in colonies where no chick feeding watches were made. Otoliths will be identified using Morrow (1977). Otoliths which cannot be identified will be sent to experts at the University of Alaska, Institute of Marine Science, or other similar institution for analysis.

Minnow traps will be set in tidal, subtidal, and inshore waters used by guillemots for feeding. Three traps, baited with meat or bread, will be set together for periods of 8 to 24 hours. The number of each species caught will be recorded. For fish, their length, measured with a ruler to the nearest millimeter, will also be recorded.

Objective F: Restoration

Methods and strategies of restoration of lost use, populations and habitat will be identified if injury is documented. No specific sampling methods are applicable to this objective.

Objective G: Oil Contamination

Pigeon Guillemot eggs which fail to hatch will be collected for analysis of their petroleum hydrocarbon content. Using aluminum foil that has been rinsed with acetone and then hexane, each egg will be removed from its nest and wrapped. Once wrapped, the egg will be placed in a cushioned box with a label written in indelible ink which describes the circumstances of its collection. The boxes containing the wrapped eggs will be stored in a cool area until they can be transported to Anchorage. A chain-of-custody form will accompany the boxes containing the eggs.

Adult guillemots to be analyzed for petroleum hydrocarbon content will not be collected by this project to avoid collection of birds whose nests are being studied for reproductive success and prey use. Adult guillemots from other oiled areas will be collected by Bird Study Number 8 following the same methods to be used for collection of Black-legged Kittiwakes.

B. Citations

See section VIII.

C. Standard Operating Procedure Requirements

The standard operating procedures are described in the Sampling Methods section. This study will duplicate methods described in Oakley (1981), Oakley and Kuletz (1979), Kuletz (1981), and Kuletz (1983). Sample collection, labelling, and chain-of-custody will be done in accordance with the Quality Assurance and Control Plans in Appendix A of the Guidelines For Preparing Detailed Study Plans for the State/Federal Natural Resource Damage Assessment and Restoration Plan.

D. Equipment Protocol

Vernier calipers and Pesola spring-balance scales will be used by this project for studying growth of guillemot chicks. The Principal Investigator will be responsible for maintenance, calibration and cleaning of this equipment.

E. Quality Assurance and Control Plans

The majority of the data for this study will be collected directly by the Principal Investigator who has previously studied guillemots at Naked Island. A biological technician will collect some data on reproduction under the direct supervision of the Principal Investigator. This technician will also be trained in the chick food watch technique developed by Kuletz (1983). Once the technician has gained familiarity with the fishes fed to chicks and demonstrated competence in the technique, the technician will conduct chick food watches without direct supervision.

Data will be entered into a relational database, Paradox, by the Principal Investigator or technicians. Data files will be checked for accuracy by the Principal Investigator prior to analysis.

The Quality Assurance and Quality Control Plan for Analytical Chemistry developed by Technical Services Study 1 will be followed by this project in the collection of all samples for petroleum hydrocarbon analysis.

F. Histopathology

No histopathological samples will be collected by this project.

G. Information Required From Other Investigators

Data on the degree of oiling at selected study sites will be required from the Coastal Habitat Study, the Air/Water Studies, and the Technical Services Study Number 3.

V. DATA ANALYSIS

A. Tests

Bias in the estimation of the total guillemot population is not expected since the population will be counted rather than sampled. The number of guillemots present in each section of coast is small enough that all guillemots are counted, and counting error is assumed to be nil. Comparisons of 1989 data to 1978-1981 data assumes there is no trend in populations. 1989 is assumed to be a random sample from the same populations sampled in 1978 to 1981.

Bias in the analysis of guillemot reproductive success will be avoided by using data only from nests found during the egg stage. Bias in the analysis of foods fed to chicks and in feeding rates will be avoided by making observations at as many nests and colonies as possible under a variety of weather and tidal conditions.

B. Analytical Methods

Because this study will attempt to discern differences in various parameters of Pigeon Guillemot ecology at Naked Island between 1978-1981 and 1989, data collected in prior years may need to be re-analyzed. Some of the data collected in prior years was never analyzed, and some was analyzed, but never published. The data from former years will be scrutinized to ensure that data from all years are treated in the same manner and that the data will allow the hypotheses specified in the objectives to be tested.

The general approach of the analysis will be to determine whether the 1989 data for a particular variable falls outside the range of variation observed in prior years. The primary test expected to be used in the analysis of the data is the student's t-test (Conover 1971, Sokal and Rolf 1969). The analytical methods expected to be used are described for each objective below.

Objectives A and B: Distribution and Abundance

Student's t test will be used to test for a significant difference in the number of guillemots counted at each island. To determine whether there were any changes in the distribution of guillemots, differences in the number of guillemots in each major bay between years will be tested with a t-test. Transect data will be reduced to annual values (mean or total) and compared with a t test.

Objective C: Breeding Biology

Student's t test will be used to test for significant differences between years in average clutch size and average fledging weight and size. Differences in hatching, fledging and nesting success will also be tested using a t test. The Mann-Whitney test will be used to test for differences in the average weight gain between 8 and 18 days for chicks raised in different years. Differences in the median dates of laying, hatching and fledging will be analyzed using a median test.

Objectives D and E: Feeding Ecology

A chi square test will be used to test for differences in the types of fishes (i.e., schooling and bottom fish) fed to chicks in different years. Differences in feeding rate will tested for with ANOVA. Differences in capture rates for species caught in minnow traps will be tested for with ANOVA.

Objective F: Restoration

No analytical methods are applicable to this objective.

Objective G: Oil Contamination

Differences in the level of petroleum hydrocarbons in adults collected in 1989 and in prior years will be tested using a t-test. If evidence of nonnormality is present in the contamination data, a log transformation will be used to normalize the data, and the Wilcoxon ranks test applied. There are no prior data on the oil content of eggs. The average and the 95 percent confidence interval for the oil content of eggs collected in 1989 will be determined.

C. Products

1. List of fish and invertebrate species fed to chicks based on chick food watches, otolith recoveries and items dropped in nests.
2. Table of guillemots counted at colonies in each year of study.
3. Table comparing breeding biology parameters for all years of study.
4. Table of length and weight of fishes recovered from nests.
5. Table of otolith recoveries.
6. Map showing the distribution of guillemot colonies in the study area.

7. Graphs comparing chick growth rates for weight, tarsus, culmen, and wing for all years of study.
8. Graph showing the percentage of fish of each major type fed to chicks throughout the nestling period for each year of study.
9. Maps showing foraging areas used in each year of study.
10. Histogram showing breeding chronology.
11. Histogram showing fish lengths for various species of fish observed being delivered to chicks.
12. Report synthesizing the results of this study.

VI. SCHEDULES AND PLANNING

A. Data Submission Schedule

Begin field work	June 1989
Complete field work	August 1989
Complete draft report	December 21, 1989

B. Special Reports

None

C. Visual Data

None

D. Sample and Data Archival

Data from this study will be archived in the Fish and Wildlife Service's Database. All original data forms and field notebooks will be placed in the Fish and Wildlife Service oil spill file system.

E. Management Plan

This study will be managed by the Principal Investigator, under the general guidance of the Fish and Wildlife Service's Marine Bird and Shorebird Oil Spill Study Coordinator and Migratory Bird Oil Spill Study Coordinator or their designees. The Principal Investigator is responsible for coordinating the collection of data, data analysis and reporting of the data in draft and final reports.

Principal Investigator	Karen Oakley
Marine and Shorebird Oil Spill Damage Assessment Coordinator	Kenton D. Wohl
Migratory Bird Oil Spill Damage Assessment Coordinator	Robert Leedy

F. Logistics

This study will coordinate with Bird Study Number 6 to establish a field camp on Naked Island. All field work will be done from a 12 ft. inflatable raft and observations done from blinds constructed on site. Logistical support, including camp transport, gasoline and food, will be provided by the MV Curlew.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries		
P. I. Karen Oakley .8FTE	$35,000	
Vacant Temporaries .6FTE	20,500	
Subtotal		$55,500
Travel/Per Diem		10,000
Contracts		0
Supplies		14,000
Equipment		30,000
Total		$109,500

B. Personnel

See VII. C.

C. Qualifications

1. Principal Investigator-Karen Oakley:

Karen Oakley received her Master's degree from the University of Alaska, Fairbanks in 1981. She conducted the research for her thesis on the Pigeon Guillemots of Naked Island in 1978. Ms. Oakley previously studied guillemots in Puget Sound, Washington, undertaking a study of chlorinated hydrocarbons (DDT and PCBs) in guillemot eggs for her Senior Thesis at the Evergreen State College.

During the late 1970's, Ms. Oakley worked on a number of projects studying marine birds in the Beaufort, Chukchi and Bering seas as part of the Outer Continental Shelf Environmental Assessment Program (OCSEAP). She also spent three seasons studying bowhead whales at Point Barrow. In 1981, she studied Glaucous-winged Gulls in Kenai

Fjords National Park, and in 1983, she directed a project studying the effects of boat traffic on harbor seals in Glacier Bay National Park. In 1987, she worked on a study to evaluate methods of censusing nocturnal seabirds, primarily petrels and auklets, in the eastern Aleutian islands.

From 1984 to 1986, Ms. Oakley worked as a habitat biologist for the Alaska Department of Fish and Game. For the past three years, she has worked as a policy analyst for the Alaska House of Representatives, specializing in natural resource issues.

VIII. CITATIONS

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IX. OTHER INFORMATION

None.

STATE-FEDERAL NATURAL RESOURCES DAMAGE ASSESSMENT DETAILED STUDY PLAN, APRIL 1989 - FEBRUARY 1990

Project Title: Assessment of Injury to Glaucous-winged Gulls using Prince William Sound

Study ID Number: Bird Study Number 10

Project Leader: Dr. Samuel M. Patten

Leading Agency: Alaska Department of Fish and Game

Cooperating Agency: U.S. Fish and Wildlife Service

Cost of Proposal: $73,000

Date of Plan: October 20, 1989

	Signature	Date
Principal Investigator	Samuel M. Patten	Oct 21, 1989
Supervisor	Donald W. Calkins	Oct 31 1989
OSIAR Senior Biometrician		
OSIAR Project Manager		
OSIAR Director		

II. INTRODUCTION:

Glaucous-winged Gulls (Larus glaucescens) are among the most numerous species of birds in Prince William Sound. Approximately 50,000 Glaucous-winged Gulls use Prince William Sound in the summer, and lesser numbers are present the year round (Isleib and Kessel, 1973; Sowls, Hatch and Lensink, 1978). They survive primarily by scavenging and foraging in littoral and intertidal areas (Patten and Patten, 1976). Since the Exxon Valdez oil spill, a high percentage of Glaucous-winged Gulls observed have been oiled. Existing literature indicates that small amounts of ingested crude oil inhibit gull chick growth and affect osmoregulation (salt gland), hepatic, and adrenal gland activity (Butler and Lukasiewicz, 1979; Peakall et al, 1982). Existing literature also demonstrates that minute quantities of (LD50=50 microns) of North Slope crude oil are toxic to gull egg embryos (Patten and Patten, 1977, 1979). Transfer of oil from adult gull breast feathers to eggs will likely cause embryo mortality (King and Lefever, 1979) and a significant decline in population productivity (Samuels and Ladino, 1984).

Previous research has verified that most of the Glaucous-winged Gulls frequenting Prince William Sound come from Egg Island and smaller colonies such as Perry Island within the Sound (Patten and Patten, 1976, 1979; Sowls, Hatch and Lensink, 1978). The Egg Island colony, located about 15 miles from Prince William Sound, is the largest Glaucous-winged Gull colony in the world (with 10,000 breeding pairs)(Patten and Patten, 1975, 1976, 1977, 1979) (Patten 1980).

This species generally represents the scavenging birds such as the closely related Herring Gull (Larus argentatus)(Patten, 1980) and scavenging passerines such as the Northwestern Crow (Corvus caurinus). Glaucous-winged Gulls have intrinsic value, and are an important part of the food chain, serving as a major scavenger. They are among the most visible birds in Prince William Sound, thereby contributing to the overall quality of life and visitor experience. The Egg Island colony has research value because it is the world's largest colony and because extensive research has been conducted there in the past (Patten and Patten, 1975, 1976, 1977, 1979; Patten, 1980). Future research will likely be compromised by oil-spill effects.

This project will replicate prior studies on the Glaucous-winged Gulls on Egg Island to determine if the Exxon Valdez oil spill has injured the population or its long-term reproductive viability (Samuels and Ladino, 1984). This study will assist in the assessment of injury to waterbirds under the Comprehensive Environmental Response, Compensation and Liability Act (42 USC 9601 et seq.). The study is consistent with Type B assessment regulations concerning the physiological malfunction category of reduced avian reproduction as defined in 43 CFR 11.62(f)(3)(r)(B).

The Principal Investigator will collect data on numbers of breeding pairs, nest density, clutch size, hatching success, and fledging success, using identical methods as in prior studies on Egg Island and other sites in southern Alaska (Patten, 1974; Patten and Patten, 1975, 1976, 1979; Patten, 1980).

Over 11,000 gulls have been banded on Egg Island as part of previous studies. Approximately 1000 nearly fledged young will be banded in 1989. Earlier band returns demonstrated movement of recently fledged juveniles to Prince William Sound from Egg Island before southward migration along the Pacific Coast (Patten and Patten, 1976, 1979). First-year juvenile gulls are subject to high mortality rates and are substantially at risk in the Prince William Sound oil spill. Cohort or age class weaknesses in large gulls may not become apparent for years because these gulls first breed at age four (Kadlec and Drury, 1968). Considerable band return data has accumulated since the initial Egg Island studies were completed over a decade ago. This data base will be reanalyzed as part of the current study and compared with new band returns to determine pre-and post-oil spill mortality locations and causes.

III. OBJECTIVES:

A. To test the hypothesis ($\alpha = 0.05$) that the total number of breeding Glaucous-winged Gulls pairs and nests in the Egg Island colony following the <u>Exxon Valdez</u> oil spill is significantly lower than historical data.

B. To test the hypothesis ($\alpha = 0.05$) that reproductive success for Glaucous-winged Gulls at Egg Island is significantly lower than prior years.

C. To test the hypothesis ($\alpha = 0.05$) that the mean distance to nearest neighboring nest (a density measurement) in the Egg Island colony following the <u>Exxon Valdez</u> oil spill is significantly lower than previous such measurements.

D. To estimate the number of egg hatching failures attributable to oil to within 10% of the actual number 95% of the time by direct observation and contaminant analysis and compare to previous data from Egg Island and other gull colonies in southern Alaska.

E. To test the hypothesis ($\alpha = 0.05$) that the chick mortality rate was higher in 1989 than historical data by comparison with prior results from Egg Island and other colonies and that the higher chick mortality rate in 1989 were caused by the EVOS.

F. To test the hypothesis that losses in productivity attributable to oil in 1989 are significantly lower than mean historical data by comparing pre- and post-spill productivity indices as measured in chicks fledged per nest.

G. To determine locations and causes of mortality of banded recently fledged juveniles and compare to prior returns.

H. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS:

A. Sampling Methods:

This study will replicate prior studies of Glaucous-winged Gulls at Egg Island. Identical methods will be used to the extent possible. The methods to be used in gathering data on breeding biology in the season following the Exxon Valdez oil spill are described below. Results will be compared to earlier studies on Egg Island and other sites in southern Alaska 1972-1977 (Patten, 1974; Patten and Patten 1975, 1976, 1977, 1979; (Patten,1980).

Reproductive data on Egg Island gulls in 1975-76 was collected at the east end of the island. The study area was located on grassy dunes southwest of Egg Island Light. The 1989 study will resume in the identical study area.

Parameters to be studied include: breeding chronology, distance to nearest neighboring nest, clutch size, hatching success (percent of eggs laid that hatch); fledging success (percent of hatched chicks that fledge); and breeding success (percent of eggs laid that fledge).

All nests under study will be marked with survey stakes at the beginning of the investigation. Each heavy wire survey stake will have a numbered bright vinyl flag attached. A fiberglass meter tape will be used to find the direct distance from every study nest to the center of the nearest neighboring nest. As part of each sequential visit through the gull colony, numbers of eggs and chicks from each nest site inspected will be recorded in weatherproof field notebooks. Visits at Egg Island will average once every three days during incubation, and once every three days during the chick stage. Young chicks will be counted in the nest upon hatching. Older chicks will be banded with USFWS 7A aluminum bands and an additional 2.5 cm lynply band with engraved codes in black alphanumeric characters on the opposite leg. Chicks will not be banded until nearly fledged in order to reduce disturbance in the study area. At the end of the survey period, counts will be made of fledged, banded chicks for the entire study area. As many chicks as possible will be banded outside the main study area. Factors influencing hatching and fledging success in southern Alaskan Larus colonies have been analyzed in detail in a previous series of publications (Patten, 1974; Patten and Patten, 1975, 1976, 1977, 1979; Patten, 1980).

Eggs which fail to hatch will be collected for analysis of their petroleum hydrocarbon content. Using aluminum foil that has been rinsed with acetone and then hexane, each egg will be removed from the nest and wrapped. Once wrapped, the egg will be placed in a cushioned box with a label written in indelible ink describing the circumstances of collection. The boxes containing wrapped eggs will be stored in a cool area until transported for analysis. A chain of custody form will accompany boxes containing the eggs. Chicks and adults will be collected for petroleum hydrocarbon analysis and histopathology following established protocols.

Location and cause of mortality of Egg Island gulls will be determined from previous band returns (11,212 gulls banded 1975-1978). Although band returns from Egg Island gulls have continued to accumulate for a decade, data since 1979 remains unanalyzed. Earlier results will be compared to returns of gulls banded in 1989. Approximately 1000 nearly fledged chicks will be banded in late July and early August 1989. This aspect of the study will focus on the mortality of banded recently fledged juveniles in Prince William Sound.

B. Citations:

See section VIII.

C. Standard Operating Procedure Requirements:

This study will be conducted using procedures employed by the Principal Investigator to measure gull productivity in Alaska since 1972. See Methods section above for a complete description.

D. Equipment Protocol:

No elaborate equipment will be used as part of this study. The Principal Investigator will conduct the study, using an inflatable boat, outboard motors, survey flags, a fiberglass meter tape, and weatherproof transit field notebooks. Others will not collect productivity data other than assisting in banding. A field assistant should be employed for assistance in boat handling and safety.

E. Quality Assurance and Control Plans:

Data will be recorded in standard formats. Chain-of-custody procedures as outlined in State/Federal Damage Assessment Plan Analytical Chemistry QA/QC will be followed. The Principal Investigator is a very experienced field biologist with no major data collection failures in eighteen years of work in Alaska.

F. Histopathology:

Chain-of-custody procedures and documentation will follow protocols developed by the Histopathology Technical Group.

G. Information Required From Other Investigators:

Gull band returns will be required from the USFWS. Data on degree of oiling at selected sites may be required from the Coastal Habitat Study, the Air/Water Studies, and the Technical Services Study Number 3. Information may also be required from the USFWS project on distribution and abundance of migratory birds (Bird Study Number 2) Information may be requested from USFWS receiving centers on numbers and locations of dead gulls and from gulls identified in the USFWS Beached Bird Survey (Bird Study Number 1).

V. DATA ANALYSIS:

A. Tests:

Objectives A and F: One sample T-tests (Snedecor and Cochran, 1980) will be used to determine if the historical mean number of breeding pairs and mean number of chicks fledged per nest is significantly higher than the 1989 count. This test assumes that the mean has a normal distribution. If necessary transformations will be used to meet this assumption.

Objectives B, C, and E: Analysis of variance procedure coupled with appropriate linear contrasts (Snedecor and Cochran, 1980) will be used to test the

hypotheses that reproductive success (including chick mortality) and distance to nearest neighbor in 1989 is lower than the historical average. This analysis assumes random samples, equal variances, and normally distributed means.
Transformations will be used, if necessary, to ensure equal variance and the normality assumption.

B. Analytical Methods:

Reproductive success of gulls on Egg Island in 1989 will be compared to gull reproductive success on Egg Island and other sites investigated by the PI in southern Alaska in previous years.

C. Products:

The products of this study will be a narrative report with maps, figures, and tables.

VI. Schedules and Planning:

A. Data Submission Schedule:

Fieldwork	June 1, 1989 to Aug. 30, 1989
Analyze Data	Sept 1, 1989 to Dec. 1, 1990
Complete Interim Report	December 21, 1989
Complete Final Report	December 23, 1990

B. Special Reports:

None.

C. Visual Data:

None.

D. Sample and Data Archival:

Samples and data will be archived at the Department of Fish and Game.

E. Management Plan:

This study will be conducted and managed by the Principal Investigator who will work under the general guidance of a Division of Wildlife Conservation Oil Spill Damage

Assessment Management Coordinator. The Management Coordinator will provide general supervision during planning, implementation and reporting phases of studies. The Principal Investigator will collect and analyze the field data and write the draft and final reports. Additional coordination will be through the Department of Fish and Game office of Oil Spill Impact Assessment and Restoration.

F. Logistics:

This study will be conducted from Cordova, with the Department of Fish and Game facilities providing a center of support. Daily operations will be conducted from cabins at the mouth of Orca Inlet and the mouth of the Eyak River. Inflatable boats will used to travel to and from Egg Island. A spike camp will be established at the east end of Egg Island. The Principal Investigator has years of experience in the Copper River Delta area.

VII. Budget:

A. Costs:

Salaries	$37.2
Travel	4.0
Contracts	8.5
Supplies	8.3
Equipment	15.0
Total	73.0

B. Personnel:

1. Samuel M. Patten
2. Field Assistant

C. Qualifications:

1. Principal Investigator - Samuel M. Patten

Sam Patten received his B.A. degree from Cornell University in 1968, majoring in Biology and German. He attended Heidelberg University 1968-71. In 1971 he began work as a Research Assistant at the University of Washington, conducting thesis research on Glaucous-winged Gulls in Glacier Bay National Monument under National Park Service sponsorship. He received his Master of Science degree in 1974.

He worked as a Research Associate for the University of Alaska in the summer of 1974, conducting research on avian populations on the outer coast of Glacier Bay for the National Park Service in an area potentially impacted by nickel mining. In 1975 he began research on gulls on the south coast of Alaska as a doctoral candidate at Johns Hopkins University. Field work was conducted as part of the NOAA-OCS gas and oil baseline studies prior to the development of oil resources. He received his Ph.D. in Animal Ecology and Behavior from the Department of Pathobiology, School of Hygiene and Public Health, Johns Hopkins, in 1980, with a dissertation on the evolution of gulls in Alaska.

Patten continued work on seabirds, shorebirds and waterfowl in Yakutat, Alaska, for Operations Research, Inc., 1980-81, under NOAA contract. He assisted in production of a data atlas of the Bering, Chukchi, and Beaufort Seas for NOAA while at the University of Alaska 1981-82. He also conducted research on avian populations in the Susitna basin, as part of the hydroelectric project, for the University of Alaska Museum in 1982. He began working for the Department of Fish and Game as Area Biologist on the Yukon-Kuskokwim Delta in 1983, conducting a cooperative management program instrumental in the population recovery of four species of geese. This management program also lead to the expansion of muskox, moose, and caribou populations on the Yukon-Kuskokwim Delta through 1989.

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STATE-FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT

DETAILED STUDY PLAN, APRIL 1989 - FEBRUARY 1990

Project Title: Injury Assessment of Hydrocarbon Uptake by Sea Ducks in Prince William Sound and the Kodiak Archipelago

Study ID Number: Bird Study Number 11

Project Leader: Dr. Samuel M. Patten

Leading Agency: Alaska Department of Fish and Game

Cooperating Agency: U.S. Fish and Wildlife Service

Cost of Proposal: $146,000

Date Submitted: 27 October 1989

	Signature	Date
Project Leader	Samuel M. Patten	10/27/89
Supervisor	Donald W. Calkins	10/27/89
OSIAR Senior Biometrician		
OSIAR Project Manager		
OSIAR Director		

II. INTRODUCTION:

The focus of this plan is a study of the effects of petroleum hydrocarbon injestion by Harlequin Ducks (Histronicus histronicus), Barrow's Goldeneyes (Bucephala islandica), Black Scoters (Oidemia nigra), White-winged Scoters (Melanitta deglandi), and Surf Scoters (Melanitta perspicillata) in Prince William Sound and the Kodiak Archipelago as a result of the Exxon Valdez oil spill. Prince William Sound and the nearshore waters of Kodiak and neighboring islands are major wintering areas for these sea duck species (Isleib and Kessel, 1973). Prince William Sound is also an important migration area for sea ducks in spring and fall, and a breeding site for resident Harlequin Ducks during the summer (Hogan, 1980). Harlequin Ducks in particular, because of their resident status and intertidal foraging habits, are considered substantially at risk to effects of the Exxon Valdez oil spill (King and Sanger, 1979).

These five sea duck species are heavily dependent on intertidal and subtidal marine invertebrates (Vermeer and Bourne, 1982). Scoters and goldeneyes utilize blue mussels, and, similar to Harlequins, consume a wide variety of clams, snails, and limpets (Koehle, Rothe and Dirksen, 1982; Dzinbal and Jarvis, 1982). Bivalves, particularly blue mussels, are well-known for their ability to concentrate pollutants at high levels (Shaw et al., 1976). The crude oil spilled from the Exxon Valdez may cause severe damage to marine invertebrates that support sea ducks throughout the year (Stekoll, Clement, and Shaw, 1980) and bioaccumulation in the food chain may result in uptake of petroleum hydrocarbons by sea ducks over a long period (Dzinbal and Jarvis, 1982; Sanger and Jones, 1982). This study will determine levels of petroleum hydrocarbon injestion by sea ducks, and will predict resultant physiological and life-history effects (Gay, Belisle and Patton, 1980; Hall and Coon, 1988).

III. OBJECTIVES:

A. To test the hypothesis ($\alpha = 0.05$) that the prevalence of petroleum hydrocarbons in gut samples from collected sea ducks is higher in the oil spill areas than in the control area.

B. To test the hypothesis ($\alpha = 0.05$) that the prevelance of petroleum hydrocarbons in tissues of collected sea ducks is significantly higher in the two oil spill areas than in the control area.

C. From evidence of histopathology, estimate the injested petroleum hydrocarbon effects on morbidity, mortality, and reproductive potential of sea ducks. This information may be related to other studies to identify changes in abundance and distribution within the affected areas.

D. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

IV. METHODS:

A. Sampling Methods:

This study will compare levels of petroleum hydrocarbons in tissues of five species of ducks collected in three study areas (Prince William Sound, Kodiak Archepelago, and an unexposed control site) throughout the year. Tissues will be collected for evidence of either histopathology or chemical contamination.

USFWS aerial survey results will be used to define the sea duck population of interest in oiled areas of Prince William Sound and Kodiak and to delineate relative concentrations. 30 ducks per species will be collected proportional to the distribution obtained from the USFWS survey. Individual ducks will be selected in a random fashion. This sample should be representative of ducks exposed to EVOS and, as a result, do a good job mimicing a simple random sample. Additional debilitated ducks may be collected to demonstrate minimal levels of effects but will not be used in the random sample.

See attached Oil Spill Seaduck Study Field S.O.P. For Sampling for complete details.

B. Citations:
See section VIII.

C. Standard Operating Procedure Requirements:
See attached Oil Spill Seaduck Study Field S.O.P For Sampling.

D. Equipment Protocol:
A trailerable 20-ft. center-console fiberglass boat will be used as transportation and as a collecting platform during this study. The boat will have appropriate safety and survival gear, marine VHF radio, and depth finder. Two to three biologists will operate the boat and take and process specimens. Birds will be taken by 12 gauge shotgun. See attached Field S.O.P.

for further details.

E. Quality Assurance and Control Plans:

Data will be recorded in standard formats. Chain-of-custody procedures as outline in State/Federal Damage Assessment Plan Analytical Chemistry QA/QC will be followed.

F. Histopathology:

Chain-of-custody procedures and documentation, including histopathology repository guidelines, will follow protocols developed by the Histopathology Technical Group.
Interpretation of results will follow published guidelines (Hall and Coons, 1988).

G. Information Required From Other Investigators:
Data on petroleum hydrocarbon levels in marine invertrebrates and the degree of oiling at selected sites may be required from the Fish/Shellfish Study Number 13, the Coastal Habitat Study, the Air/Water Studies, and the Technical Services Study Number 3.

V. DATA ANALYSIS:

A. Tests:
Objectives A and B: Multivariate analysis of variance (MANOVA), coupled with appropriate linear contrasts (Johnson and Wichern, 1988), will be used to test for differences in toxicity levels of marine invertebrates found in the gut of sea ducks or in sea duck tissues between Prince William Sound and a control area and between Kodiak and a control area. This statistic assumes that the data represent independent random samples from each population (Prince William Sound, Kodiak, and control) and each population has a multivariate normal distribution with a common covariance matrix. Q-Q plots (Hoaglin, Mosteller, and Tukey, 1985) will be used to assess the multivariate normal assumptions while Bartlett's statistic (Johnson and Wichern, 1988) will be used to assess the equal covariance assumption. If necessary, data transformations will be employed to meet these assumptions.

Objective C: Physiological effects will be classified as none, slight, or severe. Loglinear models (Agresti, 1984) will be used to model the distribution of physiological classification by area by species. A conditional likelihood ratio statistic for nested models will be used to test the hypothesis that physiological classification is independent of area. If area and physiological classifications are dependent, a Bonferroni (Snedecor and Cockran, 1980) Z-statistic (Agresti, 1984) will be used to determine differences among areas while controlling for physiological effect.

B. Analytical Methods

Tissues will be collected for either chemical analysis (presence, absence, or degree of petroleum residue) or histopathology. Both analyses will be completed by OSIAR approved specialists under contract in avian histopathology and petroleum hydrocarbon analysis. Results will be compared to unexposed specimens from an unoiled area. Choice of materials and tissues, handling, and discussion of results will follow published guidelines for interpreting residues of petroleum hydrocarbons in wildlife tissues (Hall and Coon, 1988).

C. Products:
The products of this study will be a narrative report with maps, figures, and tables.

VI. Schedules and Planning:

A. Data Submission Schedule:

Fieldwork	Sept. 15, 1989 to April 30, 1990
Analyze Data	Sept. 1, 1990 to Dec. 1, 1990
Complete Interim Report	December 21, 1989
Complete Final Report	December 23, 1990

B. Special Reports:

None

C. Visual Data:

None

D. Sample and Data Archival:

Samples and data will be archived at the Department of Fish and Game.

E. Management Plan:

This study will be conducted and managed by the Principal Investigator who will work under the general guidance of a Division of Wildlife Conservation Oil Spill Damage Assessment Management Coordinator. The Management Coordinator will provide general supervision during planning, implementation, and reporting phases of the study. The Principal Investigator will collect the field and laboratory data, prepare and handle specimens, interpret results, and write the draft and final reports. General guidance may also be provided by the DWC Waterfowl Coordinator. The Principal Investigator may be assisted in field and laboratory work by one or more DWC biologists or technicians.

F. Logistics:

The Prince William Sound aspects of this study will be conducted from Whittier, with the Department of Fish and Game facilities at Main Bay Hatchery, located in the oil spill area of western Prince William Sound, providing a base of support. Collecting will be from a center console fiberglass boat. Approximately five collecting trips are planned per season. While this deep-V boat is designed for open ocean operations, at times during the winter weather may preclude its use. The RV Montague is recommended as a base of operations conducted in cooperation with Terrestrial Mammal Study Number 3. Plans for this combined operation are already underway.

The fiberglass boat may be trailered from Whittier to Seward and transported to Kodiak on the State Ferry System. The Department of Fish and Game facilities at Kodiak would then provide a center of support. A "clean" site for collecting unexposed control specimens in northern southeast Alaska is recommended in proximity to a Department of Fish and Game facility.

VII. Budget:

A. Costs:

Salaries	$67.0
Travel	7.0
Contracts	24.0
Supplies	7.5
Equipment	40.5
TOTAL	$146.0

B. Personnel:

1. Samuel M. Patten
2. Wildlife Technician/Field and Laboratory Assistant

C. Qualifications:

1. Principal Investigator - Samuel M. Patten

Sam Patten received his B.A. degree from Cornell University in 1968, majoring in Biology and German. He attended Heidelberg University 1968-71. In 1971 he began work as a Research Assistant at the University of Washington, conducting thesis research on Glaucous-winged Gulls in Glacier Bay National Monument under National Park Service sponsorship. He received his Master of Science degree in 1974.

He worked as a Research Associate for the University of Alaska in the summer of 1974, conducting research on avian populations on the outer coast of Glacier Bay for the National Park Service in an area potentially impacted by nickel mining. In 1975 he began research on gulls on the south coast of Alaska as a doctoral candidate at Johns Hopkins University. Field work was conducted as part of the NOAA-OCS gas and oil baseline studies prior to the development of oil resources. He received his Ph.D. in Animal Ecology and Behavior from the Department of Pathobiology, School of Hygiene and Public Health, Johns Hopkins, in 1980, with a dissertation on the evolution of gulls in Alaska.

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VIII. CITATIONS

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OIL SPILL SEADUCK STUDY

FIELD S.O.P. FOR SAMPLING

A. Collection and Field Recording

1. Select collection sites according to a field plan, if one has been developed (related to intensity of oiling or intertidal study sites).

2. Target only scoters (surf, white-wing, and black), Harlequin, and goldeneyes (unless directed to eiders or scaup), especially live birds that appear to be oiled or debilitated.

3. Observe individuals and groups for feeding activity and, as much as possible, allow birds to feed prior to collection. It is important to obtain birds with as much recently ingested food as possible.

4. Collect birds with a shotgun in the most efficient and humane manner possible; 12 gauge with heavy loads, by boat pursuit if necessary into adequate range. Try to sample some of each species at a site, keeping in mind the total desired sample for the region. Although not critical, try to balance the sex composition of the samples as opportunities arise.

5. During collections, the crew should divide responsibilities to ensure that the shooter can make clean, safe shots; the boat driver pays attention to boating hazards and crew safety; and all struck birds are observed for retrieval.

6. Field processing of birds involves:

   (a) record on a map the bird's original feeding location noted by specimen number;

   (b) tie or tape the bill closed to avoid loss of food items;

   (c) affix a wire and plastic tag to one leg and annotate with pencil or indelible marker: specimen number (PWS-HD-1), species and sex, location, collector's name, and date;

   (d) record this same information in a bound field log book, with notes on the site and birds present;

   (e) bag each bird in a plastic bag and store with other birds; and sets to use). Cleaning procedures involve washing in strong detergent, water rinse, acetone soak, a final rinse in hexane, and air dried. Acetone and hexane are highly flammable and hazardous if inhaled or in contact with skin. Clean instruments with these chemicals outdoors or with forced ventilation, and use gloves at all times.

3. At the outset on each bird, a recorder should log appropriate data on the log sheet and prepare sample labels from the leg tag and field book (see example).

4. Inspect the bird externally for signs of oil; matted feathers; wounds; lesions; exudates from eyes, nostrils, or bill; and any other unusual observations. Record notes in the log book (do not describe damage caused during collection).

5. Using external instruments only, split and peek back the skin from vent to throat to get plumage out of the way (note any subdermal irregularities).

6. With scissors, open the body cavity from just forward of the vent, up one side through the ribs and shoulder, and up the throat to the base of the bill. Take special care not to touch the liver, if possible. Lay open the carcass to allow work room. Do the following steps in order:

7. Using clean internal instruments, remove the gall bladder intact with forceps or hemostats, hold it above an unsealed amber vial and puncture the bladder to collect bile. Seal and label the vial, for CHEMICAL ANALYSIS.

8. Using clean internal instruments, resect half the liver and place in an unsealed jar. Seal and label the jar, for CHEMICAL ANALYSIS.

9. Using clean internal instruments, loosen the esophagus near the throat, ensuring that food items are all in the esophagus, clamp with a hemostat and cut free above the clamp. Likewise clamp off the proventriculus at the gizzard and cut free. Over a clean jar, open the clamp on the esophageal end and strip the food contents into a clean jar. [At this point notes may be taken on kinds and number of food items present; do not touch or probe contents.] Seal and label the jar, for CHEMICAL ANALYSIS.

10. Instruments may be re-used for the next operations to obtain histopathology samples (chemical cleaning not essential). The following tissues should be carefully resected and placed together in a jar or two, maintaining a 9:1 or better ratio of formalin:tissue volume:

Serial #

Project ______________________

Page ______ of ______

NOTE: Use ballpoint pen, waterproof ink (eg Rapidograph) or fine-tip waterproof marker

Date Collected	Sample # (collector's)	Assigned # (leave blank)	Type [illegible]	Location Collected	Latitude	Longitude	Remarks

Continue on back of page →

Chain of Custody

Samples collected by ______________ (print name) of ______________ (agency) ______________ (signature) ______ (date)

Relinquished by ______________ (signature) ______ (date) at ______________ (place) ______________ (comments)

Recieved by ______________ (print name) of ______________ (agency) at ______________ (place) ______________ (signature) ______ (date)

Relinquished by ______________ (signature) ______ (date) at ______________ (place) ______________ (comments)

Recieved by ______________ (print name) of ______________ (agency) at ______________ (place) ______________ (signature) ______ (date)

Relinquished by ______________ (signature) ______ (date) at ______________ (place) ______________ (comments)

Recieved by ______________ (print name) of ______________ (agency) at ______________ (place) ______________ (signature) ______ (date)

Title:	Assessment of Injury to Shorebirds Staging and Nesting in Rocky Intertidal Habitats of Prince William Sound
Study ID Number:	Bird Study Number 12
Co-Principal Investigators:	Phillip Martin and Brian Sharp
Lead Agency:	U.S. Fish and Wildlife Service
Cost of Proposal:	$166,000
Date of Plan:	March 1989 through February 1990

Co-Principal Investigators: Phillip D. Martin Date: 10/23/89

_____________________ Date: ________

Marine & Shorebird Oil Spill Damage Assessment Coordinator: Kenton D. Wohl Date: 10-20-89

Migratory Bird Oil Spill Damage Assessment Study Coordinator: Robert R. Leedy Date: 10/20/89

Biometrician: David C Bowden Date: 10/20/89

Address: U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Telephone: (907) 786-3444

II. INTRODUCTION

Coastal habitats of Prince William Sound are used regularly by at least 23 species of shorebirds throughout the year. The most intensive use occurs in spring, when an estimated 11 million shorebirds stage in the region (Isleib 1979). Exposure of shorebirds to contaminated areas can be expected to cause injury in several different ways. Direct contact with the oil on plumage may result in direct mortality or impaired physiological condition of adults through loss of insulation and subsequent hypothermia (Hartung 1967). Transfer of oil from plumage to eggs during incubation may also cause embryonic mortality (King and Lefever 1979, Stickel and Dieter 1979). Shorebirds may ingest the oil by preening contaminated feathers (Hartung 1963), attempting to cleanse contaminated feet, or ingesting contaminated prey. The guild of shorebirds using rocky intertidal habitats relies heavily on invertebrates, such as Mytilus, Balanus, and Littorina (Smith 1952, Marsh 1983, Connors 1977), that are particularly susceptible to bioaccumulation of petroleum hydrocarbons (Broman and Ganning 1986, Shaw et al. 1986, Mageau et al. 1987). Effects from ingestion of oil by birds can range from direct mortality to subtle, often natural stressors (Holmes et al. 1978b), impaired reproduction (Grau et al. 1977, Holmes et al. 1978a, Ainley et al. 1981, Cavanagh et al. 1983), or reduced survival of young (Gorsline and Holmes 1982, Trivelpiece et al. 1984). Displacement from preferred foraging areas or destruction of preferred food resources in Prince William Sound may adversely affect viability or reproduction, or both.

Up to a half-million shorebirds stage in rocky intertidal habitats of Prince William Sound in areas heavily affected by oil. The potential injury to these populations is a function of the proportion of the population directly and indirectly exposed to oil, the duration of exposure, and the severity of physiological responses affecting individual survival and reproduction. Rocky intertidal habitat, which is abundant throughout the area, is particularly important to a few species whose entire world populations breed in the vicinity of the Bering Sea. Those species, which include the black turnstone and surfbird (Gabrielson and Lincoln 1959, Handel 1982), are of concern chiefly because a very large proportion of their world population may be exposed to contaminated areas, although the duration of exposure is likely to be a brief period during migration. Other species, such as black oystercatchers and semipalmated plovers, commonly breed throughout the Sound (Isleib and Kessel 1973). The likelihood of injury is high for these species that usually breed and forage throughout the summer in areas now impacted by oil.

III. OBJECTIVES

A. To estimate the amount of time individual spring migrant shorebirds are exposed to contaminated beaches, estimate the total number of shorebirds of each species that are exposed to contaminated beaches, and test the hypothesis that shorebirds make equal use of oiled versus non-oiled beaches.

B. To estimate the proportion of spring migrant shorebirds that become directly contaminated with oil on plumage, feet, or bills.

C. To test the hypothesis that shorebird feeding behavior differs in oiled versus non-oiled areas.

D. To test the hypothesis that breeding shorebirds in oiled areas do not differ from those in unoiled areas with respect to the following parameters: population density, nest success, chick survival, and behavior.

E. To test the hypothesis that 1989 nest success of black turnstones (a species that stages in the affected area but breeds in Bering Sea coastal habitats) is similar to that of previous years.

F. To test the hypothesis of no difference in exposure to petroleum hydrocarbons for surfbirds and black turnstones in oiled and unoiled sites by collecting adult birds for tissue samples and to identify pathways for contamination via the food chain.

G. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitats where injury is identified.

IV. METHODS

A. Sampling Methods

Objective A:

Residence time of shorebirds in Prince William Sound will be estimated using mark-recapture models. Black turnstones and surfbirds will be captured and marked with dye and colored leg-bands (Hicklin 1987). Color bands will be placed in a manner specific to the date of capture. Hand-held net guns and pull-traps (Hicklin et al. 1989) will be deployed. Birds will be weighed using spring balances, and standard measurements (culmen, wing chord) will be obtained. Trapping will be attempted when large concentrations of migrants arrive and periodically thereafter as marked birds depart. Censuses will be conducted on a daily basis to obtain resightings and an estimate of exposure time.

Numbers of shorebirds using contaminated areas will be estimated by aerial surveys, boat surveys, and ground surveys. Aerial surveys will be flown to delineate concentrations of shorebirds in relation to the degree of oil contamination of the shoreline. A complete survey of the coastline of Prince William Sound will be conducted during peak spring migration in early May as part of Bird Study No. 2, "Surveys to determine the distribution and abundance of migratory birds in Prince William Sound and the Northern Gulf of Alaska." Additional surveys of portions of Prince William Sound with high concentrations of shorebirds will be conducted on an opportunistic basis in late April and mid-May, and at lower frequencies throughout the rest of the annual cycle. A float-equipped aircraft will be flown at approximately 100' above ground level at a speed of approximately 100 knots. The aircraft will follow a course approximately 50 m from the shoreline when possible. Observers on both sides of the aircraft will map locations of shorebirds on a map of the area and record numbers of birds and time of observation on a tape recorder.

Boat surveys will be conducted along selected sections of shoreline in areas that have been used for staging by large numbers of shorebirds in past years (e.g. Green Island, north end of Montague Island). The boat will be operated at slow speed as close to the shoreline as safety allows. These surveys will be conducted at 3-4 day intervals to document timing of migration and distribution of birds in relation to the degree of shoreline impact.

Ground surveys will be established along beaches with various levels of oiling in the vicinity of Green Island and northern Montague Island. Coastlines will be divided into segments of homogenous habitat type (exposed wave-cut platforms, boulder/cobble beaches, gravel/sand beaches). For a selected sample of these beaches,shorebird censuses will be replicated at various tidal stages throughout the spring migration period. During each census, flocks will be scanned once with binoculars or telescope to record the following information: species, number of birds, location, and behavior. Data from ground and boat surveys will be recorded on standard data forms.

Objective B:

External contamination from oil will be determined by visual observation of oil on feathers. Flocks sighted on ground surveys (see above) will be scanned and the number of oiled and non-oiled birds will be recorded.

Objective C:

Foraging sequences will be recorded for a small sample of black turnstones and surfbirds (Connors 1977, Marsh 1983). Actively foraging birds will be watched for two minutes and the frequency of feeding, walking and agonistic interactions will be recorded. If oiled birds are located, sequences will be obtained for birds using beaches similar in habitat type and tidal stage, but differing with respect to oiling.

Objective D:

Breeding biology of black oystercatchers will be studied on Green Island, in areas of moderate to heavy oiling, and the Port Chalmers area of Montague Island, an area of light to negligible oiling. Population density will be determined by census (by boat and on foot) and oystercatcher locations mapped in relation to degree of oiling.

As many nests as possible (target of 15-20 nests at each location) will be located, mapped, and marked. A sample of at least 20 eggs will be measured in oiled and unoiled areas. Nests will be checked approximately every third day to determine date of hatch and hatching success.

Any unhatched eggs will be collected for analysis of their petroleum hydrocarbon content. Eggs will be handled only with stainless steel tools rinsed in acetone and hexane. They will be wrapped in Reynolds aluminum foil (dull side in) and placed in a padded, chemically cleaned jar with teflon lid.

Broods will be relocated periodically after hatch to monitor chick survival.

Behavioral observations will be recorded in 5-minute bouts on an opportunistic basis. Behavior will be categorized as follows: standing, preening, flying, feeding, incubating, and socializing. Time spent engaged in these behaviors will be recorded.

Objective E:

Black turnstone nests on the Yukon Delta will be located and monitored during the hatching period. Clutch size and hatching success will be recorded for each nest. Any unhatched eggs will be collected for petroleum hydrocarbon analysis (see objective D).

Objective F:

Specimens of surfbirds and black turnstones will be collected from both oiled and control areas, frozen whole in chemically cleaned jars, and analyzed for the presence of petroleum hydrocarbons. Target sample size will be ten specimens of each species from each site. Collection procedures will follow those outlined in the State/Federal Damage Assessment Plan Analytical Chemistry Quality Assurance/Quality Control document. Chain-of-custody procedures will be followed and a record of the circumstances of collection will be kept in a separate notebook, written in indelible ink, and signed by the Principal Investigator.

In addition, 10 - 30 specimens of black turnstones and surfbirds will be collected in both oiled and control areas for gut contents. Digestive tracts will be preserved in 10% buffered formalin and contents identified to confirm prey species composition. Specimens of important prey items will be collected and analyzed for the presence of petroleum hydrocarbons to document whether ingestion is a pathway of contamination for shorebirds.

Birds collected for food habits analysis will also be used for tissue samples. Samples of liver will be flash-frozen in liquid nitrogen and stored for analysis of hepatic enzyme levels. Blood serum will be obtained and analyzed for perturbation of normal hormone levels.

B. Citations

See section VIII

C. Standard Operating Procedures Requirements

Standard Operating Procedures have been developed for conducting ground censuses, boat and aerial surveys, capturing and marking shorebirds and determining reproductive success. See Section IV, Methods, and Section VIII, Citations.

D. Equipment Protocol

None

E. Quality Assurance and Control Plans

The Co-Principal Investigators will train all participants on-site. Data will be recorded on standard data forms. Written instructions detailing procedures for collecting, processing, and labelling samples will be provided to all personnel. Chain-of-custody procedures as outlined in State/Federal Damage Assesment Plan Analytical Chemistry QA/QC will be followed.

F. Histopathology

Blood serum samples will be obtained in a manner described by the Histopathology Technical Group for Oil Spill Assessment Studies in Prince William Sound, Alaska, Appendix 5. Chain-of-custody and documentation will be similar to that employed for specimens collected for analysis of petroleum hydrocarbons.

G. Information Required from Other Investigators

Information on the extent and persistence of oil in intertidal areas and on the abundance and contamination of potential prey species may be obtained from the Coastal Habitat Study Number 1: Comprehensive Assessment of Injury to Coastal Habitats and from Technical Services Study Number 3. Additional information on contamination of prey may be obtained from Fish/Shellfish Study Number 11: Injury to Prince William Sound Herring.

Information on the distribution and abundance of migrant shorebirds in south coastal Alaska will be solicited from all available sources.

V. DATA ANALYSIS

A. Tests

Objective A:

Logistical considerations preclude choosing a simple random sample of Prince William Sound shoreline segments for ground and boat surveys. Baseline data adequate to provide a sound basis for stratifying the sample (with the potential for a more efficient design) are lacking. Sampling units within oiled and unoiled beach types will be chosen on the basis of practicality. This will limit the utility of the censuses for extrapolating results to a larger geographic area. Differences detected could be attributable to factors other than oiling. Aerial surveys of a larger area should provide an alternative method for delineating areas of high bird use and will be treated as censuses of the areas covered.

Because bird survey data are frequently not normally distributed, non-parametric tests (Conover 1971) will be used to compare use of oiled vs. non-oiled areas, based on the results of the ground surveys. Repeated ground surveys of the same sampling units will be conducted, thus observations will be blocked by date (e.g. Friedman's test). Chi-square tests may also be used to compare use and availability of oiled vs. unoiled beaches; test will be based on flocks of birds, rather than individiuals, in order to meet the assumptions of independence.

Objective B and C:

Not Applicable

Objective D:

Nest density will be determined by a complete census of the control and experimental sites and will be expressed as nests per linear kilometer of shoreline. The comparison of densities will be descriptive if only one control and experimental area are censused; otherwise students t-test or Mann-Whitney test will be used. Reproductive performance of individual pairs of oystercatchers will be assumed to be independent. The hypothesis of equal clutch sizes will be tested with a t-test and/or chi-square contingency table. The hypothesis of equal egg size will be tested with a t-test. Chick survival will be calculated using the "Mayfield method" (Mayfield 1981, Mayfield 1975) and a confidence interval surrounding the estimate of daily survival rate will be constructed. Feeding rates in oiled and unoiled area will be compared using a t-test, under the assumption that each feeding bout is an independent sample.

Objective E through G:

Not Applicable

B. ANALYTICAL METHODS

Objective A:

See "tests" above. A minimum average residence time may be derived using a survival analysis allowing for new animals to be added after the study has begun (Pollock et al. 1989). The model requires that animals are sampled randomly, residence times are independent, and that the marking procedure does not influence residence time. Mortality will be assumed to be negligible during the study period, unless recently dead or moribund birds are observed.

Objective B:

Not applicable

Objective C:

Foraging sequences will be stratified by prey type and tidal stage to reduce the effect of confounding variables. Peck rates of birds feeding in oiled versus non-oiled areas will be compared using students t-test or Mann-Whitney tests.

Objective D:

Hatching success of nests in the experimental (oiled) versus control (non-oiled) areas will be compared using a contingency chi-square test.

Objective E:

An outlier test will be used to compare clutch sizes and hatching success from four previous years with these parameters in 1989.

Objective F:

Test as in "C". A log transform may be used to normalize contaminants data.

Objective G:

Not applicable.

C. PRODUCTS

The products listed below will be produced by this study.

1. Maps of survey areas.
2. Tables of number of birds seen on surveys, by date and location.
3. Maps of oystercatcher nest sites.
4. Tables describing nest success, breeding chronology, egg measurements, and time-budgets of oystercatchers in oiled and non-oiled areas.
5. Tables listing specimens collected and results of lab analyses.
6. Narrative report synthesizing results, and including additional maps, tables, and figures as needed.

VI. SCHEDULES & PLANNING

A. Data Submission Schedule

Begin Migration Study -- April 1989
Complete Migration Study -- May 1989
Begin Breeding Performance Study -- June 1989
Complete Field Study -- August 1989
Complete Draft Report -- December 21, 1989

B. Special Reports

None

C. Visual Data

None

D. Sample and Data Archival

All specimens collected for analysis of petroleum hydrocarbons will be deposited in the custody of Everett Robinson-Wilson, U.S. Fish and Wildlife Service (Service), Environmental Contaminants Coordinator, Anchorage. Copies of field data sheets and notebooks will be archived at the Service's Marine and Coastal Bird Project and in the oil spill file system, both in Anchorage.

E. Management Plan

This study will be managed by Co-Principal Investigators Philip Martin and Brian Sharp under the general guidance of the U.S. Fish and Wildlife Service's Marine Bird and Shorebird and Migratory Bird Oil Spill Damage Assessment Coordinator. The co-principal investigators will be responsible for collecting field data and for timely reporting of the data in draft and final reports.

F. Logistics

To complete the proposed study will require use of the USFWS 65-foot vessel MV Curlew for the duration of spring migration (25 April-20 May) and support for two field camps (Green Island and Port Chalmers) during the breeding season (15 May-30 June). Two skiffs (hard-bottomed or inflatable) suitable for inshore censuses will be needed for both phases of the study.

VII. BUDGET

A. Costs (To March 1, 1990)

Salaries

Co-PI-Martin .50FTE	$20,000	
Co-PI-Sharp .50	25,000	
Vacant Temporaries	45,000	
Subtotal		$ 90,000
Travel		10,000
Contract		-0-
Supplies		20,000
Equipment		46,000
TOTAL		$166,000

B. Personnel

See VII. C.

C. Qualifications

1. Co-Principal Investigator-Phillip Martin

Philip Martin received his Master's degree from the University of Alaska, Fairbanks, in 1983. His thesis research concerned habitat use by shorebirds in arctic tundra habitats, data for which was collected over two seasons. From 1978 to 1984, he worked on shorebirds and waterfowl in tundra habitats on the Alaska North Slope. In 1983, 1985, and 1986, he participated in seabird monitoring studies on St. Matthew Island in the Bering Sea, and the latter two years as Co-Principal Investigator.

Since 1988 he has been employed by the Arctic National Wildlife Refuge, working on a study of bird use of shoreline and nearshore habitats along the Beaufort Sea coast. He is currently Principal Investigator for that project, which includes shoreline surveys and trophic studies in nearshore waters.

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IX. OTHER INFORMATION

None

(Bird Studies 13 & 14 are not available)

CONFIDENTIAL **DRAFT**

TITLE:	Hydrocarbon Analytical Support Services and Analysis of Distribution and Weathering of Spilled Oil
STUDY ID:	Technical Service Number 1
PROJECT LEADER:	Carol-Ann Manen, Everett Robinson-Wilson
LEAD AGENCIES:	National Oceanic and Atmospheric Administration U.S. Fish and Wildlife Service
COST OF PROPOSAL:	NOAA $1,292,351 FWS $824,000 TOTAL $2,113,351
DATE OF PLAN;	March 1, 1989 to February 28, 1990

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Kathleen Anderson

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INTRODUCTION

A great number of samples of biota, sediments and water will be collected during the course of the Damage Assessment for hydrocarbon analysis. The resultant data, even though it may be produced by a number of laboratories over a period of years, needs to be accurate, precise and of demonstrated comparability for the maximum use of the data and the successful pursuit of the Damage Assessment. Rather than have each project be responsible for the analysis of their individual data, this project is planned to be responsible for all aspects chemical analytical data generation, archival and retreival.

OBJECTIVES

A. Measure petroleum hydrocarbons, hydrocarbon metabolites and other appropriate chemical/biochemical measures of hydrocarbon exposure in water, sediment and biota collected through the EXXON VALDEZ Damage Assessment.

B. Prepare a quality assurance/quality control (QA/QC) plan that established detailed procedures and protocols for sample collection, sample identification, chain of custody and shipping.

C. Establish a coordinated group, the Analytical Chemistry Group, to oversee and develop a centralized QA/QC program to assist the analytical laboratories in providing quality data and demonstrate the accuracy, precision and comparability of all data developed by the program.

D. Provide technical on-site system audits of field and laboratory data collection activities by Analytical Chemistry Group members.

E. Develop and provide appropriate instrument calibration standards and natural matrix control materials.

F. Develop an integrated synthesis of the distribution and chemical composition of spilled oil, as it weaters through time, to provide a detailed basis for final exposure assessment.

G. Identify potential alternative methods and stratehgies for restoration of lost use, populations, or habitat where injury is identified.

METHODS, DATA ANALYSIS AND SCHEDULES & PLANNING

This information for Objectives A-F is provided in "Analytical Chemistry: Operations Plan", "Analytical Chemistry: QA/QC Plan" and "Analytical Chemistry: Collection and Handling of Samples". Copies of these documents, which were generated by the Analytical

Chemistry Group are enclosed. Objective G will be met by providing the specified oversight, measurements, services and materials to those projects involved in restoration.

BUDGET

This budget projection is dependent upon the number of samples collected and the percentage of these actually analyzed.

October 13, 1989

STATE/FEDERAL DAMAGE ASSESSMENT PLAN
ANALYTICAL CHEMISTRY
OPERATIONS PLAN

1. INTRODUCTION

The Analytical Chemistry Group (ACG) serves as an ad hoc advisory and technical control group on quality assurance (QA), quality control (QC), sample collection, analyses, and documentation procedures to the Trustee Management Team. It also serves as a control point for all laboratory aspects of hydrocarbon analysis associated with the EXXON VALDEZ Natural Resource Damage Assessment. The ACG performs a wide range of review and advisory functions including:

Establish quality assurance/quality control procedures for collection, preservation, labeling, archiving, and chemical analyses of tissues, sediments and water; chain of custody and inventory control. Oversee and coordinate these procedures.

Develop a hydrocarbon analyses budget and plan; review all studies that include hydrocarbon sampling and identify duplication.

Advise on priority technical issues.

Identify key problem areas and recommend corrective remedies.

Core members of the ACG are Carol-Ann Manen, National Oceanic and Atmospheric Administration (NOAA), Everett Robinson-Wilson, U. S. Fish and Wildlife Service (F&WS), Rolly Grabbe, Alaska Department of Environmental Conservation (ADEC) and Bruce Woods, Enviromental Protection Agency (EPA). Additional members are drawn as needed from the participating Agencies.

The Chairperson is Carol-Ann Manen, NOAA.

All work, recommendations and guidelines developed by the ACG are by consensus.

2. TRAINING

To assist field personnel in providing scientifically sound and legally defensible data, the ACG has developed a training manual ("Collection and Handling of Samples") and holds training sessions for sample collection and preservation, and chain of custody and shipping procedures.

Participation in at least one training session is mandatory for all field personnel.

The Chair of the ACG is responsible for scheduling, setting up and staffing the training sessions. A minimum of two sessions will be held at the initiation of each field season; the final number and location of the training sessions will be determined in consultation with the Management Team.

3. SAMPLE INVENTORY AND CONTROL PROCEDURES

Each Project Leader/PI is responsible for the appropriateness of sample collection and preservation techniques and the adequacy of the associated documentation as described in "State/Federal Natural Resource Damage Assessment Plan: Collection and Handling of Samples".

All samples or sample data that are received by the Trustee Agencies are part of the Damage Assessment and therefore the property of the Trustees. All Damage Assessment samples will be included in the sample inventory and archived in an appropriate manner, under chain-of-custody procedures, until the Trustees indicate otherwise. Samples that are part of the Damage Assessment can not be analyzed or discarded without authority from the Trustees.

No sample will be considered to be part of the Damage Assessment unless that sample is held by a Trustee Agency or complete identification data for that sample is included in the sample inventory.

3.1 Samples - Samples and supporting data and information should be shipped to:

Fish & Wildlife Service 1011 E. Tudor Road Anchorage, AK 99503	NOAA/NMFS/Auke Bay 11305 Glacier Hwy Auke Bay, AK 99821	ADEC/Douglas Lab 7510 St.Ann's Ave. Douglas, AK 99801
ATTN: E. Robinson-Wilson (907) 786-3493	ATTN: S. Korn (907) 789-6021	ATTN: R. Mattson (907) 364-2155

Responsibility for sample handling and analysis has been assigned as follows:

F&WS: sea otters, birds, land mammals and plants
NOAA: fish, marine mammals, invertebrates, sediments and plants
ADEC: water and sediment

Support samples, such as prey items of birds or fish, are the responsiblity of the primary Agency.

The receiving Agency will archive Damage Assessment samples in a manner that includes:

Predesignated storage facilities will be used for storing samples.

Storage facilities will be locked.

Access to the samples will be limited.

One individual and an alternate will be designated as sample custodian for that Agency. Designated custodians are: E. Robinson-Wilson (F&WS), S. Korn (NOAA) and Robert Mattson (ADEC).

Each Agency, through their custodian is responsible for all aspects of sample inventory and tracking for the samples in their custody. The custodian is responsible for keeping a record of all samples under his/her jurisdiction, the names of all persons having access to the sample, the movement and analyses performed (including dates and names) of the samples and the location, storage and custodianship of samples while they were away from the primary custodian's care.

After analyses, any remaining sample and all sample tags or labels shall be returned to the sample custodian to be held until the Trustees indicate otherwise.

<u>3.2 Sample identification data</u> - Sample identification data include but are not limited to :

Name and Agency of the collector

Name of the Project that the sample supports, e.g. Air/Water #1

Sample identification
- Sample identification number
- Sample matrix, i.e. sediment, oil, water or tissue. If tissue, than the scientific and common names of the organism and the specific tissue collected (liver, lung, gonad, etc.) are required as well.

Location of sample collection site
- General name of the area
- Specific latitude and longitude of the site in degrees, minutes and seconds

Date that the sample was collected

Present location of the sample

Additional information, such as the method of collection (hand, trawl, grab, corer,etc.) and copies of the chain of custody sheets are helpful and should be included if available.

Inventory information may be provided as hard copy; an example of a form that may be used is attached or an annotated, legible photocopy of the original chain of custody form may be submitted, or inventory information may be provided in digital form. If the data are provided in digital form it must be as a table in RBASE for DOS (vers. 2.11), RBASE for OS/2 or LOTUS or EXCEL for the PC with the column headings in row 1. This information must be submitted to Sid Korn, NOAA/NMFS, Auke Bay or Everett Robinson-Wilson, F&WS, Anchorage.

The Project Leader/PI is responsible for the completeness and accuracy of all submitted data.

4. ANALYSIS

The decision to analyze or not analyze any or all of the collected samples is that of the Trustees. This decision will be based on a recommended priority ordering from the Chemistry Group and available analytical monies. The priority ordering will be based on the importance of the samples to the overall Damage Assessment, the appropriateness of sample collection and preservation techniques and the adequacy of the documentation.

All analyses will be performed within the minimum requirements outlined in "State/Federal Natural Resource Damage Assessment Plan: Quality Assurance/Quality Control".

The data resulting from the analysis of the samples are the property of the Trustees. It is anticipated that when the damage assessment is concluded, the Trustees will release these data to the collector/study leader. Until that time, all data resulting from the Damage Assessment are confidential and are not to be released in any form.

Analytical laboratories desiring to analyze Damage Assessment samples must demonstrate their analytical competence by analyzing provided accuracy based materials. All analytes of interest to the Damage Assessment in this material must be correctly identified. The concentrations reported for each analyte must be within +/- 15% of the value of each analyte or measurement parameter. Both conditions must be met for the analysis to be considered satisfactory.

Satisfactory laboratories will develop a Quality Assurance Plan, which will be reviewed by the respective agency ACG representative. All approved QAPs will be provided to the ACG for review and archival.

A minimum of three intercomparison exercises will be conducted per year to demonstrate analytical accuracy and precision and ensure that the laboratories are maintaining analytical competence.

The ACG will provide each analytical laboratory with appropriate calibration standards and control materials. This will be accomplished through a contract with the National Institute of Standards and Technology (NIST).

Specifically, NIST will

- Assess the accuracy and precision of the proposed participating laboratories prior to the initiation of damage assessment analytical work.

- Develop and provide calibration and internal standard solutions for method(s) calibration. These may be previously developed materials such as SRM 1491 (PAH in Hexane/Toluene), SRM 2260 (Concentrated PAH in Toluene) and the NS&T internal standard solutions. Methods to be considered include GC/MS and GC/FID.

- Develop and provide appropriate control materials. Control materials are required for sediment, tissue and water and must be suitable for GC/MS and GC/FID.

- Assess the accuracy and precision of the analyses of participating laboratories from the results of intercomparison exercises. The materials used for the exercises will be either gravimetrically prepared solutions, partially prepared environmental samples or environmental samples. Three exercises will be conducted per year. The NIST will collect the results of each exercise, statistically evaluate them and submit a written report to the Chairperson of the Analytical Chemistry Group within 6 weeks of the completion of each exercise. The data from each exercise will be archived at NIST.

- Serve as a Reference Laboratory

The chairperson of the ACG will be the Contracting Officer's Technical Representative for the contract with NIST.

The ACG will review and provide written reports on the results of intercomparison studies to the Management Team.

Proposed target method limits of detection for individual petroleum hydrocarbon components are 10 ng/g wet weight for tissue, 5 ng/g wet weight for sediments and 10 ng/L for non-volatile components in water.

Any changes in analytical methodology from that proposed in the original QA plan shall be validated under agency procedures and documented to the ACG.

Each analytical laboratory will designate a sample custodian, whose duties are described above. Each analytical report submitted by that laboratory will include a page signed by the sample custodian certifying that the samples described in that report have been tracked under chain-of-custody procedures.

DATA AND DELIVERABLES

Data deliverables will be reviewed by the generating Agency to verify the quality and useability of the data. A QC report on each data set will be provided by the Agency to the ACG for review and archival.

Each analytical report will be accompanied by all original data, in both hard copy and electronic format, and data documentation. The database staff will instruct and guide the data submitter with the proper protocol and formats for the electronic data. As soon as the generating Agency has accepted the report, the data will be provided directly to the database system manager.

The original data and supporting data documentation will be archived by the generating Agency under chain-of-custody procedures until the Trustees indicate otherwise. The analytical laboratory will keep copies of the data and supporting documentation for one year after completion of analysis.

No laboratory will be paid for analytical work until all required data and data documentation have been submitted, accepted and verified.

DATABASE MANAGEMENT

The database is in support of hydrocarbon chemistry for Damage Assessment activities only and consists of 1) a sample tracking and sample/site inventory system, 2) tables to maintain the chemistry and quality control (detection limits and SRM results) data and 3) a cross-referencing system to indicate which chemistry samples have supporting histopathology evaluations.

The database is in RBASE for use with MS/DOS PCs. The main database is at NOAA/NMFS/Auke Bay; a parallel and identical system is at NOAA/NOS/Rockville and a partial system at F&WS/Anchorage.

J. Price, NOAA/NOS/Rockville, is the database system manager. He has overall responsibility for the design, implementation and management of the contaminant database. He will stay in close communication with the Chair of the Analytical Chemistry Group and the individual database managers, i.e. Sid Korn, NOAA/NMFS and E. Robinson-Wilson, F&WS.

All requests for archived data will be logged by the receiver. A copy of the request will be kept by the receiver. The original will be submitted to the chair of the ACG.

Project Leaders/Principal Investigators will have acess to the data generated by their projects. All other requests will be dealt with by the ACG with assistance from the Managment Team, on a case-by-case basis.

Once the Damage Assessment is completed and the Trustees have released the data, access to the archived data will continue to be restricted to Project Leaders/PIs for data generated by their projects only, for one year. This is to allow the Project Leaders opportunity to publish their collected data. At the end of this period, access to the archived data will be unresticted.

PROPOSED SCHEDULE

September 11
- Review NIST proposal
- Award NIST contract

September 18
- Submit "check" materials to laboratories
- Request laboratories to prepare and submit QAPS

October 2
- "Check" material results submitted to NIST and ACG
- ACG meets to review check material results and to develop priority listing of chemistry samples.

October 9
- Priority listing of samples to Management Team
- Proposed analytical budget to Management Team
- QAPs submitted to Agency representatives

October 16
- First samples shipped for analysis

November 27
- First analytical data returned

December 11
- Second intercomparison exercise material shipped

December 29
- Second intercomparison data returned

March 1
- Third intercomparison exercise matrial shipped

March 22
- Third intercomparison data returned

STATE/FEDERAL DAMAGE ASSESSMENT PLAN

ANALYTICAL CHEMISTRY

COLLECTION AND HANDLING OF SAMPLES

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1. Introduction

In response to the release of more than 10 million gallons of crude oil into Prince William Sound, the State of Alaska and four Federal Agencies, the Departments of Agriculture, Commerce and Interior and the Environmental Protection Agency are acting together to assess the damages to the natural resources. Authority for this action is provided by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Clean Water Act (CWA).

A damage assessment requires documentation of the exposure of the resources to oil released from the EXXON VALDEZ, identifying which resources were injured by that exposure, measuring the magnitude of the adverse affects on each resource over time and assigning economic values for that injury. Once this is done, monetary compensation can be sought from the potentially responsible parties to restore and/or replace the injured resources.

Recovery of monetary damages may involve civil court actions. It will then be necessary to prove that the samples were collected in a scientifically approved manner and that the samples were protected from outside contamination (non-incident related) and accidental mix-ups during handling and analyses. It is, therefore, extremely important that every sample be readily identified and their location and analytical status known and documented at all times.

This document and the associated training sessions, were prepared to assist field personnel in collecting samples that will provide scientifically sound and legally defensible data to support the State/Federal Natural Resource Damage Assessment for the EXXON VALDEZ oil spill.

2. Record Keeping and Documentation

Standard operating procedures (SOPs) for all sampling procedures, including chain of custody procedures; sampling protocols; cleaning and preparation of sample collection and storage devices; and labeling, handling, and sample preservation and holding time must be written in detailed, clear, simple and easy to follow language.

Personnel must be knowledgeable and experienced in the described sampling techniques and must adhere to the SOPs.

Any changes in procedures must be recorded in detail in the field logbook. The log entry must include reasons that the change in procedure was unavoidable.

Field logbooks are issued by the Team Leader or their representative. The logbooks should be serially numbered, sturdy, bound books with sequentially numbered pages. Waterproof logbooks should be used if available.

Field data sheets, if used, must be consecutively numbered by project. The field data sheets must be referred to in entries in logbooks which reference, the precise data sheet involved and the relationship to specific data in the logbook noted.

All information pertinent to field activities, including descriptive notes on each situation, must be recorded in indelible marker in the field logbook. The information must be accurate, objective, up-to-date and legible. It should be detailed enough to allow anyone reading the entries to reconstruct the sampling situation. Additional information may be provided by field data sheets, sample tags or photographs.

Entries should be made in the logbook or on field data sheets with indelible marker at the earliest possible time. Notes should never be written on scrap paper and then transferred to the logbook.

Entries into field logbooks or field data sheets are signed or initialed, and dated by the person making the entry at the time of entry.

Each day's entries are closed out with a horizontal line, date and initial.

Errors in field logbooks or other records are corrected by drawing a single line though the error, entering the correct information and signing and dating the correction. Never erase an entry or any part of an entry.

Do not remove pages from the logbook.

Completed logbooks and field data sheets are returned to the Team Leader or their representative to be archived in a central location under chain-of-custody procedures until the Trustees indicate that they may be released.

3. Sample Identification and Labelling

A tag or label identifying the sample must be completed and attached to each sample. Waterproof (indelible) marker must be used on the tag or label. The minimum information to be included on the tag are the sample identification number, the location of the collection site, the date of collection and signature of the collector (who, what, where & when). This information and any other pertinent data such as the common and scientific names of the organism collected, the tissue collected and any remarks are recorded in the logbook. Field sample data sheets, photographs, any pertinent in-situ measurements (such as temperature, salinity, depth) and field observations are recorded in the logbook.

The location of the sampling site is determined with the aid of USGS grid maps, NOAA charts or navigational systems such as LORAN C. The site locations should be plotted on a chart of appropriate scale and photocopies incorporated into the logbook. In addition, a clear, detailed descriptive location as well as the latitude and longitude, in degrees, minutes and seconds, of the collection site must be recorded in the logbook.

4. Sampling Equipment and Sample Containers

All sample containers must be either organic-free (solvent-rinsed) glass or organic-free (solvent-rinsed) aluminum foil. Lids for the glass containers must be lined with either teflon or solvent-rinsed aluminum foil.

Certified-clean glass jars are available from various vendors and if obtainable, may be used without cleaning.

Sample collection and storage devices are cleaned by washing with soap and hot water, rinsed extensively with clean water and then rinsed with either methylene chloride or acetone followed by pentane or hexane and allowed to dry before use.

First rinse: tap water, then re-rinse in distilled water.

Second rinse: methylene chloride or acetone

Third rinse (if acetone is used): pentane or hexane

The solvents (methylene chloride, acetone, pentane and hexane) used for cleaning sample collection and storage devices must be of appropriate quality for trace organic residue analysis and be stored in glass or Teflon containers, not plastic.

New glass jars or unused aluminum foil do no need to be washed with soap and water. They must however, be solvent-rinsed as described above before use.

Glass jars may be cleaned by heating to 440°C for a minimum of 1 hour.

Clean glassware should be stored inverted or tightly capped with either solvent-rinsed aluminum foil or teflon-lined caps.

The dull side of the aluminum foil should be the side that is solvent-rinsed. Pre-cleaned squares may be stored with the clean sides folded together.

All equipment that comes in contact with the sample such as dredges or dissecting equipment must be solvent-rinsed before contacting each sample. Equipment should be steam-cleaned or washed with soap and hot water at the end of each day or between sampling locations.

5. Sampling Procedures

The method of collection must not contaminate the samples. Do not collect any subsurface samples through surface slicks. Do not collect any samples with oil-fouled equipment, such as nets or dredges. Do not touch or collect any sample with your bare hands.

Sample container volume must be appropriate to sample size; fill the jar to just below the shoulder. Overfilled jars will break when they freeze; underfilled jars will allow the sample to dry out.

At least one field blank and replicate sample should be taken for each collection site, batch of samples or 20 samples taken. (A field blank is a sample container opened in the field, closed and stored as if it contained a sample. A replicate sample is a second sample from the same site.) Rinsate blanks should be taken if appropriate.

5.1 Water - The method must be described or adequately referenced in sampling SOPs. Recommended sample size is 1-4 liters depending on the analytical methodology.

Water samples for volatiles analyses should be taken in 40 ml amber vials with no head space or bubbles.

5.2 Sediment - Any accepted methods of collecting undisturbed surface sediment samples such as box cores, hand corers, or grabs may be used. The method must be described or adequately referenced in sampling SOPs. Recommended sample size is 10-100 grams (a 4 oz. jar).

5.3 Tissue - Organisms to be analyzed for petroleum hydrocarbons should be freshly killed or recently dead. Decomposed organisms are rarely of any value for analysis.

Whole organisms may be stored in solvent-rinsed glass jars or wrapped in solvent-rinsed aluminum foil.

Tissue sections may be taken either on site from freshly killed organisms or in the laboratory from carefully collected and preserved - cold or frozen - whole organisms. Tissue should include flesh and internal organs, especially liver. Recommended sample size is 10-15 grams.

Tissue samples need to be protected from external contamination at time of collection. Contents of the intestinal tract, external slime coating, contaminated collecting utensils, etc. are all potential sources of contamination when collecting internal tissue samples.

All instruments used in handling samples must be made of a non-contaminating material (e.g. stainless steel, glass, teflon, aluminum) and solvent-rinsed between each sample collection.

Instruments used for exterior dissection must not be used for internal dissection.

Avoid hand contact with tissue sample.

Collect stomach and intestinal tract last.

Bird eggs are wrapped in solvent-rinsed aluminum foil and transported by any convenient means that will prevent breakage. They should be opened or refrigerated as soon as possible. Eggs are opened by cutting them with a solvent-rinsed scalpel or by piercing the air cell end and pouring/pulling the contents out. Avoid including pieces of egg shell with the contents or touching the contents with your hands. Total weight, volume (measured or calculated), length, width and contents weight must be recorded for each egg. Bile is collected by removing the gall bladder, puncturing it with a scalpel fitted with a new #11 blade, and collecting the contents in a 4 mL amber glass vial.

6. Sample Preservation and Holding Time

Samples must be kept cool, i.e. on ice.

Samples that are to be frozen, sediment and tissue, should be frozen quickly and rapidly. That is, these samples should be frozen as soon after collection as possible and the freezing process should be rapid.

Frozen samples must be kept frozen, at -20°C or less, until extracted or prepared for analysis. Repeated freezing and thawing of samples can destroy the integrity of the samples resulting in questionable data or the loss of data.

6.1 Water - All water samples must be immediately extracted with methylene chloride or preserved with HCl to pH<2. If preserved, water samples are stored in the dark at 4°C and extracted within 7 days. All extracts must be stored in the dark in air tight chemically clean containers until analysis.

6.2 Sediment and Tissue - Samples should not be extracted until immediately before analysis; if there is a lag between sample extraction and sample analysis, extracts must be stored in air tight containers kept in the dark at 4°C.

7. Sample Shipping

All samples, except water samples, must be kept frozen throughout the shipping process.

Samples must be packaged to prevent breakage. Glass jars should be individually wrapped so that they will not contact each other if padding shifts in transit (which styrofoam chips do). Bubble wrap or the divided boxes that new jars are shipped in work well. Pack samples in insulated containers (e.g. ice chests) with enough frozen mass to remain frozen in transit.

It is the responsibility of the sample shipper to arrange for sample receipt. Do not send samples off without arranging for pickup and storage.

To insure that samples are not compromised, shipment should not be initiated later in the week than Wednesday nor should samples be shipped in any week in which there is a holiday.

Shipments must comply with Department of Transportation regulations.

8. Chain-of-Custody Procedure

Samples must be kept in such a manner that they cannot be altered either deliberately or accidentally. Any indication that a sample has been subjected to tampering or physical alteration could disqualify it as evidence for possible legal action.

The field sampler is personally responsible for the care and custody of the samples collected until they are transferred under chain-of-custody procedures.

A sample is considered in "custody" if:

- it is in your actual physical possession or view;
- it is retained in a secured place (under lock) with restricted access
- or it is placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s)

Evidence tape or sample seals are used to detect unauthorized tampering of samples following sample collection. The seal must be attached in such a way that it is necessary to break it in order to open the container. Seals must be affixed to the container before the samples leave the custody of sampling personnel.

All samples must be accompanied by a chain-of-custody record or field sample data record (Figure 1). When samples are transferred from one individual's custody to another's, the individuals relinquishing and receiving the samples will sign and date the chain of custody record. This record documents the transfer of custody of samples from the sampler to another person or to a specified analytical laboratory.

Shipping containers must be custody-sealed for shipment. The seal must be signed before the container is shipped. The chain-of-custody record must be dated and signed to indicate any transfer of the samples. The original chain-of-custody record accompanies the shipment; a copy is retained by the sample shipper. If samples are sent by common carrier, copies of all bills of lading or air bills must be retained as part of the permanent documentation.

Whenever samples are split, a separate chain-of-custody record is prepared for those samples and marked to indicate with whom the samples are being split.

STATE/FEDERAL DAMAGE ASSESSMENT PLAN

ANALYTICAL CHEMISTRY

QUALITY ASSURANCE/QUALITY CONTROL

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This document describes the Quality Assurance for the analytical chemistry portions of the Exxon Valdez Damage Assessment Process. It is to be used in conjunction with the Analytical Chemistry Quality Assurance Programs of the Trustee Agencies. It describes only those minimum requirements necessary to validate the data generated by analytical chemistry laboratories. Quality assurance requirements for other types of measurements are not addressed.

For instructions in meeting the requirements described in this document, please consult "Collection and Handling of Samples", which was prepared by the Analytical Chemistry Group for use in training field personnel or the following Agency representatives:

Carol- Ann Manen, National Oceanic and Atmospheric Administration, 907 789-6014.

Everett Robinson-Wilson, U.S. Fish and Wildlife Service 907 786-3493.

Rolly Grabbe, Alaska Department of Environmental Conservation, 907 364-2155.

John Moore, U.S. Fish and Wildlife Service, 301 497-0524.

This Analytical Chemistry QA Plan was developed by and has the concurrence of:

Chris Brodersen, National Oceanic and Atmospheric Administration

Carol-Ann Manen, National Oceanic and Atmospheric Administration

William D. MacLeod, National Oceanic and Atmospheric Administration

Stanley D. Rice, National Oceanic and Atmospheric Administration

Susan Haseltine, U.S. Fish and Wildlife Service

John Moore, U.S. Fish and Wildlife Service

Everett Robinson-Wilson, U.S. Fish and Wildlife Service

Gregory Smith, U.S. Fish and Wildlife Service

Rolly Grabbe, Alaska Department of Environmental Conservation

Ursula Spannagal, Alaska Department of Environmental Conservation

Barry Towns, Environmental Protection Agency

Bruce Woods, Environmental Protection Agency

1. Quality Assurance for Analytical Chemistry

Each Trustee agency through their individual standard documented QA programs and guidances shall ensure that all data generated by or for that agency and their contractors, in support of the Exxon Valdez Damage Assessment, are of known, defensible, and verifiable quality.

These documented QA programs and guidances include but are not limited to:

- NOAA National Status and Trends Program, Mussel Watch Phase 4 Work/QA Project Plan
- Quality Assurance of Chemical Analyses Performed Under Contract With the USFWS
- EPA SW-846, Chpt. 1, QA/QC Requirements
- EPA Guidelines and Specification for Preparing Quality Assurance Project Plans, QAMS-005
- EPA Handbook for Sampling and Sample Preservation of Water and Wastewater

In addition, an interagency team of leading scientists from the Trustee agencies and the Environmental Protection Agency, hereafter referred to as the Analytical Chemistry Group (ACG), shall develop and oversee a centralized program which will demonstrate the quality and comparability of the chemical data obtained by the Trustee agencies.

The major components of this centralized QA program will be:

1. Development of study-specific analytical chemistry QA plans.

2. Technical on-site system audits of field and laboratory data collection activities.

3. Development and provision of appropriate instrument calibration standards and control materials.

4. Laboratory performance evaluations by means of intercomparison exercises.

5. Review of data deliverables and all supportive documentation to evaluate data quality.

1.1 Study-Specific Quality Assurance Plans

Prior to the initiation of each study, the study manager must prepare and submit a study-specific analytical chemistry QAP to the ACG for review and concurrence. This plan shall specify each study's goals, sampling procedures, analytical procedures, and all quality control measures and acceptance criteria associated with those procedures.

The QAP must be study-specific, however any documented QA guidance and/or appropriate Standard Operating Procedures (SOPs) used by the Trustee agencies may form the basis of individual study QA plans.

A Quality Assurance Plan must address the following:

* Title Page - Includes the signatures of the individuals responsible for the project and ACG concurrence.

* Project Description and Sampling Objectives - Briefly describes the what, where, and why of the project.

* Data Needs - Describes what elements, compounds, classes of compounds, and/or physical data are required. Must describe the desired detection limits, precision and accuracy of the data for the study.

* Sampling and Labelling Procedures - Describes sample collection, including field QC and preservation. Estimates the number and kind of samples to be collected. Minimum requirements for sample collection are described in Section 2.

* Chain of Custody - Describes Chain-of-Custody and documentation procedures. Minimum requirements are described in Section 2.

* Analytical Procedures - References or describes in detail proposed method(s).

* Internal Quality Control - Describes type and frequency of internal quality control. Minimum requirements are described in Section 3.

* Calibration Procedures and Frequency - Describes the methods and frequency for calibrating field and laboratory instruments. These must be specified in SOPs.

* Data Verification - Describes the data verification in SOP form and includes; (1) the methods used to identify and treat outliers, and (2) the data flow from generation of raw data through storage of verified results.

* Data Deliverables - Specifies reporting needs additional to the minimum requirements described in Section 4.

* Technical System and Performance Audits - Specifies field or intra-laboratory audits planned by the responsible Agency.

1.2 Technical System Audits

On-site system audits may be performed without prior notification by the ACG after consultation with the responsible agency.

1.3 Standards and Quality Control Materials

The National Institute of Standards and Technology (NIST) will develop and provide appropriate standards and quality control materials.

1.4 Analytical Performance Evaluations

Prior to the initiation of work, each analytical laboratory will be required to demonstrate its capability. This will be accomplished by providing laboratory documentation on the performance of the proposed methods and through the analysis of an accuracy based material. The results of this analysis must be within +/- 15% of the value of each analyte or measurement parameter.

Any changes in analytical methodology from that proposed in the original QA plan shall be validated under agency procedures and documented to the ACG.

A series of three intercomparison exercises, utilizing the blind analysis of gravimetrically prepared materials, extracts of environmental matrices (tissue, sediment and water) or the matrices themselves, will be conducted annually. Participation in these exercises is mandatory. Materials will be prepared by, and data returned to the NIST for statistical analysis. The NIST will report to the chairperson of the ACG. Unacceptable performance will result in the discarding of the associated data.

The ACG will review and provide written reports on the results of intercomparison studies to the Management Team.

1.5 Data Reporting and Deliverables

Data deliverables will be reviewed by the generating Agency to verify the quality and useability of the data. A QC report on each data set will be provided to the ACG for review.

All data and associated documentation will be held in a secure place under chain-of-custody procedures until the Trustees indicate otherwise.

2. <u>Minimum Requirements: Sampling and Sampling Equipment</u>

Sample collection activities must be described in SOP's. References to existing documents are acceptable.

The method of collection should not alter the samples.

Sample collection and storage devices shall not alter the sample.

Samples shall be held in a secure place under appropriate conditions and under chain-of-custody until the Trustees indicate otherwise.

2.1 <u>Sampling Identification and Labelling</u> - An SOP will be in place for each study which describes procedures for the unique identification of each sample. A sample tag or label will be attached to the sample container. A waterproof (indelible) marker must be used on the tag or label. Included on the tag are the sample identification number, the location of the collection site, the date of collection and signature of the collector.

The information above will also be recorded in a field notebook along with other pertinent information about the collection and signed by the collecting scientist.

2.2 <u>Field Chain-of-Custody</u> - The field sampler will be personally responsible for the care and custody of the samples collected until they are transferred to another responsible party.

Samples will be accompanied by a chain-of-custody record or field sample data record. When samples are transferred from one individual's custody to another's, the individuals relinquishing and receiving will sign, date and note the time on the record.

Shipping containers will be custody-sealed for shipment. Whenever samples are split, a separate chain-of-custody record will be prepared for those samples and marked to indicate with whom the samples are being split.

Samples shall be maintained in a manner that preserves their chemical integrity from collection through final analysis.

Sample shipper will arrange for sample receipt.

After analysis, any remaining sample and all sample tags, labels and containers shall be held under chain-of-custody procedure until the Trustees indicate otherwise.

3. Minimum Requirements: Analysis

The applicable methodology must be referenced or described in detail in the SOPs for each measurement parameter.

Method limits of detection must be calculated by matrix and analyte.

Control of the analytical method in terms of accuracy and precision must be demonstrated.

Calibration must be verified at the end of each analysis sequence.

Samples must be quantified within the demonstrated linear working range for each analyte.

Standard curves must be established with at least 3 points besides 0.

Field blanks, procedural blanks, reference materials, replicates and analyte recovery samples must be run at a minimum frequency of 5% each per sample matrix batch.

A minimum list of the petroleum hydrocarbon compounds which are to be considered for identification and quantification in water, tissue and sediment include the volatiles, i.e., benzene, toluene, xylene and the polynuclear aromatic and aliphatic hydrocarbons listed below:

Naphthalene
2-Methylnaphthalene
1-Methylnaphthalene
Biphenyl
2,6-Dimethylnaphthalene
Acenaphthylene
Acenaphthene
2,3,5-Trimethylnaphthalene
Fluorene
Phenanthrene
Anthracene
1-Methylphenanthrene
Fluoranthene
Pyrene
Benz(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-c,d)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

n-dodecane
n-tridecane
n-tetradecane
n-pentadecane
n-hexadecane
n-heptadecane
pristane
n-octadecane
phytane
n-nonadecane
n-eicosane

Benzo(e)pyrene
Perylene

4. Minimum Requirements: Reporting and Data Deliverables

Measurement results, including negative results, as if three figures were significant.

Results of quality control samples analyzed in conjunction with the study samples.

Documentation demonstrating analytical control of precision and accuracy on an analyte and matrix specific basis.

PROJECTED EXPENDITURE BREAKDOWN--NOAA

Line 100-Salaries

Class	Name	PCN	Monthly Salary & Benefits	Months	Total Cost
GS-14 Chemist	Manen		6,564	6.00	39,386
GS-13 Data Analyst	Price		5,350	3.00	13,372
GS-11 Biologist	Karn		?	5.00	15,093
				Subtotal	67,851

Line 200-Travel

	Number	Cost	Total
Travel to Seattle	2	350	700
Travel to Anchorage	4	375	1,400
Travel to Juneau	1	750	750

Line 200-Per Diem

Travel to Seattle	2	90		250
Travel to Anchorage	4	117		600
Travel to Juneau	5	117		700
			Subtotal	4,400

Line 300-Contractual

	Company	Number	Cost		Total
QA	NIST	1	220,000		220,000
Bar Coding	B(?)	1	20,000		20,000
Bile & ?	NWC	1,500	100		150,000
Tissues	TBN	500	500		250,000
Sediments	TBN	500	500		250,000
Start-up	ABL	1	150,000		150,000
Start-up	NWC	1	150,000		150,000
				Subtotal	1,190,000

Line 400-Commodities

Software and Computer Support	5,000
Subtotal	5,000

Line 500-Major Equipment

	Number	Cost	Total
Computer Compaq 386/20e	1	21,000	21,000
Hard Disk	1	1,100	1,100
Printer (Laser II D)	1	3,000	3,000
		Subtotal	25,100

Grand Total 1,292,351

PROJECTED EXPENDITURE BREAKDOWN USFWS

LINE 100 SALARIES

CLASS	NAME	PCN	MONTHLY SALARY AND BENEFITS	MONTHS	TOTAL COST
GS-13 BIOLOGIST	ROBINSON-WILSON	PERM	$5,100.00	6	$30,600.00
GS-7 TECHNICIAN		TEMP	$2,419.19	12	$29,030.31
				SUBTOTAL	$59,530.31

POSITION	WORK LOCATION	TIME FRAME	MONTHS
ROBINSON-WILSON	ANCHORAGE	1 OCT 89 - 30 SEPT 90	6
	ANCHORAGE PWS	1 OCT 89 - 30 SEPT 90	12

LINE 200 - TRAVEL

***************	NUMBER	COST	TOTAL
TO PWS	5	$150.00	$750.00
TRAVEL TO JUNEAU	5	$375.00	$1,875.00
TRAVEL TO PATUXENT	2	$750.00	$1,500.00
TRAVEL TO TEXAS A&M	2	$500.00	$1,000.00
		SUBTOTAL	$5,125.00

LINE 200 - PER DIEM

***************	NUMBER	COST	TOTAL
TO PWS	5	$75.00	$375.00
TRAVEL TO JUNEAU	5	$400.00	$2,000.00
TRAVEL TO PATUXENT	2	$750.00	$1,500.00
TRAVEL TO TEXAS A&M	2	$750.00	$1,500.00
		SUBTOTAL	$5,375.00

LINE 300 - CONTRACTUAL

***************	NUMBER	COST	TOTAL
TEXAS A&M ALIPHATIC	2000	$162.00	$324,000.00
TEXAS A&M AROMATIC	2000	$235.00	$470,000.00
TEXAS A&M TPH	1000	$30.00	$30,000.00
		SUBTOTAL	$824,000.00

LINE 400 - COMMODITIES

***************	NUMBER	COST	TOTAL
CHEMICALY CLEAN JARS CS.	100	$100.00	$10,000.00
LAB CHEMICALS	10	$100.00	$1,000.00
DISSECTING EQUIP	20	$50.00	$1,000.00
GLOVES CS.	5	$100.00	$500.00
PROTECTIVE CLOTHING	10	$250.00	$2,500.00
LAB SUPPLIES	10	$250.00	$2,500.00
SOFTWARE	3	$500.00	$1,500.00
		SUBTOTAL	$19,000.00

LINE 500 - MAJOR EQUIPMENT

***************	NUMBER	COST	TOTAL
COMPAQ 386 COMPUTER	1	$20,000.00	$20,000.00
FREEZER ULTRA LOW	2	$7,000.00	$14,000.00
		SUBTOTAL	$34,000.00

GRAND TOTAL $947,130.31

CONFIDENTIAL

STATE-FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT DETAILED STUDY PLAN, APRIL 1989 - FEBRUARY 1990

Project Title: HISTOPATHOLOGY: Examination of Abnormalities in Tissues from Birds, Mammals, Finfish, and Shellfish Exposed to the Spilled Oil

Study ID Number: Technical Services Study #2

Lead Agencies: U.S. Fish and Wildlife Service and Alaska Department of Fish and Game

Principal Investigator: Ted Meyers
Alaska Department of Fish and Game
FRED Division

Cooperating Agencies: Federal: NOAA, USFS

Total Cost of Proposal: $440,200

Group Members:

Dr. Theodore R. Meyers (chair), ADF & G, Juneau, AK
Dr. J. Christian Franson, USF&WS, Madison, WI
Dr. Roger Lee Herman, USF&WS, Leetown, WV
Dr. Bruce B. McCain, NOAA/NMFS, Seattle, WA
Dr. Albert K Sparks, NOAA/NMFS, Seattle, WA

TECHNICAL SERVICES STUDY NUMBER 2

Study Title:

Histopathology: Examination of Abnormalities in Tissues from Birds, Mammals, Finfish, and Shellfish Exposed to the Spilled Oil

Concern/Justification:

Histopathology is an important tool used in determining mechanisms of death and sublethal effects caused by infectious agents and toxic substances. A number of histopathological conditions are known to result from exposure to oil. Evidence of these conditions will be documented in tissue samples taken from selected species of birds, mammals, finfish, and shellfish as one means of demonstrating spill-related injury in those organisms. Since tissues deteriorate (autolyze) rapidly, samples taken for histological evaluation as part of the damage assessment will be collected, preserved, and processed under strict guidelines, as determined by the quality assurance program.

Objectives:

A. Measure the incidence of histopathological conditions and external lesions in selected species of birds, mammals, finfish, and shellfish collected in collaboration with relevant biological field investigations.

B. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

Relationships with Other Studies:

The incidence of histopathological abnormalities will be determined on tissues collected in many studies related to Fish/Shellfish, Marine Mammals, Terrestrial Mammals, and Birds.

Methods and Analyses:

Standard histological methods for collection, preservation, processing, and interpretation will be used for animal tissues collected at oiled and non-oiled sites. Pairwise comparisons of animal tissues collected at oiled and non-oiled sites will be made regarding cellular degenerative or necrotic changes caused by oil exposure.
Reports will be prepared to document the incidence and characteristics of histopathological conditions observed in the various groups of organisms, and determining their relationship

with exposure of the organisms to the oil spilled from the Exxon Valdez.

Lead Agencies: U.S. Fish and Wildlife Service and Alaska Department of Fish and Game

Cooperating Agency(ies): Federal: NOAA, USFS

Budgets:

Alaska Department of Fish and Game

Salaries	$ 85.0
Travel	20.0
Contracts	197.0
Supplies	4.8
Equipment	12.0
TOTAL	$318.8

U.S. Fish and Wildlife Service

Salaries	$ 86.9
Travel	13.5
Contracts	16.0
Supplies	3.0
Equipment	2.0
TOTAL	$121.4

HISTOPATHOLOGY TECHNICAL GROUP FOR OIL SPILL ASSESSMENT STUDIES IN PRINCE WILLIAM SOUND, ALASKA

Member Organizations:

U.S. Department of the Interior
U.S. Department of Commerce
Alaska Department of Fish and Game

Group Members:

Dr. Theodore R. Meyers (chair), ADF&G, Juneau, AK
Dr. J. Christian Franson, USF&WS, Madison, WI
Dr. Roger Lee Herman, USF&WS, Leetown, WV
Dr. Bruce B. McCain, NOAA/NMFS, Seattle, WA
Dr. Albert K. Sparks, NOAA/NMFS, Seattle, WA

HISTOPATHOLOGY TECHNICAL GROUP

Justification/Concern

Histopathology is an important tool used in determining mechanisms of death and sublethal effects caused by infectious agents and toxic substances. A definitive diagnosis often does not result from histological examination, but can give strong support to other positive measurements. Tissues deteriorate (autolyze) rapidly after an animal dies; therefore, to be of value, any sample taken for histological evaluation as part of the damage assessment of the Exxon Valdez oil spill must be collected, preserved, and processed under strict guidelines.

Introduction

This committee was established to serve as an ad-hoc advisory and technical control group that reports to the Management Team. Its specific function is to serve as a control point for all laboratory aspects of histopathological analysis associated with the Exxon Valdez oil spill assessment program. This includes the development of detailed sampling protocols, appropriate training of field personnel in collecting samples, review of all histological sampling proposed and identification of effort duplication, establishment of a secured repository for all histology samples for storage until processing, oversee archiving and inventory of collected samples, qualification evaluation of potential subcontractors to be hired for processing and interpretation of histology samples, quality control assurance in all work performed, advice on chain-of-custody guidelines, and development of budget estimates to accommodate the required histopathological analyses.

TABLE OF CONTENTS - Histopathology Technical Group

1. Sample Collection and Preservation Protocols

Standard protocols for necropsy and preservation of tissue samples (including a materials list and catalog numbers) for histopathology described in the appendices shall be used throughout the oil spill assessment studies. Different protocols have been designed to accommodate the different groups of animals to be encountered in the assessment studies. Necropsy procedures are included for:

e. Mean concentration of hepatocellular vacuolation due to fatty degeneration (fish).
f. A mean and total tissue necrosis index (invertebrates).
g. Histological gonadal index (invertebrates).
h. Differences in prevalences and intensities of incidental lesions caused by infectious agents (fish and invertebrates).

3. Quality Assurance in Field Collection of Samples and in Interpretation of Results

Field Collection

Veterinary personnel trained in sample taking should be utilized for on-site necropsies of birds and mammals in order to ensure adequate quality control and standardized sample collection in these less familiar and more complex species. The same high standards should be attainable in fish and invertebrates if sample collection is done by trained finfish and shellfish biologists. A fish pathologist and technician will be available to train field personnel and assist in necropsy and preservation of finfish and shellfish samples at collection sites.

Sample collection from migratory birds and sea otters should be coordinated with the U.S. Fish and Wildlife Service National Wildlife Health Laboratory in Madison, Wisconsin. Collection of samples from nonmigratory birds and other marine mammals could be coordinated with the Alaska State Veterinary Laboratory in Anchorage. Finfish and shellfish samples can be coordinated through the on-site fish pathologist and the ADF&G, Fisheries Rehabilitation, Enhancement and Development (FRED) Division Juneau Fish Pathology Laboratory.

Interpretation of Results

Quality control of all processed work will require independent blind reading of subsampled histology slides by two different laboratories.

Tissues with known lesions will be included periodically in groups of tissue samples for blind reading and determination of competency in interpretation.

4. Repository For Samples And Inventory Procedures

A common repository for storage of all histology samples awaiting processing will be established at Anchorage in a secured building in compliance with chain-of-custody requirements. Samples received will be given a unique accession number to be cross-referenced with the project and original numbering assigned by the collector.

5. Chain-Of-Custody Guidelines

Due to the evidentiary nature of sample collecting investigations, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To maintain and document sample possession, chain-of-custody procedures must be followed.

CERCLA. 1988. Natural Resource Damage Assessments. 53 Federal Regulation 5166 and 9769.

Haensly, W. E., J. M. Neff, J. R. Sharp, A. C. Morris, M. F. Bedgood, and P. D. Boem. 1982. Histopathology of *Pleuronectes platessa L.* from Aber Wrac'h and Aber Benoit, Brittany, France: long-term effects of the Amoco Cadiz crude oil spill. J. Fish Dis. 5:365-391.

Johnson, P. T. 1980. Histology of the Blue Crab, *Callinectes sapidus*: A Model for the Decapoda. Praeger Publ., New York.

Sparks, A. K. 1985. Synopsis of Invertebrate Pathology Excluding Insects. Elsevier Publ., New York.

9. **Appendices**

EXXON VALDEZ OIL SPILL

CERCLA DETAILED STUDY PLAN

Technical Services Study Number 3

GIS Technical Group

Mapping of Damage Assessment Data and Information

September 25, 1989

Technical Services Study Number 3

Mapping of Damage Assessment Data Information

Table of Contents — Page #

Natural Resource Damage Assessment and Restoration Strategy for the Exxon Valdez Oil Spill

Detailed Study Plan
September 25, 1989

Technical Services Study Number 3

Title: Mapping of Damage Assessment Data and Information

ADNR

______________________ Co-Lead

______________________ Management Official

USF&WS

______________________ Co-Lead

______________________ Management Official

OSIAR

______________________ OSIAR Program Manager

______________________ OSIAR Director

Technical Services Study Number 3
Mapping of Damage Assessment Data and Information

II. INTRODUCTION

As stated in the justification of this study group:

"A geographic information system (GIS) will be selected and implemented to facilitate the management and presentation of all information." p.183

The GIS technical group has implemented production facilities at ADNR and is currently implementing co-lead production through USF&WS. Both sites are designed to handle the mapping and data management workload created by the damage assessment and restoration studies. Cooperating agencies on this project include ADEC, USFS, and NOAA.

This GIS technical group provides the capability to map and model resource inventory data and related injury statistics. The database structure allows for modeling statistical questions such as: "How many miles of tidelands were oiled, plot the animal and plant kill statistics sampled over these lands, and determine an injury amount by extrapolating these field conclusions over all tidelands that could not be specifically sampled due to cost constraints and the remote nature of the affected coastline miles." Specifically this project provides the following services:

1) Capture and manage the base resource inventory data needed to conduct damage assessment work, which includes uplands land status (ownership), ecological shoreline classifications, and the degree of oil impact over the extent of the spill (Air/Water Study number 1). Integrate this data to a common coastline model.

2) Upon this common resource inventory base, combine the following damage statistics:

    a. The locations and values of chemical point samples collected by researchers at both NOAA and ADEC.

    b. The locations and values of ecosystem impacts collected by the Coastal Habitat Study group headed by USFS and ADF&G.

    c. The locations and values of injury statistics compiled by the Fish/Shellfish, Marine Mammals, and Birds study groups.

d. The locations and values of any additional resources of economic value such as shore fishery leases, recreational usage sites, anadromous streams, etc.

3) Provide the study groups maps and statistical reporting which represent unique combinations of the data relevant to their study conclusions of total injury assessed.

? — 4) Provide rigorous data repository and archival services of GIS data to the CERCLA litigation teams. Insure documentation of all data standards and procedures, and project audit trails to meet standards of data admissibility.

5) Provide map products and statistical reports to the CERCLA decision makers on a requested basis.

6) Work cooperatively to service the needs of CERCLA related studies.

The geographic information mapping system will support the generation of information products from most of the resource-oriented studies through the entire course of activities under the Damage Assessment Plan.

III. OBJECTIVES

The GIS Technical Services Study group is charged with providing geographic information management services related to the Exxon Valdez oil spill. Five general categories of work will be required to meet the long term objectives for this group:

Foundation Work - Collect, process, integrate, manage, and report on those data considered to be the 'primary' data sources. Examples are coastal morphology and land status. (Service/Product #1 in Introduction)

Thematic Work - Collect, process, integrate, manage, and report on those data considered to be 'secondary' data sources. Examples are chemical point samples and animal/plant impact statistics. (Service/Product #2 and #3 in Introduction)

Primary Services - Plot maps and print statistical reports, and distribute products to users. Provide technical information and support to users. Distribute high quality digital information, such as coastline data, to assure data capture integrity in field offices such as ADEC and UAF. (Service/Product #5 and #6 in Introduction)

Administrative Services - Assure data documentation, data procedures, data quality, and data admissibility within litigation requirements. Assure rigorous database architecture, disaster recovery documentation, and appropriate distribution. Assure coordination between multi-agencies on data sharing. Assure high priority personnel, fiscal, and operations management to meet overall project needs. Assure adequate audit trails. (Service/Product #4 in Introduction)

Quality Control - The utility of base data is partly a function of their overall reliability. The GIS group will concentrate on achieving a high level of data accuracy, both with respect to reflection of source documents as well as consistency with ancillary field data. Capture methods will provide for high standards of verifying with source documents. A review process which incorporates standards for updates and changes to the data will target accuracy gains from experienced staff with extensive field experience.

The dynamic nature of the themes being mapped presents a difficult problem with respect to the perceived accuracy: ownerships change hands, beach texture and composition changes with winter storm patterns, and the duration of oil on the tidelands is partly a function of wave energy, rain intensity and 'type' of oil deposited, i.e. mousse versus thick crude versus tar balls. Even the location of the coastline is subject to change from erosional processes and major events like the 1964 earthquake. Thus, a snapshot view of this landscape can be difficult to field verify due to the timing differences of field visits and data collection.

Note

A second source of accuracy problems is introduced with subjective classifications as found in both shoreline types and degree of oil impact. The subjectivity is a function of describing what is a continuum in nature as discreet classes in the database. Borderline errors occur when different people hold slightly different views of a given classification. For example, a mixed sand and gravel beach, a gravel beach and a sheltered rocky shore might all describe one area fairly well leading different people to make different interpretations, particularly when their observations will have the spread of several years between them; i.e. a 1983 source map and a 1989 field season.

IV. METHODOLOGY

There are six major steps in the development of a mature damage assessment and restoration database:

1) Determine geographical limits of the project.
2) Identify database layers.
3) Identify source material for each layer.
4) Develop capture standards and methodology.
5) Capture data layers, verify with source documents.
6) Prepare database design for security, layer integration, update procedures, archive rules, documentation, and technical aspects of data handling.

<u>Geographic Limits of the Project</u>

The project area includes all lands which have been or may be effected by the Exxon Valdez oil spill. This includes all coastal lands west of the 146th meridian, east of the 160th meridian, and south of 61 degrees, 30 minutes north latitude.

If this limit proves to be inadequate, the extent of the database can be expanded.

Within this limit, all efforts will be made to maintain a reasonable continuity of resolution and local dependability for any given data layer.

<u>Identify Database Layers</u>

<u>Foundation Work</u>

The foundation data layers have been specified by the CERCLA Management Team from the inception of the GIS mapping group. These include:

1. A standard digital coastline relevant to field applications;

2. Degree and location of all coastal lands contaminated by crude oil from the T/V Exxon Valdez;

3. Shoreline type as described by coastal morphology; and

4. Land ownership, at a resolution of one section.

In addition to these primary layers, the mapping group has included the following layers based on their collective experience on the use of maps.

5. Basemap annotation, including settlements, water bodies, peninsulas, major islands and capes;

6. Hydrography - lakes, rivers and streams, for those areas where digital information currently exists;

7. Geographic referencing including UTM tic marks and the protracted township grid.

These layers will be combined to create a standard basemap which can be distributed to all parties involved in the damage assessment and restoration process. Most study groups collect field data with locational attributes which will permit the placement of data and various summary results on basemaps.

Other foundation layers which are likely to be incorporated into the database, and in some cases have received preliminary work, include:

8. Bathymetry data, particularly for those submerged lands near the intertidal zone; and

9. Critical and important wildlife habitats including marine birds, marine mammals, anadromous fish, and bald eagles;

Thematic Work

Thematic data includes that information which is collected by the respective study groups which can be spatially referenced and therefore used in conjunction with all or some of the foundation layers. Most of these data are based upon a sampling process and therefore represent either point samples, as in the case of chemistry data, or line samples, as in the case of beach transects, or areal samples, as in the case of a trawl area for fish samples.

The technical mapping group is continuing to work with the various contacts and principal investigators with the intention of first, describing the composition and possible uses of the foundation layers, and second, to investigate possible avenues for GIS applications which would assist the study groups in the review and presentation of their findings. To date, the primary contacts have been with the coastal habitat group, the air/water group, marine mammals group, and the birds group. We have had only phone contact with the fish/shellfish group. Further, we realize we have not contacted all responsible study group leaders within these major studies.

Examples of thematic data include toxicity point samples by sample type, e.g. water, sediment, tissue, etc., mortality statistics for species sampled by the various groups, changes in ecosystem productivity as measured by health and fecundity of key species across different habitat types, impacts on aesthetic values, changes in recreational use patterns, constraints to land use permits for aquaculture, and so on until the relevant themes have been exhausted.

Work with the field groups is continuing at this time with the principle goals of communicating the capabilities of and appropriate role of a geographic information system on the damage assessment project.

Source Material, Capture Standards and Database Design

The following discussion covers methodology steps three (3) through six (6) for the major data layers identified at this point in time.

Layer 1

Coastline: 1:250,000 Primary sources of ADNR, the North Slope Borough, and NOAA have worked on this public domain dataset. This data covers the entire State geographic area, with those data clipped out that cover the spill extent. Source documents have been the most current USGS 1:250,000 quads, with quality control to assure that all data plots overlay each respective source quads. Database structure includes differentiations between coastline, major river, major lakes, and islands. This data has been totally captured and is already incorporated into the database.

1:63360 Primary source of USFS for the PWS area, using USGS quads with some partial photo rectification. Primary source of ComRim Company for all other inch to the mile quads covering CIK, KAP, and all additional quads for which there was accompanying ESI (coastal morphology) data. Source documents have been the most current USGS 1:63360 quads, with quality control to assure that all data plots overlay each respective source quad. This dataset is captured to a very fine level of resolution and much attention to detail is evident. This dataset includes only the coastline data, and is structured into the database only as such. This data has been totally captured and is already incorporated into the database.

Layer 2

Oil Impacts: Primary Source: Alaska Department of Environmental Conservation, CERCLA Air/Water Study number 1, titled "Geographic Extent, Temporal Persistence and Mapping of Floating and Beached Oil from the TV Exxon Valdez Oil Spill."

Alaska DEC has utilized two main sources of data to record the location and degree of oil on the shoreline:

1) response data consisting primarily of mapped information based on aerial observation,

2) field observations from personnel who have walked miles of shoreline in an effort to document the location and degree of oiling not attainable through aerial observation.

Data from non-DEC sources may also be considered in the compilation of this data layer.

Response Data

Response data was based on information provided by DEC staff who are present are in Valdez, Seward, Homer, and Kodiak. Daily reports filed by these teams represent a large volume of DEC source material. During the early response period, DEC compiled oil location data, both in the water and on the shoreline, primarily from aerial reconnaissance with supplementary field observations. In June, these daily flights were limited to weekly overview flights because the shoreline cleanup assessment teams (SCAT) began to collect field data on a large number of beaches.

The response data was transferred to the DEC computer mapping system in a summary fashion which expedited the immediate use of the data at the expense of providing mirror images of the source documents.

The summary response data set was transferred by digital file to the GIS technical group for use in map production. This group in turn transferred copies of the detailed coastline (1:63,360) to DEC for purposes of establishing a common digital base.

The summary response data is the only digital oil location data available at this time on either computer system.

Field Observations

As the cleanup deadline approached, DEC launched its own shoreline assessment teams whose primary task is to document the condition of the shorelines at the end of the season, particularly those which received significant treatment efforts. These crews are now working in the field and will continue to work until poor weather and lack of daylight make the efforts less than fruitful. Both DEC and Exxon winter plans specify that a beach monitoring system will be undertaken with the intent of recording changes to the oiled shoreline over the course of the winter.

The GIS technical group intends to work closely with the principal investigator of the AIR/WATER study number 1 to facilitate the incorporation of these data sources to a professional digital database which serves the needs of the related studies.

Additional Oil Impact Data:
Shoreline Cleanup Assessment Teams (SCAT Data)

The SCAT data was used to set beach cleanup schedules. It provided for a fairly standard method of ranking the degree of oil on the shoreline based on first hand observations from a team of trained staff who were paid by Exxon. Many agency field personnel used the SCAT reports in the course of their response work during the summer.

The SCAT teams divided the landscape into a series of beach segments which contained alpha-numeric codes for easy identification and information tracking. The segments were further subdivided as detailed oil location information was generated. For example, one segment may be 500 meters long and contain three classes of oil impact and four types of coastline. NOAA has requested these digital data sets from Exxon. Whether these data are appropriate for use by the CERCLA process, particularly with respect to the ADEC Air/Water study number 1, is not known at this time.

The general beach segments have been captured on the standard 1:63,360 coastline by DEC for the Prince

William Sound and Kenai Peninsula areas. (Detailed SCAT segments for PWS has also been digitally captured by mapping staff working for Exxon: source NOAA) The segment database would change as daily field reports were filed.

Further work is being done by ADEC to capture segments for the Kodiak and Alaska Peninsula areas. Early work by Kodiak ADEC through the Kodiak Borough which automated the beach segments could not be used because of a non-standard coordinate system used by the Borough.

A database was developed for each beach segment which reported on a wide variety of attributes for each segment. A sample of this database is shown in figure 1. The database was used to scale the workload, record progress and provide for agency sign-off on treatment. The database viewed by members of the technical mapping group contained data for the general segments, which were used to manage the project, and not the sub-segments which have the more exacting oil location data.

Layer 3

Shoreline Type: Primary source are the NOAA/MMS ESI Books, 1979-1984. Supplemental source is Eric Gundlach, ADEC Valdez. These data were captured in digital format under contract with ESRI, using GIS Technical Group monies through USFWS. Source documents are USGS 1:63360 quads, reduced to roughly 1:80,000, which delineate shore types in color codes.

Members of the GIS technical group have compared plots of the digital data with the source documents to assure accuracy. The maps are also currently being reviewed for accuracy by Eric Gundlach. As of this writing Eric has reviewed and submitted corrections for all PWS quads, and those CIK quads showing oiling. Still requiring Eric's review are the KAP quads showing oiling, and the CIK and KAP quads not currently showing any oiling.

Two versions of these data are maintained: the source documents as received by ESRI, and the modified versions following Eric Gundlach's review.

Please refer to the literature cited section of this

FIGURE 1 - EXAMPLE OF SCAT DATA

UNIT ID		SHORELINE DESCRIPTION	LINE MILES	CURRENT SURVEY AGENCY	CURRENT SURVEY DATE	SCAT AVAIL	DEGREE IMPACT	SUB SURF	MILES OILED	PRI	COMMENTS	NO CLNUP	WORK ORDER DATE	WORK ORDER NUMBER	START DATE	END DATE	COMMENTS	MILES TREATED	% TREATED	DEMOB DATE	COMMENTS
K01			285						0									0			
	01	E.SHUYAK I.	20.5	ADF&G	7/26/89	Y	H-VL			X			6/18/89	A020	8/1/89				70		DNR
	02	BIG FORT I.	5.5	ADEC	6/27/89	Y	VL						8/1/89	A085	8/1/89				80		
	03	S.SHUYAK I.	10	DEC	6/4/89	Y	VL			X			8/4/89	A092		7/24/89	A016				DNR
	04	NEKETA BAY	9.5	DEC	5/24/89		VL														
	05	BIG BAY	19.5	SCAT	5/21/89	Y	L					X									
	06	WONDER BAY	11	DEC	5/20/89		VL														
	07	DARK IS.	3	ADF&G	7/26/89		L														
	08	LATAX ROCKS	2.5																		
	09	CARRY IN.	17	ADF&G	5/2/89		L			X			8/5/89	A118							DNR
	10	SHANGIN	11.5	SCAT	5/23/89	Y	H														
	11	PEREVALNIE	9.5	ADF&G	7/26/89	Y	H			X			7/14/89	B017	7/15/89		A015/022		49		DNR
	12	SHUYAK ST.	10.5	ADEC	6/27/89	Y	VL						8/3/89	A104							
	13	WATERFALL	14.5	DEC	6/4/89		VL														
	14	DELPHIN B.	8.5	DEC	6/4/89		VL														
	15	DISCOVER B.	11	ADF&G	5/24/89		VL														
	16	PAUL'S B.	8.5			Y				X											USFWS
	17	PHOENIX B.	17.5	ADF&G	6/12/89		VL														
	18	DUCK CAPE	4.5										8/5/89	A119							
	19	SEAL B.	19																		
	20	TOLSTOI	10.5			Y															
	21	W.TONKI B.	11	DEC	5/30/89	Y	N														
	22	E. TONKI B.	9	ADF&G	5/23/89	Y	L														
	23	CHUGACH	11	DEC	5/30/89	Y	N						7/30/89	A088							
	24	KING COVE	9.5			Y															
	25	W MARMOT I	11	DEC	5/30/89	Y	N														
	26	E MARMOT I	9.5			Y							8/2/89	A093							
K02			192						0									0			
	01	BLUE FOX B	23	ADEC	6/27/89		VL														
	02	GRASSY I.	8	ADF&G	6/30/89		VL														
	03	DEVIL'S B.	14.5	ADF&G	6/30/89		VL														
	04	FOUL B.	18.5	SCAT	5/18/89	Y	L			X			8/1/89	A081							USFWS
	05	FOUL B. SOUTH	7.9			Y															
	06	S BAN IS.	7.5	ADEC	6/27/89	Y	L						8/4/89	A094	8/4/89				50		
	07	PARAMANOF	8.5			Y															
	08	PARAMANOFB	17.5	ADEC	6/27/89	Y	N						7/28/89	A040							
	09	TANAAK C.	4	ADF&G	6/30/89	Y	L						7/30/89	A087							
	10	N MALINA B	12	SCAT	5/19/89	Y	L			X			7/15/89	A031	8/4/89		A115/095/083				ADFG
	11	S MALINA B	16.5	ADF&G	6/30/89	Y	VL						8/4/89	A116	8/4/89	8/4/89	A077				ADFG
	12	STEEP C.	3.5	SCAT	5/19/89	Y	L						7/7/89	A013	7/7/89	7/24/89			100	7/30/89	
	13	C. NUNILIAK	4.5	ADF&G	6/1/89		VL						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
	14	MUSKOMEE	6	ADF&G	6/1/89		N						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
	15	YUKUK B.	14	ADF&G	6/1/89		L						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
	16	SELIEF B.	13	ADF&G	5/11/89		M						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
	17	BEAR CR.	9										8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
	18	VABM	4																		
K03			102						0									0			
	01	PILLAR C.	7.5	ADF&G	7/18/89	Y	N						7/24/89	A034	7/24/89	7/30/89			100	7/30/89	
	02	IZHUT B.	24	ADF&G	7/18/89	Y	N			X			7/15/89	A014	7/15/89	7/18/89			100	7/27/89	ADFG
	03	KITOI B.	16.5	ADF&G	7/18/89	Y	L						7/24/89	A033	7/26/89	7/31/89			100	7/31/89	
	04	PERL C.	4	ADF&G	6/5/89	Y	N														
	05	SELEZEN PT	5	ADF&G	7/18/89	Y	VL														
	06	MARY A BAY	11.5	ADF&G	7/18/89	Y	N						8/3/89	A105							
	07	KAZAROF BAY	16.1	ADF&G	7/18/89	Y	N														
	08	MARKA B	7	ADEC	7/18/89		N														

report for a list ESI books and total number of quads involved.

Layer 4

Land Status: Primary sources of ADNR and USFS for PWS, ADNR and USFWS for CIK and KAP. Source materials include State status plats, State Land Administration System, and equivalent ownership documentation from USFS, USFWS, and NPS. The resolution is one section, or 640 acres. Where there is concurrent ownership in any given section by more than one agency, the indicated owner was decided by a general determination of which agency owned the 'larger' portion. All of this data has been captured at this time and is undergoing final agency review. This land status data has been incorporated into the database. However, it has not been fully integrated as yet. Full data integration will create database 'knowledge' as to which agency is the uplands owner of any coastline segment. This work is ongoing at this time.

It is important to note that this data layer does not address the issue of tidelands or submerged lands ownership. Only uplands owners are currently indicated. It is also important to note that there are many valid ownership boundaries that are of such a detail that they cannot be indicated at the current product scale of 1:63360. These issues must be addressed in the future.

Layer 5

Annotation: Primary source USGS 1:63360 quads. This work is currently under way using project staff, who are performing data entry, quality control, and database integration.

Layer 6

Hydrography: Primary source is BLM photo revised USGS quads already in digital format via the ADNR ADS Project, PWS and CIK areas. This data is being translated to the GIS database. For those areas (KAP) not already covered by ADNR digital data, existing sources will be sought out, and/or the group will provide this data input themselves, using the most current 1:63360 USGS quads. Quality control to assure that all data plots overlay each respective source quad has been assured by the ADS Project on existing digital file. This work is ongoing at this point in time.

Layer 7

Geographic Referencing

Standard maps at the scale of 1:63,360 will be produced in the Universal Transverse Mercator Projection which can be co-registered with USGS quadrangle maps of the same scale. A UTM tic grid will be placed on each map and the appropriate UTM zone will be referenced. The UTM coordinates of any point can be scaled from the map with this grid.

A lat/long grid will not be used on these maps.

A township grid will be superimposed which will facilitate references made by land administrators who frequently maintain records by township and range. The township grid is based on the most recently released protraction files provided by the Bureau of Land Management. A section overlay will be provided with each atlas which will allow easy identification of any specific section.

Layer 8

Bathymetry

The marine mammals group has requested bathymetry data to assist with the description of otter habitat. However, these data have not been requested by the management team. USGS EROS has obtained a portion of NOAA bathymetry data. Example maps could be produced which might clarify their utility.

Layer 9

Habitats

Various public documents have recorded the location of important habitats such as bird rookeries, seal haul-outs, waterfowl nesting areas and so forth. Discussions with several different field biologists indicate that most documents are not current. No sustained effort has been made to capture these data at this time. Some of the point data from the ESI books on habitat is in the GIS database.

Mapping of Damage Assessment Data and Information

Schedule of Activity

Baseline Information

```
--------------------------------------------------------------------------------------------------------
                   May                    Aug                    Nov                    Feb                    May
                   '89                    '89                    '89                    '90                    '90
                    0      1      2       3      4      5        6      7      8        9     10     11      12
Data Layer

1. Shoreline       |-----------------     |                      |                      |                      |
                   |                      |                      |                      |                      |
2. Shoretype       |  ----------------------                     |                      |                      |
                   |                      |                      |                      |                      |
3. Oil Impact      |   ------------------------------------------------------------------------------------------|
                   |                      |                      |                      |                      |
4. Land Status     |------------------------------               |                      |                      |
                   |                      |                      |                      |                      |
5. Annotation      |                      |-------------         |                      |                      |
                   |                      |                      |                      |                      |
6. Hydrography     |                      |   -----------        |                      |                      |
                   |                      |                      |                      |                      |
7. Referencing     |---                   |             ----     |                      |                      |
                   |                      |                      |                      |                      |
8. Bathymetry      |(not scheduled at this time)                 |                      |                      |
                   |                      |                      |                      |                      |
9. Habitats        |----  (no further schedule at this time)     |                      |                      |
                   |                      |                      |                      |                      |
10. Atlas          |                      |                      |                      |                      |
    Production     |     ppp     ccc      |kkkkk         pppcccc       kkkkkk           |                      |
                   |                      |                      |                      |                      |
11.  Map           |                      |                      |                      |                      |
     Production    |   ------------------------------------------------------------------------------------------|
                   |                      |                      |                      |                      |
12.  Database      |                      |                      |                      |                      |
     Integration   |   ------------------------------------------------------------------------------------------|
                   |                      |                      |                      |                      |
--------------------------------------------------------------------------------------------------------
```

Notes:

1. Shoreline types are complete for PWS and CIK, final review by E. Gundlach is required for KAP region.

2. Oil impact data is based on air/water study number 1 in the CERCLA document. The database is updated through periodic monitoring. See Air/Water study #1 detailed plan for schedule of complete end of summer oil database.

3. Under **atlas production**, p refers to Prince William Sound, c refers to Cook Inlet, Kenai Peninsula; and k refers to the Kodiak, Alaska Peninsula area.

VI. BUDGET/PERSONNEL

1. Job Costing

2. What Study Plan Budget Bought

   A. U.S. Fish and Wildlife Service - USFWS

   B. Alaska Department of Natural Resources - ADNR

3. Costs To Date

   A. Overall Summary

   B. Personnel Costs Detail

   C. Cost Detail

   Travel, Contractual, Commodities, Equipment

4. Cooperative Resource Allocations

1. JOB COSTING

According to guidelines established by the CERCLA Management Team, the following budget / job costing procedures will be implemented for the GIS technical group.

The existing GIS technical group budget is to be used for the following purposes:

1. Work related to capturing, controlling, documenting, and integrating, etc. those data related to the foundation layers.

2. Primary service work associated with the foundation layers.

3. Administrative work associated with the foundation layers.

The ADNR $488.0 and USFWS $66.0 are dedicated through February 28, 1990 for this purpose.

The GIS technical group will create job costing procedures for the following categories of work:

1) Work related to capturing, controlling, documenting, and integrating those data related to thematic layers.

2) Primary service work associated with thematic layers.

3) Administrative work associated with thematic layers.

Generally these job costing procedures will work as follows:

1) GIS personnel resources will be calculated at an hourly cost to include benefits. Personnel will include direct service individuals, and administrative individuals required to facilitate the requisite work.

2) Supplies will be calculated at cost plus documented handling.

3) Equipment costs are currently covered under the existing GIS technical group budget and through agency cooperation.

4) Environmental costs such as space, lighting, etc. are currently covered under the existing GIS Group budget, and/or existing agency budgets.

5) Logistical handling such as mail, shipping, phone calls, will be tracked where feasible and calculated at cost.

As the GIS technical group works with a user/study group on jobs, the following steps will occur:

1) Based on information gathered from the user, the GIS technical group will give a 'best guess' estimate of time and materials.

2) Services will actually be contracted for on a time and materials basis.

3) The GIS technical group will report accumulated costs with associated backup to the user/study groups at monthly intervals.

4) The user/study group is responsible for tracking and paying these costs. The GIS technical group is responsible for assuring that all costs bought the maximum return on labor, supplies, etc.

5) The user/study group is responsible for implementing the financial mechanism required to make this money available for the GIS technical group to use, (as in State RSA).

2) <u>WHAT STUDY PLAN BUDGET BOUGHT</u>

A. USFWS and USFS

$50.0 USFS	Contract work at USGS/EROS to help produce initial atlas drafts and plot maps. This money has been totally consumed. Outstanding deliverable from EROS is database transfer to ADNR with associated database documentation.
$5.5 USF&WS	Monies used to purchase from ComRim Systems, Inc. 1:63360 coastline digital data over CIK and KAP quads. This product has been delivered.
$61.5 USF&WS	Monies used to purchase ESI data in digital format from ESRI company. This product has been delivered.
$66.0 USF&WS	These monies will be used in conjunction with ADNR to provide services/goods

through 2/90.

Budget	YTD Costs	Balance
$183.0	$117.0	$66.0

B. ADNR

The ADNR GIS Project, located within the Land Records Information Section, is charged as co-lead for the Technical Services Study Number 3, Mapping of Damage Assessment Data and Information.

Based upon projected workload analysis, ADNR requested a $488.0 budget prorated for the field season 7/1/89 through 2/28/90. The Study Plan budget is:

Salaries	$134.0
Travel	11.5
Contracts	58.0
Supplies	45.0
Equipment	239.5
	$488.0

This budget plan calls for 100% dedication of the following resources:

Personnel - Three full time positions to handle 1) Programming, 2) Data Modeling, 3) Data administration. Additionally these monies will provide overtime pay for existing staff.

Travel - Connecting with Management (Juneau) and field offices in Kodiak and Valdez.

Contractual - Equipment maintenance, training, etc.

Supplies - High volumes of paper, chemicals, graphic supplies, etc. will be consumed.

Equipment - ADNR has implemented an oil spill subsystem as listed below:

Plotter - High volume color map output

Two Workstations - Speed and storage to handle large graphic database

Ethernet - Connect the subsystem through the existing ADNR computer to access existing equipment (other terminals, plotter, disk drives, tape unit, etc.)

High Density Tape Backup - Provide high density media to archive database

Software - Licenses for plotter, workstation and Ethernet software

3. <u>COSTS TO DATE 4/16/89 - 8/15/89</u>

ADNR

A. OVERALL SUMMARY

Personnel

	Exxon/CERCLA/HB154	ADNR General Fund
Costs	$52,100	$53,475
Labor Hours	1,514.0	1,778.5

As one can see, the CERCLA/HB154 needs are currently being highly supplemented at this point in time via reprioritized ADNR General Fund resources. This is expected to diminish as the third of three HB154 positions become filled, and also hopefully as the schedule demands diminish.

Travel

Travel is costing less than expected so far through the utilization of the DEC Charter Flight system between Anchorage, Valdez, and Kodiak. It is not known if this will continue through the winter.

Contractual - Monies to date are for equipment maintenance.

Supplies - Monies to date are for supplies.

Equipment

To date, the CERCLA GIS work has used an average of 62.5% of ADNR's existing computer equipment (CPU & peripherals) capacity since April, 1989. This resource has not been charged for. Because ADNR could not take this oil spill workload without impacting existing work, ADNR requested to implement an oil spill computer subsystem through this study plan budget.

As of September 10, all major oil spill subsystem equipment was installed. Staff are now finalizing operating procedures for this complex equipment.

All oil spill work will be moved to the subsystem, allowing ADNR to recoup the computer capacity funded by State General Funding that has been allocated since 4/15/89 to facilitate quick response to CERCLA mapping/information needs.

B. PERSONNEL COSTS/DETAIL Period 4/15/89 - 8/16/89

ADNR

	Labor Hours	Cost
Cooperatively Funded ADNR General Fund	1,778.5	$53,475
Exxon FY89/CERCLA/HB154	1,514.0	52,100
TOTAL	3292.5 hrs.	$95,575

COST DETAIL
(200 Travel, 300 Contractual, 400 Supplies, 500 Equipment)

State Fiscal Year 89 4/15 - 6/30/89

In addition to $36.6 to be charged through the State to Exxon for incremental labor, the project forwarded approximately $8,000 to Exxon for travel, supplies, misc. This was against an FY 89 supplemental budget amount of $8,100 for 200, 300, 400 categories.

State Fiscal Year 90/Field Year 7/1/89 - 2/28/90
(Costs as of 8/15/89)

	Budget	YTD Costs	Balance
200 Travel	11.5	$ 1,703	$ 9,797
300 Contractual	58.0	41,177	16,823
400 Supplies	45.0	17,301	27,699
500 Equipment	239.5	226,924	12,576
	354.0	287,105	66,895

3. **Cooperative Resource Allocations**

The selection of the ADNR Land Records Information Section, GIS Project as the production site (co-lead) for the CERCLA related mapping and statistical reporting needs was particularly attractive due to the existing Department expertise with large land appraisal exercises. Thus the

CERCLA process is benefiting from the Section infrastructure for administrative and managerial support, the existing four GIS positions, and the Department's mini computer equipment.

As of 8/15/89, the State has allocated more ADNR General Fund labor hours by a factor of 117%:

1,778.5 (General Fund hrs.)/1,514.0 (HB154 hrs.) = 117%

ADNR has also cooperatively shared an average of 62.5% of its GIS computing resources, in addition to the strong administrative support required for fast response to project implementation.

On what?

VII. Literature Cited

1. Environmental Sensitivity Index Maps
source: NOAA and MMS, pre-spill inventory from 1979 to 1984

ESI Book Name	Number of ESI Maps	Year
Prince William Sound	37	1983
Cook Inlet Kenai Peninsula	57	
Southern Alaska Peninsula	61	
Shelikof Straits	40	1983
Kodiak	45	
Total	240	

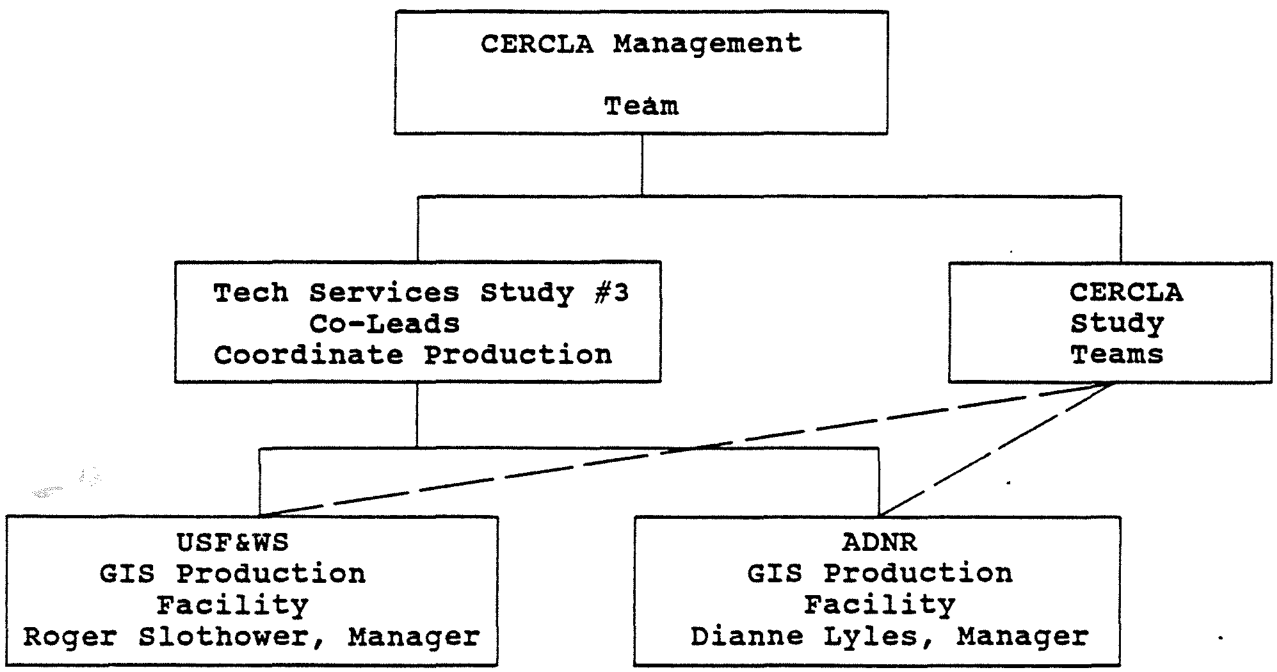
2. Please refer to citations from Pollution Abstracts at the end of this report for supplemental reference.

VIII. Additional Information

ORGANIZATIONAL CHART

Technical Services Study Number 3

Mapping of Damage Assessment Data and Information



VIII. Additional Information

PERSONNEL COSTING BACKUP
ADNR

Position	Name	Man Months
Section Chief	Dianne M. Lyles	hrs. to be determined and allocated cooperatively
GIS Manager	Richard McMahon	" "
Senior Modeler	Jean Tam	" "
Senior Analyst	Jim Jurgens	" "
GIS Programmer	Hal Brackett	" "
Admin. Assistant	Lex McKenzie	" "
Oil Spill Tech	Marilu Koschak	8 months 7/89 - 2/90
Oil Spill Programmer	Kathryn Engle	8 months 7/89 - 2/90
Oil Spill Data Administrator	Vacant, soon to be filled	8 months 7/89 - 2/90

USFWS

Position	Name	Man Months
GIS Manager	Roger Slothower	hrs. to be determined and allocated cooperatively
GIS Production	Mark Kildow	" "
GIS Technician	Barbara Boyle	" "
GIS Technician (oil Spill)	vacant	8 months 7/89 - 2/90
GIS Technician (oil spill)	vacant	8 months 7/89 - 2/90

USFS

Position	Name	Man Months
GIS Analyst	Zane Cornett	hrs. to be determined and allocated cooperatively
GIS Analyst	Bruce Williams	" "

PERSONNEL COSTING BACKUP[1]

ADNR/State General Fund Costs
4/15/89 - 8/16/89

Position	Hrly Rate	# Hrs	Benefit Rate	$ Amount	% Reg. Time On Oil Spill
Section Chief (OT)[2]	29.90	73.5	1.19	2,615	
Section Chief (regular time)	29.90	356.0	1.34	14,263	55%
GIS Mgr. (4/15-7/15)	19.85	305.5	1.34	8,125	70%
GIS Mgr. (7/16-8/15)	21.93	147.0	1.34	4,319	
Senior Modeler (4/15-7/15)	18.49	282.5	1.34	6,999	59%
Senior Modeler (7/16-8/15)	19.85	98.5	1.34	2,620	
Senior Analyst	23.46	334.0	1.34	10,499	51%
GIS Programmer	17.26	138.0	1.34	3,191	21%
Admin Assistant	14.48	43.5	1.34	844	7%
		1,778.5		$53,475	

Assumes:
- 19% benefits for OT
- 34% benefits for regular time
- no consideration for other Section personnel with spill related support activities (estimated at $3000 - $5000)

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[1] All staff listed on this page are existing ADNR staff cooperatively allocated to this project.

[2] not compensated - no cash flow.

ADNR Personnel Costing Backup
Exxon/CERCLA/HB154 Costs

$36,600	FY 89 OT Charges for Exxon reimbursement
15,500	7/1 - 8/15/89 Oil Spill Payroll
$52,100	TOTAL

	# Req Hrs	# OT Hrs	$ Amount
Section Chief		259.0	
GIS Manager		295.5	
Senior Modeler		199.5	
Senior Analyst		370.5	
GIS Programmer		130.5	
Admin Assistant		61.0	
Oil Spill Modeler (HB154 position)	75.0	6.5	
Oil Spill Analyst (HB154 position)	92.0	24.5	
	167.0 hrs.	1,347.0 hrs.	$52,100

Vacancy

Oil Spill Data Administrator (HB154 position) (vacant, soon to be filled)

BIBLIOGRAPHIC REFERENCES FROM POLLUTION ABSTRACTS

5/L/1
88-03260
Fate and persistence of crude oil stranded on a sheltered beach
Owens, E.H.; Harper, J.R.; Robson, W.; Boehm, P.D.
Woodward-Clyde Consult., 7330 Westview Dr., Houston, TX 77055, USA
ARCTIC VOL. 40, NO. suppl. 1, pp. 109-123, Publ.Yr: 1987
SUMMARY LANGUAGE - ENGLISH, FRENCH; Special issue: Baffin Island Oil Spill (BIOS) Project.
Languages: ENGLISH
Journal Announcement: V19N3
Details observations, mapping and sampling were conducted following an experimentally spill of 15 m super(3) of crude oil adjacent to the coast at Cape Hatt, Baffin Island, N.W.T. The beach could not retain all of the oil that reached the shoreline, and as a result, one-third of the spilled oil was recovered in cleanup activities on the water, approximately one-third was lost to the atmosphere and to the ocean and one-third remained stranded on the intertidal zone. The stranded oil was subjected to natural cleaning during approximately 6 months of open-water periods from 1981 to 1983. Over this period the surface area of oil cover was reduced by approximately half, whereas estimates indicate that 80% of the oil initially stranded (5.3 m super(3)) was removed. The primary conclusion from the investigations undertaken to date is that oil is removed substantial quantities from the intertidal zone even in such a sheltered, low-energy arctic environment. Similar changes should also be expected from comparable environments in lower latitudes.
Descriptors: oil spills; marine pollution; beaches; Baffin I., Cape Hatt; research programs
Identifiers: BIOS

5/L/2
87-06366
Estimating and quantifying oil contamination on the shoreline
Owens, E.H.
Geosci. Serv. Ltd., 340 Stoneywood Rd., Dyce, Aberdeen AB2 9JX, UK
MAR. POLLUT. BULL VOL. 18, NO. 3, pp. 110-118, Publ.Yr: 1987
SUMMARY LANGUAGE - ENGLISH
Languages: ENGLISH
Journal Announcement: V18N5
A wide range of parameters can be used to describe the degree of oil contamination on the shoreline following a spill. This study compares five parameters, obtained by visual estimates and systematic ground mapping on a gravel beach at an experimental spill site. For shoreline cleanup decisions the most relevant parameters involves the measurement of the area of surface oil cover and calculation of the volume of contaminated sediments. Accurate estimates of the volume of oil on the shore require sampling and measurements of the concentrations of oil in the sediments. The reliability of aerial or ground estimates of the oil distribution on a gravel beach decreases with time as the colour of the surface oil changes to blend with the local sediments.
Descriptors: oil spills; contamination; marine pollution; sediments; monitoring measurements

5/L/4
87-04757
Measuring oil at sea by means of airborne microwave radiometry in the range 5-34 GHz

Gillot, R.A.; Toselli, F. (eds.); Skou, N.
Electromag. Inst., Tech. Univ. Denmark, Lyngby, Denmark
THE ARCHIMEDES 1 EXPERIMENT pp. 83-104, Publ.Yr: 1985
COMM. EUROPEAN COMMUNITIES, LUXEMBOURG (LUXEMBOURG)
ENVIRON. QUAL. LIFE SER., , ,
Languages: ENGLISH

The Technical University of Denmark (TUD) participated in the Archimedes oil spill remote sensing experiments with its airborne multifrequency imaging radiometer system - originally developed for sea ice investigations in the arctic region. Side-looking radars and multispectral scanners offer great potential for detection and mapping of oil spills on the sea, but the microwave radiometer offers, a unique potential for the determination of oil slick thickness, hence eventually total oil volume within the slick. So, there is at present within Europe a great interest in turning the microwave radiometer from a research instrument into an operational oil mapping and quantifying instrument.

Descriptors: oil spills; marine pollution; microwaves; pollutant detection
Identifiers: Archimedes 1

5/L/5
87-04754
Detecting oil at sea by means of a HH polarized side looking airborne radar
Gillot, R.A.; Toselli, F. (eds.); Madsen, S.
Electromag. Inst., Tech. Univ. Denmark, Lyngby, Denmark
THE ARCHIMEDES 1 EXPERIMENT pp. 51-64, Publ.Yr: 1985
COMM. EUROPEAN COMMUNITIES, LUXEMBOURG (LUXEMBOURG)
ENVIRON. QUAL. LIFE SER., , ,
Languages: ENGLISH

The Technical University of Denmark (TUD) participated in the Archimedes oil spill remote sensing experiments with its SideLooking Airborne Radar (SLAR) and its multifrequency imaging radiometer system. The purpose of the SLAR measurements was first of all to provide large scale mapping of oil spills, indicating spill position and extent.

Descriptors: oil spills; remote sensing; pollutant detection; marine environments

5/L/6
85-04808
A review of the impacts and recovery of intertidal habitats and communities following accidental oil spills
Martin, L.C.
ESL Environ. Sci. Ltd., Vancouver, B.C., Canada
11. Annual Aquatic Toxicity Workshop Richmond, B.C. (Canada) 13-15 Nov 1984
ABSTRACTS OF PAPERS PRESENTED AT 11th ANNUAL AQUATIC TOXICITY WORKSHOP, RICHMOND, B.C., NOVEMBER 13-15, 1984 (np),
SUMMARY LANGUAGE - ENGLISH; Summary only.
Languages: ENGLISH

A recent review of worldwide oilspill case histories and followup studies has indicated that intertidal habitats and organisms are frequently the resources which have been most visibly affected following oil spills. The impacts and recovery of intertidal communities following these events has varied widely depending on the circumstances surrounding the spill and the characteristics of the intertidal habitat and community affected. This paper examines the contribution of some of these factors to the impact and recovery of intertidal habitats and communities.

Descriptors: oil spills; marine pollution; ecosystems

5/L/8

85-00182
Simulation of spilled oil behavior in bays and coastal waters
Hess, K.W.
NOAA TECH. MEMO Publ.Yr: 1983
NWS/TDL, SILVER SPRING, MD (USA)
SUMMARY LANGUAGE - ENGLISH; NTIS Order No.: PB84-122597; NOAA-TM-NWS-TDL-CP-83-2.
Languages: ENGLISH
OILSPILL is a computer program designed to forecast the behavior of floating oil in the coastal zone. The program, written in FORTRAN IV, runs on the AFOS (Automation of Field Operations and Services). Data General Eclipse S/230 computer. It can be stored on floppy disk and retrieved when it is to be run. The program, which is run at the Alphanumeric Display Module (ADM), requires input such as oil spill location, map parameters, and wind and water current forecasts.
Descriptors: simulation; oil spills; pollutant dispersion; bays; coastal water; computer programs; marine pollution

5/L/9
84-05601
Calculations of seabird population recovery from potential oilspills in the mid-Atlantic region of the United States
Samuels, W.B.; Ladino, A.
U.S. Miner. Manage. Serv., Mailstop 644, Reston, VA 22092, USA
ECOL. MODEL VOL. 21, NO. 1-2, pp. 63-84, Publ.Yr: 1984
SUMMARY LANGUAGE - ENGLISH
Languages: ENGLISH
Calculations were made of herring gull (Larus argentatus) and common tern (Sterna hirundo) population recovery from potential oilspill damage in the U.S. mid-Atlantic Outer Continental Shelf (OCS) oil leasing area. Population recovery was examined using a density-dependent age-specific life history table for each species. Both a deterministic and a stochastic approach were used in the calculations. In the deterministic approach, it was assumed that an oilspill contact to a seabird colony had occurred. Using the density-dependent model, population recovery was calculated for several different mortality scenarios. Assuming that all age classes suffer 95% mortality from an oilspill contact, a worst case scenario, it was estimated that the herring gull and common tern populations could recover to their pre-spill levels in approximately 45 years and more than 100 years, respectively.
Descriptors: oil spills; Larus argentatus; Sterna hirundo; mathematical models; population dynamics; wildlife

5/L/11
79-06455
NOAA surface mapping radar: Theory and application.
Evans, M.
NOAA, Wave Propagation Lab., R45x5, 325 S. Broadway, Boulder, CO 80302
Energy/environment '78: A symposium on energy development impacts Los Angeles, CA Aug. 22-24, 1978
Energy/environment '78: A symposium on energy development impacts: Proceedings. Edited by J. Siva-Lindstedt Publ.Yr: (1978?) pp. 259-270
(n.p.)
illus. refs.
Abs.
Languages: ENGLISH
Doc Type: CONFERENCE PAPER
The NOAA has developed a remote sensing instrument for the measurement of surface currents over large areas of oceans. This system utilizes the backscatter of a surface current-induced Doppler shifted signal from 6-m ocean waves. A single map, containing 800 surface current vectors and

covering 2,000 km2 of ocean, can be produced in J8 min. The CODAR (Coastal Ocean Dynamics Radar) system was successfully tested in Florida, Alaska, California, Georgia, and Washington over the previous 2 yr. Some areas for potential use for this system include real time oil spill trajectory monitoring, environmental impact studies, beach erosion studies, coastal zone management, and nuclear power plant thermal plume trajectory analysis. (AM, FT)

Descriptors: Measuring instruments; Currents; Oceans; Monitoring systems; Oil spills; Beaches; Erosion; Coastal zones; Resource management; Thermal discharges; Nuclear power plants; Remote sensing

Identifiers: CODAR; radar

5/L/12
79-05225
Oilspill has minimal effect on environment.
Koons, C. B.; Wheeler, R. B.
NORTHERN OFFSHORE 7(5), 24-25, Publ.Yr: May 1978 Coden: NROFA9
illus. no refs.
Sum.
Languages: ENGLISH
Doc Type: JOURNAL PAPER

About 400,000 T/yr of petroleum enters the North Sea and northeastern Atlantic, 95% of which comes from industrial wastes, transportation operations, and river and urban runoff. The estimated standing crop of dispersed hydrocarbons in the North Sea is 1.6 million t. The estimated standing crop of particulate petroleum floating on the surface is j180 t. The Ekofisk Bravo blowout which spilled 12,000-20,000 t appears rather insignificant when compared with the total standing crop of dispersed hydrocarbons. Physical, chemical, and biological factors which act on petroleum following an oil spill to lessen the possible effects on human and animal life are evaporation, biodegradation, drifting, and spreading. Studies in warm and cold marine waters confirm that although fish and other marine animals take up hydrocarbons, they are able to metabolize them. Priority should be given to protection of bays, estuaries, and marshes, areas most biologically productive; once these environments are contaminated, oil tends to persist longer. Short and long-term effects on birds were slight. (SS, FT)

Descriptors: Oil spills; Oil pollution; Environmental impact; Hydrocarbons; North Sea; Petroleum; Marine environments; Industrial wastes; Runoff; Toxicity; Marine organisms

Identifiers: Ekofisk Bravo blowout

5/L/13
79-03900
Risk forecasting for the Argo Merchant spill.
Wyant, T.; Smith, R. A.
USGS, National Center, Reston, VA 22090
In the wake of the Argo Merchant Kingston, R. I. Jan. 11-13, 1978
In the wake of the Argo Merchant: Proceedings of a symposium Publ.Yr: Aug. 1978 pp. 28-33
Publ: Kingston, R. I. University of Rhode Island, Center for Ocean Management Studies
illus. refs.
Abs.
Languages: ENGLISH
Doc Type: CONFERENCE PAPER

An oilspill trajectory model, originally developed to assess environmental risks of Outer Continental Shelf oil production, was used during the Argo Merchant spill to forecast the risk to various shoreline and marine resources. The model indicated a low risk to these resources given the location and season of the spill and the particular wind

conditions under which the spill occurred. Oil from the Argo Merchant, in fact, contacted few of these resources. Had a spill at this location occurred under other typical wind conditions for the season or at a different time of year, the risk would have been much higher. Quantitative estimates of risks were constructed assuming different initial conditions, seasons, and durations of spillage. (AM)
  Descriptors: Oil spills; Pollutant dispersal; Massachusetts Coast; Pollution forecasting; Mathematical models
  Identifiers: Argo Merchant

5/L/14
79-02745
  The effects of Bunker C oil and an oil dispersant: Pt. 2-effects on the accumulation of chlorine-labelled Bunker C oil in various fish tissues.
  McKeown, B. A.; March, G. L.
  Simon Fraser Univ., Dept. of Biological Sciences, Burnaby, B.C. V5A 1S6, Can.
  MARINE ENVIRONMENTAL RESEARCH 1(2), 119-123, Publ.Yr: Oct. 1978
  illus. refs.
  PA Citation No. 79-00268 Abs.
  Languages: ENGLISH
  Doc Type: JOURNAL PAPER
  Fish were exposed to 150 ppm concentrations of Bunker C and Oilsperse 43 for 24 hr prior to killing and tissue removal. There is an increased movement of the emulsified oil across the gill structure although accumulation by this tissue is similar for both test conditions. The liver and kidney showed significantly higher levels of the oil/dispersant mixture whereas muscle accumulations were less dramatic. The amounts of Bunker C found in the gills, liver and kidney were considerably higher than that found in the muscle. Consideration was given to the varying capability of the blood to carry polar, compared with non-polar, compounds. (AM)
  Descriptors: Fuel oils; Fish; Tissues; Toxicity; Hydrocarbons; Oil removers
  Identifiers: Bunker C oil; Oilsperse 43

7/M/2
86-04708
  Oil concentrations in seawater following dispersion with and without the use of chemical dispersants: A review of published data
  Chapman, P.
  Sea Fish. Res. Inst., Private Bag X2, Rogge Bay 8012, Cape Town, South Africa
  SPEC. REP. SEA FISH. RES. INST. S. AFR./SPES. VERS. NAVORSINST. SEEVIS. S.-AFR NO. 2, Publ.Yr: 1985
?TYPE S7/M/3-25^H^H51

7/M/4
85-04860
  Laboratory evaluation of chemical dispersants for use on oil spills at sea
  Anderson, J.W.; McQuerry, D.L.; Kiesser, S.L.
  Battelle, Mar. Res. Lab., Sequim, WA 98382, USA
  ENVIRON. SCI. TECHNOL VOL. 19, NO. 5, pp. 454-457, Publ.Yr: 1985
  SUMMARY LANGUAGE - ENGLISH

7/M/5
85-03421
  Toxicity testing of oil spill dispersants in South Africa
  Moldan, A.G.S.; Chapman, P.

Address not stated
S. AFR. J. MAR. SCI./S.-AFR. TYDSKR. SEEWET NO. 1, pp. 145-152, Publ.Yr: 1983
SUMMARY LANGUAGE - AFRIKAANS, ENGLISH

7/M/12
81-07906
Industry's Role in Preparation of ASTM Spill Control Consensus Standards
Leek, W.R.
Chevron USA, Inc.
Int. Oil Pollut. Prevent. Conf.(IOPPEC) Hamburg; W. Ger. 1980
IN "INT. OIL POLLUT. PREVENT. CONF. Publ.Yr: 1980
HAMBURG MESSE & CONGRESS GMBH, W. GER.

7/M/13
81-06696
Oil Spill Contingency Plans and Policies in Norway and the United Kingdom
O'Neill, T.
Sch. Forestry and Environ. Studies, Yale Univ., Hartford, CT
COASTAL ZONE MGMT. J VOL. 8, NO. 4, pp. 289-317, Publ.Yr: 1980

7/M/14
81-05247
Oil Spill Contingency Plans and Policies in Norway and the United Kingdom
O'Neill, T.
Sch. Forestry and Environ. Studies, Yale Univ.
COAST. ZONE MGMT. J VOL. 8, NO. 4, pp. 289-319, Publ.Yr: 1980

7/M/15
81-01174
Improved identification of spilled oils by infrared spectroscopy.
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