Exxon Valdez Oil Spill
Restoration Project Annual Report

Harbor Seal and Sea Otter Cooperative Subsistence Harvest Assistance

Restoration Projects 94244 and 95244
Annual Report

This annual report has been prepared for peer review as part of the *Exxon Valdez* Oil Spill Trustee Council restoration program for the purpose of assessing project progress. Peer review comments have not been addressed in this annual report.

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Restoration Projects 94244 and 95244
Annual Report

Study History: The project was initiated under Restoration Project 94244 in the Fiscal Year 1994 Work Plan, and continued as Restoration Project 95244 in the FY 1995 Work Plan. This is the first annual report prepared for this project, and summarizes activities for the first two study years. A separate report was prepared by the Alaska Sea Otter Commission as part of the contract supported by this project, entitled "Status and Trends of Harbor Seal and Sea Otter Populations in Prince William Sound and Lower Cook Inlet" (1995). The project is continuing in FY 1996 as Restoration Project 96244 with a new title, "Community-Based Harbor Seal Management and Biological Sampling."

Abstract: The project's goal was to develop an ongoing exchange of information and consensus building between subsistence hunters, scientists, and agencies regarding actions to support the recovery of injured populations of harbor seals and sea otters. Information on harbor seal and sea otter populations and trends was compiled, presented at workshops, and distributed in a report. Three workshops involving scientists and subsistence hunters occurred. Participants concurred that harbor seal populations remain depressed, and that hunters and scientists should work together to restore the populations. Most hunters believed that sea otter populations have largely recovered from the oil spill. Scientists and hunters can work together on biosampling programs, inclusion of hunters in scientific studies, and integration of traditional ecological knowledge into biological studies. Consensus-building was impeded by the lack of a formal organization representing subsistence users of harbor seals. However, as an outcome of the process initiated by this project, the subsistence users themselves formed an Alaska Native Harbor Seal Commission as a formal co-management body, which will be directly involved in this continuing project. Additionally, research was conducted to collect traditional knowledge and data on harbor seal harvest locations. A video entitled "Alaskan Harbor Seals: Science and Subsistence" was produced.

Key Words: Cook Inlet, *Enhyrda lutris*, *Exxon Valdez*, harbor seals, *Phoca vitulina*, Prince William Sound, sea otters, subsistence uses.

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EXECUTIVE SUMMARY

INTRODUCTION

Populations of harbor seals and sea otters were injured as a result of the *Exxon Valdez* oil spill and have not recovered. Both harbor seals and sea otters are taken for subsistence uses by Alaska Native hunters of communities of the oil spill region. Under the terms of the federal Marine Mammal Protection Act, subsistence uses of harbor seals and sea otters may be restricted only if these populations are declared depleted. Although injured by the spill, neither population has been so classified. Consequently, any conservation actions on the part of Alaska Native hunters can only be undertaken voluntarily. The overall goals of this project were to work cooperatively with subsistence hunters to involve them in marine mammal management, and to develop on ongoing exchange of information and consensus building between hunters, scientists, and agencies regarding appropriate actions which subsistence users might take to assist in the recovery of these injured resources. The Division of Subsistence of the Alaska Department of Fish and Game was the lead agency for this project.

OBJECTIVES

In federal Fiscal Years 1994 and 1995, the project had five objectives. These were: 1) compile the available information on harbor seal and sea otter populations and trends; 2) hold meetings and workshops for marine mammal biologists and subsistence users to exchange, review, and discuss this information; 3) produce an informational video; 4) collect new information regarding harbor seal harvest locations and traditional ecological knowledge regarding harbor seals and sea otters; and 5) develop recommendations for subsistence users of harbor seals and sea otters based upon the study findings and workshop results.

METHODS

The compilation of existing information was accomplished through a contract, in the form of a cooperative agreement, between the Alaska Department of Fish and Game and the Alaska Sea Otter Commission. The Alaska Sea Otter Commission contracted with Dr. Brendan Kelly of the Institute of Marine Science, University of Alaska Fairbanks, to prepare the report and present the findings in project workshops. Dr. Kelly's report was prepared as a separate document, entitled, "Status and Trends of Harbor Seal and Sea Otter Populations in Prince William Sound and lower Cook Inlet."

Four meetings/workshops were organized as part of the project. The first involved marine mammal biologists, other agency personnel, and representatives of the Alaska Sea Otter Commission and the Chugach Regional Resources Commission. Its purpose was to plan the data completion report and the subsequent workshops. Two large workshops, each attended by over 30 people, took place in Anchorage. Participating were subsistence hunters, other community and regional organization representatives, marine mammal biologists, and other agency representatives. The workshops consisted of data presentations and discussions. Detailed written summaries of the two workshops were distributed to all the participants. A third

workshop took place in Cordova as part of a meeting of the newly formed Alaska Native Harbor Seal Commission.

Division of Subsistence staff undertook research in Prince William Sound (Cordova, Valdez, Tatitlek, Chenega Bay) and lower Cook Inlet (Seldovia, Port Graham, Nanwalek) communities, interviewing hunters and mapping harbor seal harvest locations. The results of these interviews were incorporated into data bases. This work is continuing.

Portions of the first workshop were video taped and incorporated into the informational video, entitled "Alaskan Harbor Seals: Science and Subsistence." Also included were interviews with two marine mammal biologists and the chair of the Alaska Native Harbor Seal Commission. Topics that are covered include the impact of the oil spill on harbor seal populations, current research, biosampling, and co-management.

RESULTS

The data compilation report concluded that subsistence harvests of harbor seals currently take about four to eight percent of the total harbor seal populations of Prince William Sound and lower Cook Inlet annually. A healthy harbor seal population would be able to grow despite this level of harvest. However, because the harbor seal population of the Gulf of Alaska is declining, for unknown reasons, these harvests add to the decline. Because of incomplete data, the actual effect of the subsistence harvest on the population cannot be determined.

Regarding sea otters, current subsistence harvests are about one to three percent of the total population of lower Cook Inlet and Prince William Sound annually. The report concluded that this level of subsistence harvest is sustainable.

All of the workshops resulted in a lively exchange of information and a basic resolve that hunters and scientists need to develop more effective ways to work together towards a common goal of effective harbor seal and sea otter management and conservation. Dr. Brendan Kelly presented the findings of the data compilation report at both of the Anchorage workshops. Among the topics and consensus points of the first workshop, which occurred on December 2, 1994, were the following:

- There was a consensus that the harbor seal populations of Prince William Sound and Lower Cook Inlet remain severely depressed.
- While sea otter populations of Prince William Sound are not yet classified as recovered by the Trustee Council, most hunters and users have concluded that sea otters are abundant and have largely recovered from any spill effects
- Substantial traditional knowledge is held by Alaska Natives. Although sometimes dismissed by western scientists as "anecdotal," such information is vital to a full understanding of marine mammal populations and trends. Procedures need to be developed so that this traditional knowledge can be appropriately collected, organized, and accessed. Alaska Natives must be full participants in such an endeavor.
- Hunters also need to be meaningfully involved in biological research.
- Alaska Native groups must be involved in current stock assessments by the National Marine Fisheries Service and the US Fish and Wildlife Service

- A strong need exists to establish positive working relationships between Alaska Native communities and governmental agencies. This need is being addressed for sea otters through the Alaska Native Harbor Seal Commission, but no such organization existed to represent subsistence users of harbor seals.

The second workshop took place in Anchorage on March 2, 1995. Based upon a recommendation from the first workshop, participation was expanded to include representatives from southeast Alaska, Kodiak Island communities, and the Aleutian/Pribilof Islands area, to bring their perspectives on harbor seal and sea otter conservation issues. Again, a series of data presentations was followed by discussion. A set of conservation actions for harbor seals and sea otters, based upon the data compilation report, was distributed and discussed. Major highlights of this second workshop included the following:

- Participants from outside the Chugach Region concurred that harbor seal populations continue to decline. In addition to oil spill effects, they suggested other causes, including food shortages, commercial fisheries-related mortalities, and killer whale predation.
- As in the first workshop, the need to combine traditional knowledge with that of biologists was stressed
- The National Marine Fisheries Service has identified three stocks of harbor seals in Alaska. Alaska Natives need to participate in this stock assessment program.
- There is a tremendous potential for furthering knowledge about harbor seal and sea otter populations through a biological sampling program that involves subsistence hunters. There was consensus among the workshop participants that these programs be supported.
- Development of other recommendations for harbor seal hunters is hindered by the lack of a formal organization which represents the interests of subsistence hunters of harbor seals.
- Following this workshop, the Alaska Native representatives caucused, and agreed to work on the formation of a Harbor Seal Commission.

The Alaska Native Harbor Seal Commission was formed subsequent to this second workshop. The project supported a third workshop in connection with a meeting of the Commission in Cordova in September 1995. Topics of discussion included stock assessments, biosampling, the development of the traditional knowledge database, and the informational video.

DISCUSSION

During the first two years of the project, notable steps were taken towards achieving the project's goals. These included preparation and distribution of a major data summary report; enhancing communications between subsistence hunters and scientists through a series of workshops, written communications, and a video; and the collection of new data on subsistence hunting patterns of harbor seals and traditional ecological knowledge about marine mammals. Perhaps most important, as a result of the process initiated by this project, harbor seal hunters and users themselves have formed an Alaska Native Harbor Seal Commission. Because the

workshops held as part of this project consisted of ad hoc groups of community representatives, there was no formal mechanism to act upon any conservation recommendations concerning harbor seals. With the formation of the Harbor Seal Commission, a forum now exists in which a consensus on conservation actions can be achieved.

CONCLUSIONS

The goals and objectives for the continuation of this project into Fiscal Year 1996 were based directly on the findings and recommendations of the two major workshops organized as part of this cooperative project. Because of the relatively low levels of subsistence harvests of sea otters, the conclusion that these harvests are not impeding population recovery, and the view among the large majority of subsistence users that sea otter populations are well on their way towards full recovery from the oil spill, it was decided to focus the full attention of this project in the future on harbor seal restoration. Meeting the Trustee Council's recovery objective for harbor seals will be enhanced by continuing the dialogue begun under this project between scientists and subsistence users, involving subsistence hunters in research efforts, implementing biosampling programs, integrating traditional knowledge into scientific studies, and collaborating in the development of recommendations for conservation actions by subsistence hunters. Correspondingly, in Fiscal Year 1996, the Alaska Native Harbor Seal Commission will be a major participant in this continuing project. Workshops and community meetings will continue, and a pilot biosampling program will take place in Prince William Sound and lower Cook Inlet. Work will also continue on developing an accessible traditional knowledge database. The creation of the Alaska Native Harbor Seal Commission as a formal co-management body increases the likelihood that a consensus can be reached on the appropriate steps to take to restore the injured harbor seal population of the oil spill area.

INTRODUCTION

Populations of harbor seals and sea otters were injured as a result of the *Exxon Valdez* Oil Spill. The harbor seal populations of Prince William Sound and the northern Gulf of Alaska were in decline before the oil spill for unknown reasons. The spill compounded this decline; an estimated 300 seals died (*Exxon Valdez* Oil Spill Trustee Council [EVOSTC] 1994a:III-9). Sea otters were among the resources must vulnerable to injury from the spilled oil, with an estimated 3,500 to 5,500 dying in the first few months after the spill (EVOSTC 1994a:III-10). According to the *Exxon Valdez* Oil Spill Restoration Plan (EVOSTC 1994b:44, 52), neither harbor seals nor sea otters have recovered from these oil spill injuries.

Harbor seals are a primary subsistence resource in the Alaska Native communities of the oil spill region (Wolfe and Mishler 1993). Subsistence harvests of harbor seals have declined in many of communities since the spill because of the reduced population size and voluntary efforts on the part of hunters to limit their harvests to aid in recovery. Sea otters are also harvested for subsistence purposes in the communities of the oil spill region (Stephensen et al. 1994).

In order to address these injuries, the *Exxon Valdez* Oil Spill Trustee Council funded restoration projects in the federal Fiscal Year 1994 (FY 94) Restoration Work Plan (No. 94244) and the FY 95 Restoration Work Plan to cooperatively assess the relationships between the population trends of sea otters and harbor seals in Prince William Sound and lower Cook Inlet, the oil spill, and subsistence harvests of these populations. Initially, this project idea originated with the Restoration Planning Working Group in 1992 as a means to implement draft restoration Option 8, to "restrict or eliminate legal harvest of marine and terrestrial mammals and sea ducks." An action proposed under this restoration option was "to convey information to subsistence users about the status of injured species of marine mammals and other resources and, if appropriate, encourage voluntary reductions in harvest levels" (EVOSTC 1992:B-13). The purpose of the proposed project would be to evaluate the voluntary conservation efforts of subsistence hunters and to identify measures which subsistence users could take to further assist in harbor seal restoration. In developing the project proposal further, it was recognized that conservation measures would need to be arrived at through a cooperative process involving the hunters themselves. Further, such a process would have to be based upon a shared understanding of the available data and conservation goals. Thus, the overall goal of the project became to work cooperatively with subsistence hunters to involve them in marine mammal management, in support of the ongoing efforts of the Alaska Sea Otter Commission. A further goal was to develop an ongoing exchange of information and consensus building with regard to the management of harbor seals. The Division of Subsistence of the Alaska Department of Fish and Game was the lead agency for this project.

Under the terms of the federal Marine Mammal Protection Act, only Alaska Natives may hunt marine mammals, including harbor seals and sea otters, for subsistence purposes. (No non-subsistence hunting is allowed.) The Act further specifies that subsistence uses may not be restricted unless a marine mammal population has become depleted. Although injured by the oil spill, the harbor seal and sea otter populations of the Gulf of Alaska have not been declared depleted. Therefore, any conservation efforts on the part of Alaska Native hunters must be undertaken voluntarily. Decisions regarding such efforts need to be reached collaboratively, and can only be reached through organizations that are endorsed by the marine mammal hunting communities themselves. When the project got underway, such an organization, the Alaska Seal

Otter Commission, was actively involved in conservation planning for sea otters, but no such organization existed for harbor seals. As discussed below, directly as a result of this project, the Alaska Native Harbor Seal Commission formed, and has taken on the task of participating in harbor seal conservation, recovery, and co-management on behalf of Alaska Native subsistence users of harbor seals.

The project approached its goals with two basic strategies. The first was the preparation of a written report which summarizes and analyzes the available information about the relationships between harbor seal and sea otter population dynamics and subsistence harvests. A second focus of efforts was to develop a public participation process, including workshops, written communications, and community meetings, which built upon ongoing efforts towards cooperative management of marine mammals. This report summarizes the results of the first two years of the project. The project continued with revised and expanded goals, objectives, and methods, in federal Fiscal Year 1996 (see below).

OBJECTIVES

Project objectives for FY 94 and FY 95 included:

- A compilation of available data on harbor seal and sea otter populations and trends
- Meetings of marine mammal biologists and subsistence users of harbor seals and sea otters to evaluate and discuss the data
- Production of an informational video
- Collection of harvest location data for harbor seals and other information, including traditional ecological knowledge, in Prince William Sound and lower Cook Inlet communities
- Development of recommendations for subsistence users of harbor seals and sea otters based upon study findings and workshop results

METHODS

Data Compilation

The compilation of existing information was accomplished through a contract (in the form of a cooperative agreement) between the ADF&G and the Alaska Sea Otter Commission. The cooperative agreement is attached as Appendix A. The ASOC was chosen to do this work because of the organization's previous efforts on sea otter management plans, its expertise in marine mammal biology and issues, and its relationship with the communities of the study region, all of which use both sea otters and harbor seals for subsistence purposes. Also, because at the time there was no similar organization for harbor seals, it was appropriate to combine these data compilation efforts into a single agreement. The ASOC contracted with Dr. Brendan Kelly of the Institute of Marine Science, University of Alaska Fairbanks, to compile the information, prepare a written report, and present the findings at the project workshops (see below).

This project incorporated information on the numbers, distribution and degree of recovery of the populations of harbor seals and sea otters from restoration projects 94064 (Harbor Seal

Habitat Use and Monitoring) and 94246 (Sea Otter Recovery Monitoring Project). As part of this project, information was also gathered on seal and sea otter harvests in Prince William Sound and the Lower Kenai Peninsula to help marine mammal researchers to evaluate the impacts, if any, of the harvest on the recovery of those populations. This assessment of harvests is discussed in more detail in the section below on "Research."

Workshops

The study design called for a meeting of an "ad hoc group" of hunters and scientists to develop recommendations for subsistence users concerning how they might support restoration efforts for harbor seals and sea otters. It was recognized that any compliance with the group's recommendations would be voluntary, as the ad hoc group would have no authority to compel changes in hunting efforts or methods. As planning for the project progressed, it was decided to hold a series of meetings and workshops to address the project's goals concerning communication and the development of recommendations.

Three workshops and one agency planning meeting were held to plan the project, review information, and discuss potential recommendations to subsistence users. The first meeting involved agency personal, a few other marine mammal biologists, and a few regional organization representatives. Originally, it was hoped to hold this planning workshop in the spring of 1994, but most marine mammal biologists were already in the field by May. This resulted in postponing the agency/biologist meeting until September 1994. The first two workshops were multi-community meetings held in Anchorage in December 1994 and March 1995. They involved hunters, other subsistence users of harbor seals and sea otters, marine mammal biologists, other agency personnel, and representatives of regional and state-wide organizations which represent subsistence users of marine mammals. The third workshop in September 1995 took place in Cordova as part of a meeting of the newly formed Alaska Native Harbor Seal Commission.

Research

Information on subsistence sea otter harvests was available through the US Fish and Wildlife Service marking and tagging program. This included harvest quantities, timing of harvests, and location of harvests (Stephensen et al. 1994). For harbor seals, the Division of Subsistence, under contract with the National Marine Fisheries Service, had developed a harvest monitoring program using local research assistants. This program collected data on harvest quantities, harvest composition by age and sex, and timing of the harvest (Wolfe and Mishler 1993, 1994, 1995).

For this restoration project, division researchers also interviewed harbor seal hunters concerning harvest locations. Prior to beginning this aspect of the research, letters were sent to each village government seeking approval for the project. After receiving this approval, Ronald Stanek conducted interviews with hunters from Seldovia, Port Graham, and Nanwalek, while Jody Seitz and Bill Simeone interviewed Cordova, Tatitlek, Valdez, and Chenega Bay hunters. Harvest location data were entered into a GIS database by ADF&G cartographer Carol Barnhill. This research is ongoing.

Additionally, division researchers conducted key respondent interviews in the study communities covering such topics as trends in harbor seal and sea otter populations and distribution. Field notes from previous division projects were reviewed, edited, and further annotated. These notes, along with the new information, were incorporated into a data base using the askSam system. A preliminary discussion of the data base took place at the Alaska Native Harbor Seal Commission workshop in Cordova in September 1995 (see below). This data base development is continuing into FY 1996.

RESULTS

Data Compilation

Under the terms of the cooperative agreement between ADF&G and the ASOC, Dr. Brendan Kelly, along with two graduate students, Jill Anthony and Laurie Jemison, prepared a report entitled "Status and Trends of Harbor Seal and Sea Otter Populations in Prince William Sound and lower Cook Inlet" (ASOC 1995). A preliminary draft of the report was completed in November 1994 and provided the basis for Dr. Kelly's presentations at the first workshop (see below). This draft was circulated widely for review by marine mammal biologists and agencies. A revised draft was prepared in February 1995 for the second workshop. Following some further minor revisions, the report was finalized and printed in July 1995. Approximately 50 copies were distributed to workshop participants, marine mammal biologists, agencies, and the Oil Spill Public Information Center. This report is attached as Appendix K

Regarding the current relationship between subsistence harvests and the recovery of harbor seal populations in Prince William Sound, the report concluded that (ASOC 1995:19-20):

> Assuming a combined harbor seal population in Lower Cook Inlet and Prince William Sound of 5,481 - 9,730, the 1992 and 1993 subsistence harvest was equivalent to 4 - 8% of the population. A healthy harbor seal population would be able to grow in spite of such a harvest. The population in the Gulf of Alaska, however, has been declining for reasons that are not known. Whatever the cause, the harvests will increase the rate of the decline. The actual effect of the harvest on the population trend cannot be predicted accurately due to incomplete knowledge of the population size, other sources of mortality, and the rates of movements between areas.

Regarding sea otters, the report concluded that hunters in Prince William Sound have removed less than 3 % of the sea otter population over the last two years. In Cook Inlet, less than 1 % of the population was harvested in 1993 and 1994 (ASOC 1995:53). The report concluded that, "This current level of subsistence harvest is sustainable by the sea otter population" (ASOC 1995:54).

Mapping and Traditional Knowledge

As noted above, Division of Subsistence staff interviewed seal hunters in Seldovia, Nanwalek, Port Graham, Cordova, Tatitlek, Chenega Bay, and Valdez regarding harvest

locations and aspects of traditional ecological knowledge. Much, but not all, of the results of these interviews were incorporated into a field note database called "Whiskers," a compilation of traditional ecological knowledge about Alaska marine mammals. In FY 1996, data collection, mapping, and data base development will continue. An overview of the findings of this research will appear in the final project report.

Meetings and Workshops

As noted above, three hunter/scientist workshops and an agency planning meeting took place as part of this project. Each will be discussed in turn. For the first and second workshops, both of which involved subsistence hunters and users as well as agency representatives and scientists, the following overviews are based primarily on summaries prepared and distributed following each of the workshops.

Agency Planning Meeting.--

This workshop took place in Anchorage on October 7, 1994. The agenda appears as Appendix B. The purpose of the meeting was to organize the project, arrive at a general consensus about realistic goals, update each other on research activities, provide guidance to the Alaska Sea Otter Commission concerning the report it would prepare as part of the project, and discuss the proposed workshops between subsistence users, biologists, and other agency staff. The participants were:

- James Fall, Alaska Department of Fish and Game, Division of Subsistence
- Sue Mello, National Marine Fisheries Service
- Rita Miraglia, Alaska Department of Fish and Game, Division of Subsistence
- Kathy Frost, Alaska Department of Fish and Game, Division of Wildlife Conservation
- Patty Brown, Chugach Regional Resources Commission
- Polly Wheeler, Alaska Sea Otter Commission
- Laurie Jemison, University of Alaska Fairbanks
- Brendan Kelly, University of Alaska Fairbanks
- Craig Mishler, Alaska Department of Fish and Game, Division of Subsistence
- Ron Stanek, Alaska Department of Fish and Game, Division of Subsistence
- Angela Doroff, US Fish and Wildlife Service, Marine Mammals Management
- Brad Smith, National Marine Fisheries Service

Discussion topics and discussion leaders were as follows:

- Review project goals, objectives, and schedules (Jim Fall)
- Review Division of Subsistence study findings regarding harbor seal harvests in 1992, 1993, and 1994 (Jim Fall and Craig Mishler)
- Review harbor seal population status and trends, lower Cook Inlet and Prince William Sound (Kathy Frost)

- Review sea otter population status and trends, lower Cook Inlet and Prince William Sound (Angela Doroff)
- Brief the group on summer research (Kathy Frost, Brendan Kelly, others)
- Discuss Alaska Sea Otter Commission contract and proposed products (Jim Fall, Polly Wheeler, Brendan Kelly, others)
- Discuss agenda for a workshop with subsistence users, researchers, and managers (everyone)
- Set tentative date for the workshop (everyone)

Concerning the data summary report, the workshop participants agreed that the following topics were appropriate. These served as the guidelines for the draft report (discussed above).

- Overview of population status and trends, harbor seals and sea otters, with a focus on Prince William Sound and lower Cook Inlet
- Summary of *Exxon Valdez* oil spill studies on harbor seals and sea otters.
- Summary of subsistence harvest data from sea otter tagging program, including harvest numbers and location of harvests.
- Summary of Division of Subsistence harvest quantity and location data for harbor seals
- An overview of recovery goals and objectives
- A discussion of the potential relationships between subsistence harvests and these recovery goals and objectives

First Hunter/Scientist Workshop.--

The first workshop involving hunters, other community representatives, scientists, and other agency and organization representatives took place on December 2, 1994 in Anchorage at the RurAL CAP library. Prior to the workshop, a one-page project description was mailed to communities and organizations, outlining the workshop and project goals. (Appendix C). As explained to the participants, the purpose of the workshop was to bring together community representatives, marine mammal biologists, co-management groups, and other agency representatives to collaboratively review and share information about populations of harbor seals and sea otters of Prince William Sound and Cook Inlet. The workshop centered on a discussion of actions that might be taken to aid in the recovery of these populations after the *Exxon Valdez* oil spill. A copy of the agenda is attached as Appendix D. Also, each community representative was mailed a list of questions and topics to think about prior to the meeting (Appendix E).

Approximately 31 people participated in the workshop. A list of attendees is attached as Appendix F. A brief overview of some of the discussion which took place during the workshop was prepared by James Fall (Division of Subsistence, ADF&G) with assistance from Polly Wheeler (ASOC), incorporating notes regarding the major discussion points taken by Carl Hild (RurAL CAP) during the workshop It was distributed to all participants and is the basis for the following synopsis. The summary pointed out that it was not meant to imply that there was complete agreement among participants on all of the discussion points. Unless noted otherwise, it was also not meant to represent the positions or opinions of any particular individuals or organizations.

Discussion of draft Harbor Seal and Sea Otter Report

Brendan Kelly of the University of Alaska summarized the draft report that he and two of his graduate students (Jill Anthony and Laurie Jemison) prepared for the workshop on "Status and Trends of Harbor Seal and Sea Otter Populations in Prince William Sound and Lower Cook Inlet, Alaska." Discussions followed Brendan's presentations for each species. Sections of this presentation and discussion were video-taped and were incorporated into the informational video (see below). Most of the discussion focused on harbor seals. Among the major points of discussion were the following:

- There was consensus that harbor seal populations in both Prince William Sound and Cook Inlet continue to be severely depressed. Hunters shared specific observations of areas where they have noted declines.
- Substantial knowledge is held by Alaska Native hunters. We need to develop an acceptable and appropriate way to recognize, collect, and use this information.
- The marine mammal biologists noted that basic information is lacking for harbor seals, such as good population estimates, historical data, information on distribution of seals, especially in the winter and near glaciers, movements of animals, and interactions between subpopulations.
- The need to involve hunters meaningfully in research was brought out repeatedly by both the hunters themselves and biologists (see summary of afternoon session).
- The National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS) have prepared draft stock assessments for these and other marine mammal populations. These assessments raise important questions about the definition of stocks, the current population levels of these stocks, current levels of subsistence harvests, and the number of animals that may be taken each year from each stock without injuring the stock or its growth to desirable levels (the PBR or "potential biological removal"). The need for Alaska Native groups to review these assessments and to be actively involved in this process was emphasized. The stock assessments point to the need for more and better information. Many were drawn up based upon poor or very limited data. A teleconference was scheduled for December 14, 1994 as an opportunity for Alaska Natives to comment on these draft stock assessments.
- One community representative asked "How close [are federal agencies] to regulation of [harbor seal] hunters?" The NMFS (Linda Shaw) responded by saying there needs to be a finding that the population is depleted before any restrictions on hunting are imposed. The NMFS prefers to approach any necessary hunter restrictions through a process of co-management.
- Section 119 of the Marine Mammal Protection Act (MMPA) provides for co-management agreements with Alaska Native organizations and contains appropriation language. The process to deal with Section 119 is currently being developed.
- Regarding sea otters, there is some evidence of limited recovery from the effects of the spill in Prince William Sound, but full recovery there has not taken place. It was reported by the Seward representative that sea otter numbers in Resurrection Bay continue to be down since

the spill. Most other Alaska Native participants in the workshop, however, stated that they believe that sea otters are relatively abundant and have largely recovered from the oil spill.

- The Alaska Sea Otter Commission is developing regional management plans for sea otter populations.

Comments and Recommendations from Community Representatives

Most of the afternoon was spent discussing the need for involvement by subsistence hunters and other local community residents in marine mammal research and co-management activities. There was general agreement that such involvement is necessary for complete understanding of marine mammal populations and trends, and for recovery of these species. There was also a consensus that this involvement is presently very inadequate (and in most studies, nonexistent) and much needs to be done to correct this situation. Additionally, community representatives stated that the need exists for local communities and hunter organizations to be pro-active in defining issues, identifying information needs, and designing necessary research. Following are some of the points brought out by community representatives.

Traditional Knowledge

- Hunters have a great deal of knowledge about marine mammal populations that is essential to a full understanding of these populations. Examples of this knowledge include distributions of animals at different times of the year, historical information, and observations of the condition of harvested animals. It is often not possible for marine mammal biologists to collect this information because of their limited time in the field.
- Often, the knowledge held by hunters is dismissed by western scientists as "anecdotal" and "secondary" to quantified data such as population numbers. However, experience in working with hunters (such as those involved in the Alaska and Inuvialuit Beluga Whale Committee) shows that, to the contrary, such information is critical to biological studies and management decisions. All studies should try to incorporate both kinds of information.
- Procedures need to be developed so that the large amount of traditional knowledge already collected can be accessed by scientists, perhaps through databases. This would enable biologists to consult and cite these databases during their research. This would also add scientific credibility to this kind of information.
- Alaska Native groups and/or communities need to be participants in the collection and use of this information so that they are a part of the process and have some control of and responsibility for the use of the data. The issue of Native ownership or co-ownership of data was discussed.
- In working with Native people, western scientists need to respect Alaska Native traditions regarding instruction and knowledge. For example, it is disrespectful to argue with elders. Joint observations and participation in hunts and scientific investigations may be better techniques than relying solely on a great deal of direct questioning, which may be viewed as intrusive.

- RurAL CAP and the Indigenous Peoples' Council for Marine Mammals sponsored a workshop on "Alaska Native Traditional Knowledge and Ways of Knowing" in September 1994. A summary of the workshop is available from RurAL CAP (Carl Hild). RurAL CAP is seeking additional funding to support traditional knowledge projects.

Potential Use and Misuse of the Information:

- The information provided by Alaska Natives should not be used against local communities. For example, there is distrust among some hunters that harvest information may be used to unfairly restrict their harvest activities.
- Some kinds of information that is collected during research projects from Native hunters should not be given out to the general public. An example includes locations of harvest activities.
- Alaska Natives should not be asked to justify their reasons for not wanting to share data. Participation in research projects and providing harvest data need to remain voluntary.
- There are risks involved for hunters in providing harvest data to researchers. There is also a risk if such information is not available, because agency decisions might be made anyway, without reliable data.

Involvement of Hunters and Other Local Community Residents in Research

- Scientific studies of resources need to involve hunters and other local community residents in study designs and implementation.
- Native organizations require technical assistance in preparing project proposals for (for example) Trustee Council funding. Sources need to be found to provide funds to Native organizations to acquire this technical assistance and develop these skills.
- Scientific projects should include training and payment of hunters for their current observations and local historic knowledge.
- The contributions of hunters need to be clearly acknowledged in summaries of project results.
- Research projects should hire local boats, crews, and observers.
- All projects should make data that has been collected available to those who participated.

Potential Organizational Structures

- A strong need exists to establish a positive working relationship between Native communities and governmental agencies.
- As of December 1994, no statewide or regional organization existed to represent subsistence users of harbor seals and to facilitate interactions between them, scientists, and government agencies. Such commissions exist for other marine mammals (e.g. beluga, sea otter, bowhead whale, walrus) and have proved to be effective.
- Creation of a Harbor Seal Commission would be a positive step towards restoration of this population by facilitating communication and cooperation between users and scientists.

- The people involved in this workshop should work to establish a Harbor Seal Commission with restoration funding and/or other sources of funding such as Administration for Native Americans (ANA) grants.
- There are other appropriate forums for discussion of these issues. These include community meetings and additional subsistence restoration workshops. Another opportunity is the "Understanding Harvest Assessment Methods" symposium being sponsored by the University of Alaska and the ADF&G at Girdwood on April 20 - 22, 1995.

What to do Next?

- Follow-up with a second workshop, one goal of which would be to facilitate the organization of a Harbor Seal Commission. This meeting should occur before April, 1995 when other activities may prevent community involvement. Consideration should be given to inviting representatives from other harbor seal and sea otter using areas, such as Kodiak.
- Villages may call for individual community meetings prior to the follow-up workshop to discuss the information provided in this first workshop and to review ideas about a harbor seal commission.
- Multiple representatives from each community (as in this workshop) should also attend the next one.

It was agreed that a summary of the first workshop would be distributed, following which a second workshop would be organized. Decisions needed to be made on an agenda for the second workshop, as well as a time and place to hold it. This planning took place in January and February 1995, and primarily involved ADF&G and ASOC staff.

Second Hunter/Scientist Workshop.--

This second hunter/scientist workshop took place on March 2, 1995 in Anchorage. It was again held in the RurAL CAP library. The purpose of the second workshop was to build upon the information and consensus points from the first workshop, which took place on December 2, 1994. For both meetings, a primary goal was to bring together community representatives, marine mammal biologists, co-management groups, and other agency representatives to collaboratively review and share information about populations of harbor seals and sea otters of Prince William Sound and Cook Inlet. The workshop again centered on a discussion of actions that might be taken to aid in the recovery of these populations after the *Exxon Valdez* oil spill. A copy of the agenda is attached as Appendix G.

Over 30 people attended portions of the workshop, with about 31 people participating in most of the meeting. A list of attendees is attached as Appendix H. Consistent with the recommendations from the first workshop, participants from southeast Alaska, Kodiak Island, and the Aleutian Islands were invited to give overviews of their communities' observations regarding harbor seals and sea otters and to assist with identifying ways to aid in their recovery.

The following is a brief overview of some of the discussion which took place during the second workshop. It was prepared by James Fall (Division of Subsistence, ADF&G) with assistance from Polly Wheeler (ASOC). This summary is not meant to imply that there was complete agreement among participants on all of the discussion points. Unless noted otherwise, it is also not meant to represent the positions or opinions of any particular individuals or organizations.

Major topics and highlights of the second workshop

- Participants from outside the Chugach region concurred with Prince William Sound and lower Cook Inlet representatives and biologists about declines in harbor seal populations in the Gulf of Alaska region. Community representatives identified several potential causes of the decline in addition to the *Exxon Valdez* oil spill, such as food shortages caused by commercial trawl fisheries, commercial fisheries-related mortalities, and killer whale predation.
- As in the first workshop, the need to combine the knowledge of subsistence hunters with that of biologists was stressed. Direct involvement of subsistence hunters in scientific studies is highly desirable.
- NMFS has identified three stocks of harbor seals in Alaska. Alaska Natives need to closely monitor and participate in the stock assessment program.
- There is tremendous potential for furthering knowledge about harbor seal and sea otter populations through a biological sampling program that involves subsistence hunters. There was consensus among participants that subsistence hunters should be encouraged to participate in these programs. There is also a strong need for agencies to coordinate these sampling programs and to find funding sources to support them.
- Development of other recommendations for harbor seal hunters is hindered by the lack of a formal organization which represents the interests of subsistence users of harbor seals.
- Following the workshop, community representatives agreed to work on the formation of a Harbor Seal Commission.

Overview of the Second Workshop Discussions

Overview of the Project and the First Workshop

The meeting began with introductions. Jim Fall then gave a brief synopsis of the purpose of the restoration project. He then gave a summary of the first workshop.

Discussion of Draft Harbor Seal and Sea Otter Report

Brendan Kelly of the University of Alaska provided an overview of the status of harbor seal and sea otter populations based upon the report that he and two of his graduate students (Jill Anthony and Laurie Jemison) prepared for the restoration project on "Status and Trends of Harbor Seal and Sea Otter Populations in Prince William Sound and Lower Cook Inlet, Alaska"

(AOSC 1995) A revised draft of the report was distributed for further review. Following are some of the topics discussed during Brendan's presentation.

The Prince William Sound subsistence harvest of harbor seals is about 4 to 8 percent of the regional population estimate. This level of harvest is sustainable by a healthy population. However, since the population is declining, the subsistence harvest is adding to the decline. The level of subsistence harvest of sea otters is relatively small and is not an important factor in the recovery of sea otter populations from the effects of the oil spill.

How reliable are harbor seal population estimates and trends that are provided by marine mammal biologists and by local community observers? This topic came up in discussions of harbor seal population trends in the Copper River Flats, where only three population counts by scientists have taken place. Although local observers may not be able to discern changes in large populations, their involvement is important in assessments in of local population trends. This is an example of why traditional knowledge and western scientific knowledge need to be integrated. This was a theme throughout the workshop.

Reports from Local Community Representatives

Pete Squartsoff of Port Lions voiced concern about declines in seal populations in the Kodiak Island area. He stressed that researchers need to hire knowledgeable local people in their projects.

Flore Lekanof, representing the communities of the Aleutian/Pribilof Islands area, provided an overview of the subsistence uses of marine mammals in his region. He is especially concerned by steep declines in sea lion numbers and probable restrictions on their use, which may lead to increased subsistence harvest pressures on harbor seals. Flore also said that there needs to be more research done on the movements of seals between and within regions.

Harold Martin, representing the communities of southeast Alaska, said that there are no problems with harbor seal numbers in southeast Alaska despite bounty programs in the past. Harold believes that population estimates for southeast are too low, in part because surveys do not involve local communities. There is some cause for concern in that hunters from Tenakee report taking seals with unusually thin layers of fat, suggesting that they are not getting enough food. Regarding the Gulf of Alaska harbor seal populations, Harold stated that not all of the decline can be attributed to the oil spill. He believes that the by-catch by trawlers is reducing the food supply for seals and they are starving. Harold also stated that sea otter numbers continue to grow in southeast Alaska and they are moving into inside waters, where they will have impacts on subsistence shellfish resources.

George Gatter of Old Harbor noted that as new commercial fisheries have opened or expanded, such as cod fisheries, seal numbers have declined, including at rookeries. He believes there has also been habitat destruction caused by commercial trawlers. He also noted that he has observed an increase in the number of killer whales and asked about the effects of killer whale predation on harbor seals.

Mark King of Cordova/Eyak reported that he has observed killer whale predation on seals and sea lions. Killer whales learn where the rookeries are and are very effective hunters. Kathy Frost of ADF&G reported that a restoration project for this coming year (FY 96 Work Plan) will investigate the effects killer whale predation and commercial fisheries moralities on harbor seal populations (Project Number 96012).

Virginia Squartsoff of Larsen Bay said that she is concerned that commercial fishermen (seiners) continue to shoot seals to protect their catches, and that this too is a cause of the population decline. Kate Wynne (UAF-Kodiak) noted that until this year, fishermen were allowed to scare seals away by firing guns, but this is not longer legal. She is getting the word out that if seal populations continue to decline, commercial fisheries will suffer. Peer pressure needs to be developed to prevent these seal mortalities. This appears to have worked for sea lions.

Discussions of Research and Data Needs

Regarding the decline in seal numbers, Flore Lekanof asked if there are data on seal diets. The biologists noted that there is a strong need for more data on this subject. A big unknown is what is happening to young animals. They cannot go long without food and their food supply may be impacted by commercial fisheries by-catch. Gary Kompkoff (Tatitlek) noted that herring declines in Prince William Sound also have an impact. Kathy Frost noted that data on harbor seal diets are 20 years old and more seal stomach contents need to be collected for study.

Dave Withrow (NMFS) gave an overview of harbor seal population surveys, which are done over several years in a cycle of four regions. The fourth part, the Aleutians, has been finished and results should be available in a month or so. A survey may take place along the north Alaska Peninsula and Bristol Bay in August and September. Work has also been done on a "correction factor," the number that is used to convert the observed number of seals into an estimate of the total population. Based on work in Southeast Alaska, a correction factor of 1.7 is being used in recent surveys.

Biological Sampling Programs

There needs to be an increase in hunter involvement in sampling programs. Harvested seals can provide a wealth of information. Kate Wynne, Kathy Frost, and Una Swain provided information on what can be learned from samples of whiskers, skin, and fat. An issue is sources of funding for these kinds of programs. Kathy Frost said that some funding for sample collection will be requested from the Trustee Council. (Note: a pilot biosampling component was included in Project Number 96244.) Linda Shaw (NMFS) said that NMFS might have funding for a statewide sampling program to be implemented through the harvest monitoring project conducted by the Division of Subsistence, ADF&G. (Note: NMFS funded a sampling program in limited areas of southeast Alaska, the Aleutian Islands, and Bristol Bay for FY 1996.) Port Lions and Old Harbor now have freezers for preserving samples. These tissue collection programs will only work if villages get involved. It will also be important for biologists to get the sample collection programs organized. The formation of a harbor seal commission would be very beneficial to this effort, because it could assist with organizing the program and getting support from communities and hunters.

Una Swain brought collection kits which she described. She offered to distribute kits to interested hunters. All of the kits were distributed at the meeting. Pat Norman of Port Graham expressed interest in bringing marine mammal biologists to his community to explain the use of the kits. Pat thought that there would be strong support for this program in his community.

Subsistence Harvest Monitoring Program

Jim Fall gave an overview of the harbor seal subsistence harvest monitoring project which is conducted by the Division of Subsistence through funding from NMFS using a network of local community researchers. An overview is attached as Appendix I. The report summarizing the second year's findings had just been published (Wolfe and Mishler 1994).

Stock Assessments

Dave Withrow of NMFS gave an overview of the marine mammal stock assessment process. (See summary of first workshop, above, for more background.) Three stocks of harbor seals have been identified: southeast Alaska, Gulf of Alaska and Prince William Sound, and Bering Sea including the Aleutian Islands. Takes of stocks that are identified as strategic will be reviewed annually, with the goal to reduce the incidental takes by commercial fisheries to zero. (Note: on August 25, 1995, the National Marine Fisheries Service published a notice of completion of marine mammal stock assessments in the Federal Register. Of the three harbor seal stocks in Alaska, two were not classified as strategic, and no determination was made on the third, that of the Gulf of Alaska [National Marine Fisheries Service 1995]).

Development of Hunter Recommendations

Brendan Kelly and Jim Fall distributed an "Outline of Proposed Conservation Actions for Harbor Seals and Sea Otters" which was extracted from Brendan's restoration project report (see Appendix J). The discussion centered on the need for better organization, communications, and sharing of information within the scientific community and between scientists and subsistence users. The development of a harbor seal commission would support this communication, although meetings between hunters and biologists would also need to continue and expand. It was clear that development of a consensus on specific recommendations would be difficult without a formal organization such as a commission.

Despite the difficulty of developing recommendations without a formal structure, there appeared to be a consensus among the participants that subsistence hunters should be encouraged to participate in biological sampling programs.

Another potential recommendation that was discussed was encouraging seal hunters from areas with declining stocks to travel to other areas where stocks are stronger, such as Southeast Alaska or Bristol Bay. It was also noted that during the oil spill, when Prince William Sound subsistence hunters did not hunt, sharing of seal and other resources from southeast Alaska occurred and perhaps this also could be encouraged to relieve hunting pressures. However, community representatives were not supportive of urging hunters to travel outside their own traditional use harvest for hunting. It was noted that communities have their own traditional territories which are respected by other hunters. It would also be very expensive to subsidize this kind of travel. Sharing is not new, but should probably not be part of a government subsidized program.

Follow-up to the Workshop

Immediately following the second workshop, participants met concurrently in two working groups.

1. The agency representatives and marine mammal biologists reviewed biological sampling plans and possibilities. It was clear that coordination of these efforts needs to take place.
2. Community representatives met along with Polly Wheeler (ASOC) to further discuss the formation of a Harbor Seal Commission. There was a consensus among this group that a statewide Harbor Seal Commission be formed, with representation from those areas which use harbor seals. The Chugach Regional Resources Commission and the Alaska Sea Otter Commission volunteered to provide some initial technical support for the formation of the commission. Monica Riedel was appointed as the acting chair. She planned to schedule an organizational teleconference/meeting and identify "seed money" to get the commission organized.

In the summary of this second workshop that was distributed to each participant, the following suggestions were made concerning "What to do next?"

- Hold a third workshop, perhaps in conjunction with a meeting of the Harbor Seal Commission. [This workshop took place in Cordova in late September, see below].
- Individual community meetings should be scheduled to discuss the information provided at the workshops, review ideas about a harbor seal commission, and organize biological sampling programs. (Note: these will take place in the next phase of the project.)
- The report prepared by Brendan Kelly for the Alaska Sea Otter Commission should be finalized and distributed. [This took place in July 1995.]

Third Hunter/Scientist Workshop.--

The third workshop took place as part of a meeting of Alaska Native Harbor Seal Commission in Cordova on September 27, 1995. Participating were:

Monica Riedel, chair of the ANHSC (from Cordova)
Harold Martin, vice-chair (from Juneau)
Alfred Quijance, treasurer (from Seldovia)
Mitch Simeonoff (from Akhiok)
Flore Lekanof (from St. George and Anchorage)
Craig Mishler, ADF&G Division of Subsistence
Carl Hild, marine mammal biologist, RurAL CAP
Linda Shaw, NMFS
Gilbert Olson, Alaska Sea Otter Commission
Andy Allen, Cordova subsistence harbor seal hunter.

An important topic of discussion at the meeting concerned the recently released harbor seal stock assessments published in the Federal Register on August 25 (National Marine Fisheries Service 1995). There was much discussion about the "N/D" (not determined) classification used in place of a minimum estimate of harbor seals in the Gulf of Alaska. According to NMFS, this estimate could not be made because of incomplete genetic data on the range of animals to be included in the stock.

Craig Mishler (ADF&G) gave a presentation on four topics:

1. the results of the ADF&G/NMFS 1994 harbor seal harvest survey,
2. the new harbor seal biosampling research funded by NMFS for southeast Alaska, the Aleutian Islands, and Bristol Bay,
3. a preliminary overview of the askSam database of indigenous local knowledge about marine mammals ("Whiskers"), and
4. the harbor seal informational video which he was then preparing as part of this project.

Monica Riedel reported on the Harbor Seal Commission's biosampling program in Prince William Sound and lower Cook Inlet as designed by Kate Wynne (UAF Kodiak) and Vicki Vanek (ADF&G) as part of Restoration Project 96244, approved in August by the Trustee Council. Each commission member was asked to seek a letter of appointment from the organizations they represent so that they could become official rather than interim commissioners. They were also asked to seek alternate members who could attend meetings in their place. This structure was adopted from the Alaska Sea Otter Commission.

In summary, this meeting went extremely well. Participants were very convivial and appear to be working in harmony on a wide range of substantive issues. They are eager to educate themselves more on the biological issues, and are taking steps to deal with the recovery of declining stocks. On the latter topic, Craig Mishler suggested that the commission may want to recommend some conservation measures such as those adopted by the St. Paul Sea Lion Commission to reduce their struck and lost rates (which he later supplied to commission members), a suggestion that was well-received. As the co-management of Alaskan marine mammals becomes a greater reality, this commission could very well lead the way for other Alaska Native groups.

Video

The informational video produced as part of this project is entitled, "Alaskan Harbor Seals: Science and Subsistence." It is 29 minutes in length. The purpose of the video is to improve communication between scientists and subsistence users of harbor seals. The video includes footage from the first harbor seal/sea otter workshop held in Anchorage in December 1994. It also includes video-taped in-depth interviews with Jon Lewis (ADF&G), Kathy Frost (ADF&G) and Monica Riedel (ANHSC). Topics discussed include the impact of the oil spill on harbor seal populations in Prince William sound and the Gulf of Alaska, current research, biosampling, and co-management. The video was in the final stages of production in late October 1995. Up to 100 copies will be distributed by the end of November 1995.

DISCUSSION

During the first two years of this project, notable steps were taken to accomplish the project goals. These included

- A major summary, in report form, of the data on the present status of harbor seal and sea otter populations of the spill area (ASOC 1995), which was the basis for presentations at two workshops and was distributed to communities, researchers, hunters, and organizations throughout the spill area.
- Communication between subsistence users and hunters of sea otters and harbor seals was enhanced though two large workshops and written summaries.
- New data on subsistence harvests of harbor seals and traditional ecological knowledge of both seal and sea otters were collected and organized.
- Perhaps most notable, as a result of the process initiated by this project, harbor seal hunters and users have themselves formed a new Alaska Native Harbor Seal Commission. The purposes of the commission, as summarized in its Certificate of Incorporation (ANHSC 1995), include:

    1. To encourage and implement self-regulation of harbor seal use by coastal Alaska Natives who utilize this resource by involving Native users in the decision making process
    2. To provide education and information to the public, appropriate management agencies, and other interested parties
    3. To represent its member coastal Alaska Native communities in reviewing and commenting on regulatory changes or resource development which may affect harbor seals
    4. To promote conservation and well-being and sustainable development of harbor seals for use by Alaska Natives
    5. To be involved in all phases of scientific, biological, and other research programs involving harbor seals
    6. To actively participate in the formulation of, and/or implementation of, harvest monitoring efforts, and protection of the harbor seal population
    7. To encourage the Alaska Native Harbor Seal Commission, government of the United States of America, other nations, and indigenous groups to cooperate in exchanging information that contributes toward improved management of harbor seals.

    Each of these purposes is consistent with the goals of restoring the injured harbor seal population of the oil spill area.

A set of draft recommendations (conservation actions) for subsistence hunters to consider was prepared and discussed at the workshops. Because the workshops consisted of ad hoc groups of community representatives and scientists, there was no formal mechanism to act upon any of these recommendations. Outside of the workshops, however, actions are taking place.

These include a biosampling program for harbor seals involving Alaska Native hunters, the continuing work of the Alaska Sea Otter Commission on management plans for sea otters, the formation of the Alaska Native Harbor Seal Commission, and the continuing support of this project by the Trustee Council. The goals and objectives in the project design for Restoration Project 96244, which will now focus specifically on harbor seals, are based primarily on the recommendations of the two major workshops. The ANHSC, representing the interests of the subsistence users of harbor seals, will be a major participant in the project, filling a major gap that was identified at the workshops.

CONCLUSIONS

For sea otters, the Trustee Council's recovery objective states that sea otters will be considered recovered when population abundance and distribution are comparable to prespill abundance and distribution, and when all ages appear healthy (EVOSTC 1994b:52). Although the Trustee Council does not consider sea otter populations recovered from the effects of the spill, most subsistence users who were involved in this project stated that, in there view, sea otters are relatively abundant and have recovered since 1989. Also, because of relatively low levels of subsistence harvest, these harvests currently have little effect on sea otter recovery. Increased harvests could affect particular subpopulations, however (ASOC 1995:53). The primary action that subsistence users of sea otters can take to support restoration is to participate in the activities of the Alaska Sea Otter Commission and support its efforts to cooperatively develop regional management plans for the species. Consequently, sea otters will not be part of this continuing restoration project.

The Trustee Council's recovery objective for harbor seals states that recovery will have occurred when harbor seal population trends are stable or increasing (EVOSTC 1994b:44). Based on findings from the workshops which involved scientists and subsistence users of harbor seals and supported by this project, meeting this recovery objective will be enhanced by continuing dialogue between scientists and subsistence users, involving subsistence hunters in research efforts, integrating traditional knowledge into scientific studies, and collaborating in the development of recommendations for subsistence hunters about how they can assist in harbor seal recovery. For example, subsistence hunters can provide substantial information about the winter location and abundance of seals, the condition of seals taken for subsistence purposes, and seal behavior.

In FY 1996, this continuing project will implement the recommendations of the workshops by supporting the activities of the newly formed Alaska Native Harbor Seal Commission, funding workshops and community meetings which review data and hypotheses, collecting and organizing traditional knowledge into an accessible database, developing a pilot biological sampling program, and providing other technical support to the Alaska Native Harbor Seal Commission. The formation of this formal co-management body for harbor seals increases the likelihood that a consensus can be reached on the appropriate steps to take to restore the injured harbor seal population of the oil spill area, as well as the reduced populations in the Gulf of Alaska overall.

ACKNOWLEDGEMENTS

First of all, the important contributions of all of the workshop participants need to be gratefully acknowledged. Special thanks go to Polly Wheeler, executive director of the Alaska Sea Otter Commission, whose support was vital to the success of this project. Brendan Kelly, Laurie Jemison, and Jill Anthony are to be thanked for their work on the data summary report. The author also acknowledges the contributions from the research of Division of Subsistence subsistence resource specialists Craig Mishler, Rita Miraglia, Jody Seitz, Bill Simeone, and Ron Stanek. They, along with Lisa Scarbrough, assisted with organizing the workshops and participated in them. Thanks also to the Rural Alaska Community Action Program for providing the space to hold the first two workshops. Finally, Monica Riedel of Cordova deserves special mention for moving forward with the workshop suggestions and being the catalyst for the formation of the Alaska Native Harbor Seal Commission.

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APPENDIX A

ADF&G # Coop-95-024

Cooperative Agreement between the Alaska Department of Fish and Game and the Alaska Sea Otter Commission

This agreement is made and entered into by the Alaska Department of Fish and Game, Division of Subsistence, 333 Raspberry Road, Anchorage, Alaska 99518, and the Alaska Sea Otter Commission, PO Box 83177, Fairbanks, Alaska, 99708, for the period September 1, 1994 through June 30, 1995.

I. Purpose of the Agreement

Populations of harbor seals and sea otters were injured as a result of the *Exxon Valdez* Oil Spill. According to the draft *Exxon Valdez* Oil Spill Restoration Plan, neither species has recovered from these injuries. Consequently, the *Exxon Valdez* Oil Spill Trustee Council has funded a project (No. 94244) to cooperatively assess the relationships between the population trends of sea otters and harbor seals in Prince William Sound and lower Cook Inlet, the oil spill, and subsistence harvests of these populations. The goal of the project is to work cooperatively with subsistence hunters to involve them in marine mammal management, in support of the ongoing efforts of the Alaska Sea Otter Commission, and to develop an ongoing exchange of information and consensus building with regard to the management of harbor seals. The Division of Subsistence of the Alaska Department of Fish and Game is the lead agency for this project.

The project has two primary objectives. The first is a written report which summarizes and analyzes the available information about the relationships between harbor seal and sea otter population dynamics and subsistence harvests. The division requires assistance in the preparation of this report because division staff do not have the biological expertise to prepare such a report. A second objective is a public participation process, including a workshop, newsletters, and community meetings, which builds upon ongoing efforts towards cooperative management of marine mammals.

The Alaska Sea Otter Commission (ASOC) is uniquely qualified to participate in this restoration project under the terms of this cooperative agreement, and it is essential that the ASOC be meaningfully involved in order to meet the project's goals. The ASOC was formed in 1988 to promote Alaska Native participation in resource policy decisions affecting sea otters and their uses. Its purposes include the conservation and well-being of sea otter populations, involving Alaska Natives in resource decisions, and working with regulatory agencies toward the common goal of enhancing and promoting healthy populations of sea otters. All of these purposes are consistent with the goals of the subsistence restoration project. To achieve these goals, the ASOC has a board of directors who represent the communities that use sea otters, publishes a newsletter, and has prepared draft management plans for the species for southeast Alaska, the Chugach region, and lower Cook Inlet (the latter two are the regions in which the restoration project is to take place). Its staff includes professional marine mammal biologists and resource specialists who have taken the lead in developing the management plans in cooperation with resource management agencies.

It is also the intent of this cooperative agreement that it will further the goals of the Memorandum of Agreement between the ASOC, the Department of Fish and Game, and the U.S. Fish and Wildlife Service (FWS). These three parties entered into this MOA on February 1, 1994. Among the goals of the agreement are the conservation of northern sea otters, research for sound management decisions, harvest monitoring and reporting, and education and information sharing. The parties agreed to work together toward the resolution of management conflicts. As part of the MOA, the ASOC agreed to (among

other things): provide a method for transfer of local knowledge about sea otters and their uses to federal, state, and tribal agencies so that this information can be used in decisions about the conservation and management of sea otters; work with coastal Alaska Native villages to promote responsible management practices and nonwasteful uses of sea otters; act as a liaison between village governments and federal and state agencies with regard to management concerns, research, educational information, village concerns, and federal laws and regulations; and cooperate with the FWS and the ADF&G in developing and disseminating educational materials on the conservation and management, and utilization of sea otters. Also as part of the MOA, the ADF&G agreed to cooperate with the ASOC and the FWS in developing and disseminating educational materials on the conservation, management, and utilization of sea otters.

Although the activities of the ASOC have focused on sea otters, the goals of the restoration project regarding harbor seals will also be achieved most readily by this cooperative agreement. All of the communities of Prince William Sound and lower Cook Inlet which use sea otters for subsistence purposes also use harbor seals. In most cases, the same individuals who hunt sea otters also hunt seals. Thus the public participation process should include both species. Also, the biological processes which are affecting both species should be addressed in a single report prepared by professionals with knowledge about both species. The staff of the sea otter commission have this expertise and experience. Finally, building upon the ASOC's experiences regarding sea otters will promote the achievement of similar goals for harbor seals.

II. Covenants of the Department of Fish and Game
The Division of Subsistence does hereby agree:

1. To provide up to $10,000 to the ASOC to carry out their duties under this agreement. This includes all salary, travel, and supplies. Payments will be made upon receipt and acceptance of monthly invoices.

2. To provide the ASOC with data about the subsistence harvests of harbor seals in communities of Prince William Sound and lower Cook Inlet, including, when available, harvest quantities and harvest locations.

3. To provide the ASOC with copies of notes based on interviews conducted by division staff with knowledgeable subsistence hunters about sea otter and harbor seal uses, populations, and other traditional knowledge.

4. To communicate with communities involved in the project to explain research goals and obtain community support for the research.

5. To arrange a workshop with subsistence users of sea otters and harbor seals, marine mammal biologists, and ASOC staff to review the research findings and develop recommendations for subsistence users regarding ways to assist in the recovery of these populations.

6. To organize a series of community meetings where these study findings and recommendations will be discussed, and to involve the ASOC in these meetings.

7. James Fall and Rita Miraglia will serve as project leaders for ADF&G.

III. Covenants of the Alaska Sea Otter Commission
The Alaska Sea Otter Commission does hereby agree

1. To prepare a work plan within two weeks of the effective date of this agreement which includes the steps that will be taken to prepare the report described in (3), below, including data sources, key individuals to consult, and an outline of the report's contents. The work plan must be reviewed and approved by ADF&G before further work on the project continues.

2. To participate in a workshop in October 1994 with marine mammal biologists from the Department of Fish and Game and other agencies and organizations, and Division of Subsistence staff, to discuss project goals and objectives and begin to plan a public workshop and a series of public meetings.

3. To prepare a draft report which compiles available data on the sea otter and harbor seal populations of Prince William Sound and lower Cook Inlet. The report will contain the following:

-- Overview of population status and trends
-- Summary of *Exxon Valdez* oil spill studies on harbor seals and sea otters.
-- Summary of subsistence harvest data from sea otter tagging program, including harvest numbers and location of harvests. (The Division of Subsistence will supply similar data for harbor seals, which should be summarized here also.)
-- An overview of recovery goals and objectives
-- A discussion of the potential relationships between subsistence harvests and these recovery goals and objectives

4. To present a draft of the report to an ad hoc committee of subsistence users, biologists from the Department of Fish and Game and other agencies and organizations, and Division of Subsistence staff, in November 1994.

5. To assist the ad hoc committee in developing data interpretations for the public.

6. To complete a final report which incorporates suggestions developed by the ad hoc committee.

7. To participate in public meetings to exchange information with subsistence users, occurring primarily during the period from December 1994 through March 1995.

IV. It is mutually agreed that

1. Nothing in this agreement shall obligate any party in the expenditure of funds, or future payments of money, in excess of appropriations authorized by law.

2. Each party agrees that it will be responsible for its own acts and the results thereof and each party shall not be responsible for the acts of the other party; and each party agrees it will assume to itself risk and liability resulting in any manner under this agreement.

3. No board member, or the Commissioner, shall be admitted to any share or part of the agreement or to any benefit that may arise therefrom.

4. Each party will comply with all applicable laws, regulations, and executive orders relative to Equal Employment Opportunity.

5. Nothing herein is intended to conflict with federal, state, or local laws or regulations. If there are conflicts, this agreement will be amended at the first opportunity to bring it into conformance with conflicting laws or regulations.

6. Policy and position announcements relating specifically to this cooperative program may be made only by mutual consent of the parties to the agreement.

7. Upon termination of this agreement any equipment purchased for studies initially in furtherance of this agreement will be returned to the agency of initial purchase.

8. The effective date of this agreement shall be the date of the last approval signature.

9. A draft report is due by November 18, 1994. A final report must be delivered by December 2. Final invoices are due by June 15, 1995.

10. Twenty percent will be withheld by ADF&G pending satisfactory completion of all work items and receipt and acceptance of the final report.

11. A free exchange of research and assessment data among agencies is encouraged and is necessary to insure the success of these cooperative studies.

12. Any material published or data acquired as a result of this cooperative program may be reproduced, with credit given to the agencies, or organizations responsible for the development of the material.

13. This agreement may be revised with mutual consent by issuance of a written amendment, signed and dated by both parties.

14. The ASOC and any agents and employees act in an independent capacity and are not officers or employees or agents of the state in the performance of this contract.

15. The indemnity and insurance provisions in appendix A, which is attached, are incorporated and made a part of this agreement. ASOC shall provide a certificate of the required insurance prior to the effective date of the agreement.

16. The parties consent to the jurisdiction of the Superior Court of the State of Alaska and shall be bound by the laws of Alaska with respect to any dispute under this agreement.

SIGNED: DATED:

Director
Division of Subsistence, Alaska Department of Fish and Game
Juneau, Alaska

9/28/94

Director, Division of Habitat and Restoration
Alaska Department of Fish and Game
Juneau, Alaska

9/29/94

Chief of Restoration Planning
Alaska Department of Fish and Game
Juneau, Alaska

9/29/94

Director, Division of Administration
Alaska Department of Fish and Game
Juneau, Alaska

9 29 94

Chair
Alaska Sea Otter Commission
Fairbanks, Alaska

9/27/94

APPENDIX B

AGENDA

Organizational Meeting: Oil Spill Restoration Project 94244 (Harbor Seals and Sea Otters)
October 7, 1994
Anchorage, AK

Participants

ADF&G, Division of Subsistence: Jim Fall, Rita Miraglia, Craig Mishler, Ron Stanek
ADF&G, Division of Wildlife Conservation: Kathy Frost
NMFS: Linda Shaw
USFWS: Angela Doroff
Alaska Sea Otter Commission: Polly Wheeler, Brendan Kelly
Chugach Regional Resources Commission: Patty Brown-Schwalenberg

The purpose of the meeting is to organize the project, arrive at a general consensus about realistic goals, update each other on research activities, provide guidance to the Alaska Sea Otter Commission concerning the report they will prepare as part of the project, and discuss the proposed workshop between subsistence users, biologists, and other agency staff.

Proposed discussion topics:

- Review project goals, objectives, and schedules (Jim Fall)
- Review Division of Subsistence study findings regarding harbor seal harvests in 1992, 1993 and 1994 (Jim Fall and Craig Mishler)
- Review harbor seal population status and trends, lower Cook Inlet and Prince William Sound (Kathy Frost)
- Review sea otter population status and trends, lower Cook Inlet and Prince William Sound (Angela Doroff)
- Brief the group on summer research (Kathy Frost, Brendan Kelly, others)
- Discuss Sea Otter Commission contract and proposed products (Jim Fall, Polly Wheeler, Brendan Kelly, others)
- Discuss agenda for a workshop with subsistence users, researchers, and managers (everyone)
- Set tentative date for workshop (everyone)

Proposed overview report

Proposed contents of the overview report to be prepared by the ASOC, which is to serve as the basis for discussions at the workshop:

- Overview of population status and trends, harbor seals and sea otters, with a focus on Prince William Sound and lower Cook Inlet
- Summary of *Exxon Valdez* oil spill studies on harbor seals and sea otters.
- Summary of subsistence harvest data from sea otter tagging program, including harvest numbers and location of harvests.
- Summary of Division of Subsistence harvest quantity and location data for harbor seals
- An overview of recovery goals and objectives
- A discussion of the potential relationships between subsistence harvests and these recovery goals and objectives

APPENDIX C

BRIEF PROJECT DESCRIPTION

DISTRIBUTED TO PARTICIPATING COMMUNITIES

(appears on next page)

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

DIVISION OF SUBSISTENCE

333 RASPBERRY ROAD
ANCHORAGE, ALASKA 99518-1599
PHONE: (907) 267-2353
FAX: (907) 349-4712

July 1994 (update 11/94)

Exxon Valdez Oil Spill Trustee Council Restoration Project No. 94244
Harbor Seal and Sea Otter Recovery

The *Exxon Valdez* Oil Spill Trustee Council has funded a project to cooperatively assess the relationships between the population trends of sea otters and harbor seals in Prince William Sound and lower Cook Inlet, the oil spill, and subsistence harvests of these populations. The goal of the project is to work cooperatively with subsistence hunters to involve them in marine mammal management, to support the ongoing efforts of the Alaska Sea Otter Commission, and to develop an ongoing exchange of information and consensus building with regard to the management of harbor seals. The Division of Subsistence of the Alaska Department of Fish and Game is the lead agency for this project. The division is coordinating this effort with another project, funded by the National Marine Fisheries Service, to estimate the subsistence harvests of harbor seals and sea lions by Alaska Natives.

As part of this project, division researchers will be interviewing subsistence hunters about their uses of harbor seals and sea otters. For harbor seals, information about harvest quantities and harvest locations will be collected. These data are already available for sea otters through the U.S. Fish and Wildlife Service's tagging program. For both species, researchers will collect information from hunters about population trends, harvest strategies, and traditional conservation practices.

A portion of this project will be done by the Alaska Sea Otter Commission (ASOC) through a contract with the Department of Fish and Game. Under this contract, the ASOC will participate in a workshop of marine mammal biologists; prepare a report which compiles available data on the sea otter and harbor seal populations of Prince William Sound and lower Cook Inlet; present the findings of the report to an ad hoc committee of subsistence users, biologists from the Department of Fish and Game and other agencies and organizations, and Division of Subsistence staff; assist the ad hoc committee in developing data interpretations for the public; and participate in public meetings to exchange information with subsistence users. The written report prepared by the ASOC will contain information about population status and trends, an overview of oil spill studies, a summary of subsistence harvest data, an overview of recovery goals and objectives, and a discussion of the potential relationships between subsistence harvests and these recovery goals and objectives

Overall Project Schedule

May 1994	Household interviews regarding harbor seal subsistence harvests
August - Sept. 1994	Hunter interviews regarding harvest locations and traditional knowledge
September - October	Data compilation by the Alaska Sea Otter Commission
October 1994	Marine mammal biologist workshop
December 1994	Workshop with biologists and subsistence users to review ASOC findings
January1995 to April 1995	Community meetings to discuss workshop results and recommendations

We anticipate that the project will continue for a second year, with additional data collection, workshops, newsletters, and community meetings. For more information about this project, please contact:

James Fall, Regional Program Manager
Division of Subsistence
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99518
907-267-2359 (voice); 907-349-4712 (fax)

APPENDIX D

HARBOR SEAL AND SEA OTTER RESTORATION WORKSHOP

Sponsored by: **Division of Subsistence, Alaska Department of Fish and Game**
Alaska Sea Otter Commission (ASOC)

When: **Friday, December 2, 1994. 8:30 a.m. to 5 p.m.**

Where **RurAL CAP Library**
Rural Alaska Community Action Program
731 E. 8th Avenue
Anchorage
907-279-2511

Purpose: To bring together community representatives, scientists, co-management groups, and agency representatives to collaboratively review and share information about the status of populations of harbor seals and sea otters that were injured by the Exxon Valdez oil spill and to discuss actions that might be taken to aid in the recovery of these populations.

Participants: Communities of Cordova/Eyak, Tatitlek, Valdez, Chenega Bay, Seward, Nanwalek, Port Graham, Seldovia
Alaska Department of Fish and Game
Alaska Sea Otter Commission
RurALCAP
Chugach Regional Resources Commission
National Marine Fisheries Service
US Fish and Wildlife Service
University of Alaska

Agenda: Sea Otter & Harbor Seal Restoration Workshop

Time	Topic	Presenter
8:30	Greetings and Introductions	Workshop chair
8:45	Why we are here: purpose of restoration project, agenda	Jim Fall, ADF&G
9:00	Overview of ASOC Report: Harbor Seals	Brendan Kelly & Polly Wheeler
9:45	Discussion of Harbor Seal Report	
10:30	Break	
10:45	Overview of ASOC Report: Sea Otters	Brendan Kelly & Polly Wheeler
11:15	Discussion of Sea Otter Report	
12:00	Lunch Break	
1:15	Reports/Comments from Community Representatives	Chair & Workshop facilitator
2:30	Overview of NMFS and USFWS Management Activities	NMFS & FWS representatives
3:00	Break	
3:15	Overview of ASOC and IPCOMM activities	Carl Hild, Polly Wheeler
3:45	Where do we go from here? Possible development of recommendations to hunters Set agenda and schedule for possible community meetings	Workshop facilitator
5:00	End.	

For more information, call Jim Fall, ADF&G, 267-2359

APPENDIX E

HARBOR SEAL AND SEA OTTER RESTORATION WORKSHOP INFORMATION FOR COMMUNITY PARTICIPANTS

Questions to think about for harbor seals and sea otters in your area:

- What is the population status? Are numbers up or down compared to five, ten, twenty years ago? Are numbers increasing or decreasing today?
- What about changes in the population structure? For example, do you see more adults and less pups, more males and less females?
- Have there been changes in the distribution of harbor seals and sea otters? Are they scarce in areas where there used to be more? Have they moved into new areas?
- Have there been changes in the condition of animals? For example, more skinny animals, changes in pelt quality, changes in fat quality? What about observations of lesions, sores, tumors?
- Have hunters observed any changes in the behavior of animals?
- What kinds of information do people in your community need about harbor seals and sea otters?
- What are the best ways to communicate information to subsistence users of marine mammals in your community?
- Would a public meeting where the kinds of information reviewed in this workshop are discussed be useful in your community? If so, when should it happen? If not, how can we best communicate with hunters and other users?

If you have any questions about the workshop, call Jim Fall, ADF&G, 267-2359 9 (12/2/94)

APPENDIX F

List of Attendees, First Harbor Seal/Sea Otter Restoration Workshop, December 2, 1994

Polly Wheeler, Alaska Sea Otter Commission
Ann Hoover-Miller, Pacific Rim Research
Helmar Olson, Valdez
Walter Meganack, Jr., Port Graham
Linda Shaw, NMFS
Patty Brown, Chugach Regional Resources Association
Brian Stanley, Qutecak Tribe, Seward
Ron Totemoff, Tatitlek
John M. Totemoff, Chenega Bay
Paul Kompkoff, Jr., Chenega Bay
Steve Totemoff, Jr, Tatitlek
Jim Totemoff, Cordova/Eyak
Gary Kompkoff, Tatitlek
Pat Norman, Port Graham
Patrick J. Olson, Valdez
Kate Wynne, UAF, Kodiak
Jody Seitz, Division of Subsistence, ADF&G
Lisa Scarbrough, Division of Subsistence, ADF&G
Ron Stanek, Subsistence Division, ADF&G
Alfred Quijance, Seldovia
Hoyt Ogle, Seldovia
Arnold Melsheimer, Nanwalek
Kathy Frost, Division of Wildlife Conservation, ADF&G
Laurie Jemison, University of Alaska Fairbanks
Angela Doroff, Marine Mammals Management, US Fish and Wildlife Service
James Fall, Division of Subsistence, ADF&G
Monica Riedel, Cordova/Eyak
Rita Miraglia, Subsistence Division, ADF&G
Craig Mishler, Subsistence Division, ADF&G
Brendan Kelly, UAF, Fairbanks
Carl Hild, RurAL CAP
Carl Jack, RurAL CAP

APPENDIX G

HARBOR SEAL AND SEA OTTER RESTORATION WORKSHOP #2

Sponsored by: **Division of Subsistence, Alaska Department of Fish and Game**
Alaska Sea Otter Commission (ASOC)

Time: **Thursday, March 2, 1995, 8:30 a.m.**

Place: RurAL CAP Library: 731 E. 8th Avenue, Anchorage; 279-2511

Participants: Representatives of communities of the oil spill area which use harbor seals and/or sea otters for subsistence, ADF&G, Fish and Wildlife Service, National Marine Fisheries Service, University of Alaska, Alaska Sea Otter Commission, Chugach Regional Resources Commission, RurAL CAP, Southeast Alaska Native Subsistence Commission, Aleutian-Pribilof Islands Association

Purpose: To bring together community representatives, scientists, co-management groups, and agency representatives to collaboratively review and share information about the status of populations of harbor seals and sea otters that were injured by the *Exxon Valdez* oil spill and to discuss actions that might be taken to aid in the recovery of these populations.

Agenda

Workshop chair: Polly Wheeler, Alaska Sea Otter Commission

8:30 a.m.	Greetings and introductions	Polly Wheeler, ASOC
8:45 a.m.	Purpose of the workshop Overview of first workshop	Jim Fall, ADF&G
9:00 a.m.	Discussion of report "Status and Trends of Harbor Seal and Sea Otter Populations in Prince William Sound and Lower Cook Inlet, Alaska."	Brendan Kelly, UAF
9:30	Reports from Kodiak Island Communities, Southeast Alaska, and Aleutian-Pribilof Islands	
10:15 - 10:30	Break	
10:30	Updates on plans for research and other restoration activities in 1995	
11:00	Participation of hunters in biological sampling programs	Kate Wynne, UAF
11:15	Overview of Division of Subsistence Harbor Seal Harvest Monitoring Project	
11:30	Update on Stock Assessments	Dave Withrow, NMFS
Lunch	12 noon - 1:15 p.m.	
1:15	Discussion of the formation of a regional or multi-regional Harbor Seal Commission.	
2:15	Potential development of recommendations concerning actions which hunters might take to contribute to restoration of harbor seals and sea otter populations in the oil spill area	
3:15	Adjourn Restoration Workshop	
3:30	Reconvene as an ad hoc group for further discussion of a harbor seal commission	
4:30	Adjourn meeting	

APPENDIX H

List of Attendees, Second Harbor Seal/Sea Otter Restoration Workshop March 2, 1995

Monica Riedel, Cordova/Eyak
Mark King, Cordova/Eyak
Gary Kompkoff, Tatitlek
Ron Totemoff, Tatitlek
Helmar Olson, Valdez
John M. Totemoff, Chenega Bay
Paul Kompkoff, Jr., Chenega Bay
Walter Meganack, Jr., Port Graham
Pat Norman, Port Graham
Alice Greene, Nanwalek
Theresa Wilson, Nanwalek
Lillian Elvsaas, Seldovia
Alfred Quijance, Seldovia
Pete Squartsoff, Port Lions
Virginia Squartsoff, Larsen Bay
George Gatter, Old Harbor
Harold Martin, Southeast Alaska Subsistence Commission
Flore Lekanof, Aleutian/Pribilof Islands Association
James Fall, Subsistence Division, ADF&G
Ron Stanek, Subsistence Division, ADF&G
Rita Miraglia, Subsistence Division, ADF&G
Bill Simeone, Subsistence Division, ADF&G
Craig Mishler, Subsistence Division, ADF&G
Una Swain, Division of Wildlife Conservation, ADF&G
Kathy Frost, Division of Wildlife Conservation, ADF&G
Polly Wheeler, Alaska Sea Otter Commission
Brendan Kelly, UAF, Fairbanks
Kate Wynne, UAF, Kodiak
Dave Withrow, NMFS
Linda Shaw, NMFS
Patty Brown, Chugach Regional Resources Association
Carl Hild, RurAL CAP

APPENDIX I

OVERVIEW OF THE SUBSISTENCE HARBOR SEAL AND SEA LION HARVEST MONITORING PROJECT

- **Conducted by the Division of Subsistence, ADF&G, under contract with the National Marine Fisheries Service**

- **Conducted in cooperation with the Indigenous Peoples' Council for Marine Mammals and RurAL CAP**

- **The study began in 1992 and is now completing its third year.**

- **The purpose of the project is to estimate the annual take of harbor seals and sea lions by subsistence hunters using a system of local community research assistants.**
  - **63 local community assistants worked on the project for 1992**
  - **74 local community assistants worked on the project for 1993**

- **Objectives included estimates of the take by season, geographic area, and age and sex**

- **The project was approved by the governments of each community. Review of the data has been sought from the communities, IPCOMM and RurAL CAP. Copies of reports have been provided to all communities in the study.**

- **Data are collected through systematic household interviews.**

  - **For 1992, 2,105 Alaska Native households in 65 communities were interviewed**
  - **For 1993, 2,087 Alaska Native households in 60 communities were interviewed**

- For 1994, 2,029 Alaska Native households in 59 communities were interviewed

- Key respondent interviews have also been conducted on a variety of topics, such as use patterns, traditional hunting rules, and ecological knowledge.

- Two technical papers have been published, one for 1992 harvests (Technical Paper No. 229) and one for 1993 harvests (Technical Paper No. 233).

- Interviews documenting harvests for 1994 are done; the data are now being reviewed and a third report should be available this summer.

- Interviews for 1995 will begin this month, with a second round in January 1996

- Study findings were generally consistent over the first three years of the study. The estimated harbor seal take was
  - 2,867 in 1992
  - 2,729 in 1993
  - 2,594 in 1994

- The largest portion of the harbor seal harvest is by Tlingit and Haida hunters in southeast Alaska

- By a number of standards, the network of local (village) and regional (ADF&G) researchers for collecting subsistence harvest information appears to have worked successfully.

- The project's findings show that subsistence harvests of marine mammals can be successfully documented with a research methodology that uses local researchers in major research roles.

APPENDIX J

OUTLINE OF CONSERVATION ACTIONS FOR HARBOR SEALS

1. Involve Alaska Native subsistence hunters in the management of harbor seals in Alaska

2. Determine the boundaries, if any, between separate stocks of Pacific harbor seals

3. Determine and monitor the status and trends of the Pacific harbor seal population

4. Define the OSP range for the Pacific harbor seal population

5. Monitor the subsistence harvests of harbor seals to ensure that they are consistent with the MMPA

6. Identify and monitor essential habitats of Pacific harbor seals

7. Protect the harbor seal population from detrimental human activities

8. Coordinate local, state, federal, and international efforts to implement Conservation Plan provisions

OUTLINE OF CONSERVATION ACTIONS FOR SEA OTTERS

1. Define the OSP range for sea otters in the Chugach and Cook Inlet regions

2. Determine and monitor the distribution and size of the sea otter populations in the Chugach and Cook Inlet regions

3. Establish PBR levels consistent with the MMPA

4. Monitor the harvest of sea otters in the Chugach and Cook Inlet regions to ensure that it is within sustainable levels

5. Monitor the effects of sea otters on crab and shellfish populations in the Chugach and Cook Inlet regions

6. Identify and protect essential habitats for sea otters in the Chugach and Cook Inlet regions

7. Coordinate local, regional, state-wide, national and international conservation efforts

APPENDIX K

Status and trends of harbor seal and sea otter populations in Prince William Sound and lower Cook Inlet, Alaska

Alaska Sea Otter Commission
P.O. Box 83177
Fairbanks, Alaska 99708

prepared by

Brendan Kelly, Jill Anthony and Laurie Jemison
Institute of Marine Science
University of Alaska
Fairbanks, AK 99775-7200

Prepared for the Alaska Department of Fish and Game, Division of Subsistence Cooperative Agreement #95-024

Preparation of this report was funded by the Exxon Valdez Trustee Council as part of Restoration Project #94-244

July 1995

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ACKNOWLEDGEMENTS

This report benefited from discussions with our colleagues and the people of the Chugach and lower Cook Inlet regions. It was improved by discussions with participants of the Harbor Seal/Sea Otter Restoration workshop held in Anchorage in December 1994. Participants are listed below. Additional critical reviews were provided by G.H. Bishop,
J. Fall, K.J. Frost, M. Kuizenga, L.F. Lowry, L.T. Quakenbush, and P.C. Wheeler.

Angela Doroff, USFWS
Patty Brown-Schwalenberg, Executive Director CRRC
Jim Fall, ADF&G Subsistence
Ron Stanek, ADF&G Subsistence
Jody Seitz, PWS Science Center
Jim Totemoff, Eyak Traditional Council
Monica Riedel, Eyak Traditional Council
Paul Kompkoff, Jr., Chenega Bay IRA Council
Walter Meganack, Jr., Port Graham
Arnold Melsheimer, Nanwalek
Patrick Norman, Port Graham
Kate Wynne, MAP
Hoyt Olge, Seldovia
Anne Hoover-Miller, Pacific Rim Research
Brian Stanley, Qutecak Tribe, Seward
Steve Totemoff Jr., Tatitlek
Gary Kompkoff, Tatitlek IRA Council
Ron Totemoff, Tatitlek
Patrick Olson, Valdez
Helmer Olson, Valdez Native Association
Kathy Frost, ADF&G Wildlife Conservation
Lauri Jemison, UAF
Linda Shaw, NMFS
Alfred Quijance, Seldovia
Carl Hild, RurAL CAP
Carl Jack, RurAL CAP
Craig Mishler, ADF&G Subsistence
Lisa Scarbrough, ADF&G Subsistence
Polly Wheeler, ASOC
Brendan Kelly, IMS/UAF

Funding provided by *Exxon Valdez* Oil Spill Trustee Council is gratefully acknowledegd.

SUMMARY

Successful restoration of harbor seal and sea otter populations affected by the *Exxon Valdez* oil spill requires knowledge of boundaries between stocks, population size, potential rates of population growth and rates of mortality.

Insufficient information is available to determine whether more than one harbor seal or sea otter stock exists in Alaska. Until such information becomes available, the National Marine Fisheries Service assumes three harbor seal stocks; Southeast Alaska, the Gulf of Alaska, and the Bering Sea. The United States Fish and Wildlife Service, however, assumes a single stock of sea otters.

Pacific harbor seal and sea otter populations were decreased by high levels of commercial harvests in the past but now are increasing in most areas. Harbor seal numbers have been declining, however, in the Gulf of Alaska (including Prince William Sound and Cook Inlet) for the past two decades. In Southeast Alaska, harbor seal numbers have been increasing. The status of harbor seals in the Bering Sea is uncertain. Sea otters have reoccupied most of their range in Alaska and some populations have grown as much as 20% per year.

As many as 300 harbor seals and 5,000 sea otters may have been killed by the *Exxon Valdez* oil spill in 1989. Harbor seal numbers continued to decline after the spill, but sea otter numbers have increased again.

According to the United States Fish and Wildlife Service and the National Marine Fisheries service, subsistence hunters have taken 4-8% of the harbor seals and 1-3% of the sea otters in Prince William Sound and Lower Cook Inlet in each of the past two years. The take of harbor seals could be sustained by a healthy population but it and all other sources of mortality are contributing to an on-going population decline. Scientists have been unable to determine the causes of that decline. The sea otter harvest is well below sustainable level.

INTRODUCTION

Harbor seals (*Phoca vitulina richardsi*) and sea otters (*Enhydra lutris*) in the Gulf of Alaska were injured by the 1989 *Exxon Valdez* oil spill. As one of many projects aimed at restoration of Prince William Sound, the *Exxon Valdez* Oil Spill (EVOS) Trustee Council funded a project (#94244) proposed by the Division of Subsistence, Alaska Department of Fish and Game. The project intended to " assess the impacts of subsistence harvests of harbor seals and sea otters on the recovery of these species, and work cooperatively with subsistence hunters to find ways to reduce this impact." The Division of Subsistence entered into a cooperative agreement with the Alaska Sea Otter Commission (ASOC) to carry out the project. The ASOC contracted with the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, to develop this report.

In December 1994, the Division of Subsistence (ADFG) and the ASOC sponsored a workshop to share local traditional knowledge and western scientific knowledge of sea otters and harbor seals in Prince William Sound. In preparation for the workshop, and as part of the cooperative agreement, the available scientific information on population trends of sea otters and harbor seals with reference to the effects of the *Exxon Valdez* oil spill, subsistence harvests, and other causes of mortality was summarized.

The 1994 amendments to the Marine Mammal Protection Act (MMPA) required the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) to prepare stock assessments for all marine mammal species. Among other things, the stock assessments were to include a determination of whether the combination of all takes by people - including incidental fisheries take, subsistence harvests, and takes for public display or scientific research - exceeds the potential biological removal level, or PBR. The PBR is the product of the minimal population estimate, one half the maximal rate of net production, and a recovery factor that ranges from 0.1 to 1.0 (National Marine Fisheries service 1994a). According to computer simulations of marine mammal population growth, takes below the PBR level would maintain or re-establish marine mammal populations within their OSP range (Lerczak *et al.* 1994; Wade 1994). Stocks experiencing levels of harvest or take greater than the PBR level are to be classified as "strategic," and, for stocks also interacting with a commercial fishery, a take reduction team is to be established. Stock assessments were drafted in August 1994 and subsequently were reviewed by the public and Scientific Review Groups. The final assessments were to be released in March of 1995, but are unavailable as of June 1995.

An important element of the stock assessments is the definition of stocks. Effective management of animal populations requires knowing whether or not groups in different areas exchange individuals. Isolated groups are more susceptible to extinction than are inter-connected groups, and each separate group, referred to as a stock, requires its own management regime. The Marine Mammal Protection Act defines a stock as a group of animals that share a common space and interbreed. Once a stock is identified, its management requires, at a minimum, knowledge of its size, potential growth rate, and mortality rates.

This report addresses the following topics, first for sea otters and then for harbor seals in Alaska.

- Biological background
- Stock Identity
- Population Levels and Trends
    - Alaska
    - Southeastern Bering Sea
    - Prince William Sound
    - Lower Cook Inlet
    - Copper River Delta
    - Gulf of Alaska
    - Southeast Alaska
    - Aleutian Islands
- Oil Spill Effects
    - Observed Mortality
    - Estimated Mortality
    - Indirect Effects
- Subsistence Effects
    - Statewide Subsistence Harvest
    - Harvests in Prince William Sound and Lower Cook Inlet
- Recovery Goals and Objectives

Following the above sections, an outline of possible conservation actions is included.

HARBOR SEALS

Biological Background

Harbor seals live in coastal waters of the North Atlantic and North Pacific oceans. In Alaska, they occur from the southeast region northward to Cook Inlet and westward throughout the Aleutian Islands and the southern Bering Sea. As adults they are 5-6 feet long and weigh 200-300 pounds. Females give birth in June or July to a single pup; molting occurs in August and September.

The following overview is based on Hoover-Miller's (1994) review of the biology of Pacific harbor seals. Harbor seals inhabit temperate and sub-Arctic waters of the North Atlantic and North Pacific oceans. They typically occur in coastal waters, coming out of the water (hauling out) on a variety of substrates including rock and sand beaches, tidal mud flats and sand bars, offshore rocks, reefs, glacial and sea ice, and man-made objects. They are members of the family Phocidae (order Carnivora), also referred to as "earless" seals because they lack external ear pinnae. The body is covered with short, straight hair ranging in color from white to black. Coat pattern varies between two basic types, a light phase and a dark phase (Stutz 1967; Shaughnessy and Fay 1977; Kelly 1981). Adult male harbor seals average about 67 inches in length and weigh 165 to 300 pounds, the weight varying geographically, seasonally, and with blubber thickness. Adult females are about 10% smaller than the males but are otherwise similar in appearance. The range of harbor seals and spotted seals (*Phoca largha*) overlap in Bristol and Kuskokwim bays, where they occur together during the summer months. Spotted seals are similar in appearance to light phase harbor seals and only recently have been recognized as a separate species based on ecological, behavioral, and morphological differences (Shaughnessy and Fay 1977; King 1983). Harbor seals pup, breed, and molt annually, but the exact timing of these events varies throughout their range. Females give birth to single pups usually on shore or on glacial ice. Pups typically are born in May, June, or July in Alaska and are weaned at three to six weeks of age. Ovulation and mating occur after weaning. In Alaska molting, or the shedding of old hair, occurs in August and September, at which time harbor seals spend long periods out of the water.

Stock Identity

Several studies suggest a single stock of harbor seals in Alaska. The NMFS is studying stock identity among Pacific harbor seals but data are inconclusive. Currently, they assume three stocks in Alaska; a southeast stock, a Gulf of Alaska stock, and a Bering Sea (including the Aleutian Islands) stock.

Harbor seals are distributed continuously around the rim of the North Pacific Ocean from Baja California north to Prince William Sound and west to Hokkaido, Japan (Scheffer 1958; Bigg 1981; King 1983; Riedman 1990). Several authors have concluded that there is a single form of the species throughout that range (Mohr 1965; Chapskii 1969; Bychkov 1971; Burns and Fay 1974; Kosygin *et al.* 1975; Burns and Gol'tsev 1984). Several characteristics of harbor seals - including the ratios of light and dark colored seals, body sizes, skull shapes, and pupping seasons - vary from south to north in the Pacific Ocean (Bigg 1969a; Shaughnessy and Fay 1977; Burns and Gol'tsev 1984). Those variations may result from south to north changes in environmental conditions (such as day length or temperature) or different characteristics may be favored at the extremes of the range with interbreeding creating intermediate forms between the south and north (Kelly 1981; Temte *et al.* 1991).

Shaughnessy and Fay (1977) suggested that there were no geographical boundaries subdividing North Pacific harbor seals (with the possible exception of the distance between the Commander and Aleutian islands) and that the Pacific harbor seal population consists of a series of largely, but not exclusively, intra-breeding groups. Genetic variability in nuclear DNA of 79 harbor seals from the eastern North Pacific Ocean also showed "evidence of gene flow along the coast" that "appears to follow a stepping-stone pattern latitudinally" (Lehman *et al.* 1993). DNA collected from an additional 28 seals in Alaska also have been analyzed (Westlake *et al.* 1994). Samples from Kodiak (5), southeast Alaska (5), Prince William Sound (7), and Bristol Bay (11) showed no evidence of genetic differences between regions. Westlake *et al.* (1994) thought it equally likely, however, that the lack of genetic differences in their samples was due to interbreeding between areas or the small number of samples analyzed. Additional genetic sampling is underway. Meanwhile, the Alaska Scientific Review Group agreed with Hoover-Miller (1994), who concluded that in Alaska "the boundaries of distinct harbor seal populations, if any, have not been determined." Nonetheless, the NMFS drafted stock assessments for three possible stocks in Alaska; Gulf of Alaska stock, Bering Sea stock, and southeast

Alaska stock (National Marine Fisheries Service 1994b,c,d). Initially, they suggested two stocks in Alaska, one in southeast Alaska and another to the west of that region. They based that separation "primarily on the limited dispersal movements recorded for harbor seals, in conjunction with the distinct gap in their geographic distribution between the eastern coastal waters of southeast Alaska and the Gulf of Alaska, Bering Sea." The Alaska Scientific Review Group, however, pointed out that there has been no study of dispersal, which refers to the breeding of individuals in a different location than that of their parents (Hamilton and May 1977; Wright 1977, 1978; Greenwood *et al.* 1978; Waser 1985, 1987; Waser and Jones 1983). Nor are there any breaks in harbor seal distribution between southeast Alaska and the Gulf of Alaska according to information from local hunters and biologists (Pitcher and Calkins 1979; Acuna and Selig 1983; Jettmar 1984; Loughlin 1994; R. Dalton, Sr. personal communication). In a subsequent draft, the NMFS separated harbor seals in Alaska into three stocks "based primarily on the significant population decline of seals in the Gulf of Alaska versus stable populations in southeast Alaska and the Bering Sea." The stock assessment for the proposed Bering Sea stock, however, points out that data on the population in the Bering Sea are contradictory and its status is unclear.

Population Levels and Trends

North Pacific Ocean - A reliable estimate of the number of harbor seals in the North Pacific Ocean is not available, but the most recent rough estimates total 464,000. Overall, the number of Pacific harbor seals is increasing.

The number of harbor seals in the North Pacific Ocean has never been known with precision. The population was crudely estimated at 50,000-200,000 in the 1950s (Scheffer 1958), 320,000 in 1980 (Bigg 1981), and 464,000 in 1993 (Kelly 1993). The difference between those estimates has as much, or more, to do with their imprecision as with changes in the population size over time. Harbor seals are difficult to census as they spend much of their time under the water and out of view. Censuses generally consist of counts of the seals resting out of the water, with no attempt to account for the seals in the water. The proportion of seals out of the water varies seasonally (Hoover 1983). The greatest numbers are visible on terrestrial haulouts when the adults are molting (Bishop 1967). In at least one glacial fjord, peak numbers are seen in June and July, when the young are suckling (Hoover 1983). The time of day, weather, and tidal height have been

shown to influence the number of seals out of the water, and the influence of those factors varies from site to site (Hoover 1983; Hoover-Miller 1994).

Most effective for estimating population size are those surveys which correct visual counts with estimates of the numbers in the water based on concurrent radio-tracking studies (Olesiuk *et al.* 1990; Huber *et al.* 1992).

Most often, censuses are conducted during the late summer and autumn period when most seals are molting. Usually, counts are made from low-flying aircraft, either directly or by way of photographs. Surveys generally are repeated several times, and the highest count is taken as an estimate of the minimal number of seals in the area, or the mean count is taken as an index of local population size. Higher counts usually are obtained when repetitive counts are made from high ground above the seals (Johnson 1974, 1975, 1976; Kelly 1978, 1979; Hoover 1983; Pitcher 1990; Loughlin 1993; Mathews and Kelly *in press*).

Harbor seal numbers were greatly reduced in many locations during the last two centuries by commercial harvests and kills to protect commercial fisheries (Fisher 1952; Bishop 1967; Bigg 1969b; Itoo and Shukunobe 1986; Olesiuk *et al.* 1990; Hanan 1992; Paige 1993). In Alaska, a predator control program began killing harbor seals in the 1920s. Approximately 7,500 harbor seals were killed for a bounty each year from the late 1920s through the 1940s (Paige 1993). Government agents, using rifles and dynamite, increased the kill to about 12,000 per year in the 1950s. Commercial harvests for skins increased the harvest even higher in the 1960s with a peak of 60,000 harbor seals per year in the middle of that decade (Courtright 1968; Vania *et al.* 1969; Pitcher 1977). Only subsistence harvests have continued in Alaska since passage of the MMPA in 1972. Predator control kills also occurred in Canada and Japan during much of this century. During the past two or three decades, however, protective legislation has resulted in population growth in many areas, with a few notable exceptions.

Harbor seal numbers have remained low in the vicinity of northeastern Hokkaido apparently due to continued removal in coastal salmon traps (Itoo and Shukunobe 1986). In the Kuril Islands, harbor seals appear to have doubled over the past three decades (Kuzin *et al.* 1984). The population in Kamchatka appears to be steady at about 200 animals, and in the Commander Islands, the population appears to have been stable for at least the past 12 years (Mineev 1975; Kuzin 1982; A. M. Burdin, personal communication).

In Baja California, Mexico, harbor seals presently number in excess of 1,000 animals and appear to be increasing (M. Lowry, personal communication). In California, harbor seals increased by an order of magnitude between 1958 and 1972 and continue to increase at about 6% per year (Hanan 1992). Similar growth

is occurring in Oregon (6% per year) and Washington (8% per year) according to recent aerial surveys (Huber *et al.* 1992; H. Huber, personal communication). More rapid growth (12.5% per year) has been observed in British Columbia since 1973 (Olesiuk *et al.* 1990).

Alaska - Harbor seal numbers have been increasing in southeast Alaska, but declining in the Gulf of Alaska, including Prince William Sound and the Kodiak area, since the 1970s. Population trends in the Bering Sea are unclear.

In 1973, the Alaska Department of Fish and Game estimated that there were 270,000 harbor seals in Alaska. That estimate was based on incomplete surveys and harvest records, however, and it likely was inaccurate (Pitcher 1985). In 1991, the NMFS began a series of surveys with the goal of estimating the total number of harbor seals in Alaska. To date, they have reported on surveys in the southeastern Bering Sea, Prince William Sound, Cook Inlet, the Copper River Delta, the Gulf of Alaska including the Kodiak region, and southeast Alaska (Table 1).

The NMFS reports included tabulation of numbers of seals seen out of the water with no correction for the proportion in the water and unseen. Those uncorrected counts were entered into the PBR calculations in the NMFS' first draft stock assessments for harbor seals. The Alaska Scientific Review Group advised the NMFS to apply correction factors to more realistically estimate population size and PBR levels (Lowry 1994). Correction factors derived from radio-tagged seals in British Columbia, Washington, and Oregon range from 1.2 to 2.0 times the number of seals visible (Olesiuk *et al.* 1990; Huber *et al.* 1992), and the NMFS corrected the Alaska counts by multiplying by 1.6.

Table 1. Harbor seals counted in aerial surveys by the National Marine Fisheries Service (Loughlin 1992, 1993, 1994).

Maximal counts include only seals out of the water and visible on the day of the highest counts except as noted. Corrected counts apply factors of 1.2 to 2.0 to include estimates of the number of seals in the water (Olesiuk *et al.*, 1990; Huber *et al.*, 1992).

Location	Year	Maximal count	Corrected count
SE Bering Sea	1991	10,601	12,721 - 21,202
Prince William Sound	1991	2,584	3,101 - 5,168
Prince William Sound	1991	2,882[a]	3,488 - 5,764
Copper River Delta	1991	4,182	5,018 - 8,364
Gulf of Alaska[b]	1992	7,823	9,388 - 15,646
Southeast Alaska	1993	22,447	26,936 - 44,894

[a] Includes maximal count from each survey location over a four day period.

[b] Including Cook Inlet.

Southeastern Bering Sea

Most of the NMFS surveys were conducted in August and September to coincide with the period of peak numbers on terrestrial sites. Additional surveys were conducted in the southeastern Bering Sea in June 1991 for comparison with surveys conducted during that month in previous years (Loughlin 1992). At four sites between 1965 and 1991, the means of 12 counts in June varied between 4,000 and 20,000 seals (Figure 1). The 1991 count of 10,601 was close to the median value, and no clear trend was evident. The 1976 count included 5,600 more seals than the 1975 count suggesting an impossibly high birth rate (Loughlin 1992); a major shift in distribution (Everitt and Braham 1980); or low precision in aerial surveys.

Peak numbers of harbor seals observed on Otter Island in the Pribilof group were higher in 1974 than in 1978, but the counts were made at different times and using different methods. Daily counts of seals on land and visible in the water between 5 July and 25 August 1974 peaked at 1,224 on 16 August (Johnson 1974). In 1978, counts of seals ashore only were made between 6 and 31 July, and a maximal count of 707 was obtained on 16 July (Kelly 1978). The differences in the method and timing of counts make it impossible to determine whether the Otter Island population was stable, increasing, or decreasing (Hoover-Miller 1994). Furthermore, there have been no reliable population estimates of harbor seals on Otter Island since 1978.

The number of harbor seals observed at Nanvak Bay decreased from about 3,000 to 679 between 1975 and 1993 (Johnson *et al.* 1989; Wilson and Jemison 1994). That decrease may be attributable to the seals being displaced by walruses reestablishing a haulout at Cape Peirce (Jemison 1992; Hoover-Miller 1994).

Prince William Sound

A 1991 survey by the ADFG was the first attempt to census harbor seals in all of Prince William Sound. The NMFS thought the survey underestimated the number of seals in the Sound because not all areas were surveyed, finding and counting seals on glacial ice was difficult, dark-phase seals could not always be distinguished from rocks nor light-phase seals from ice, seals were frequently disturbed by boat traffic, and an unknown proportion of seals were in the water (Loughlin 1992).

Determining long-term population trends in Prince William Sound is difficult, because most previous surveys were incomplete. In 1972, approximately 4,000 seals were counted in an aerial survey of the Sound (Pitcher and Vania1973). Based on those data and harvest records, the population was

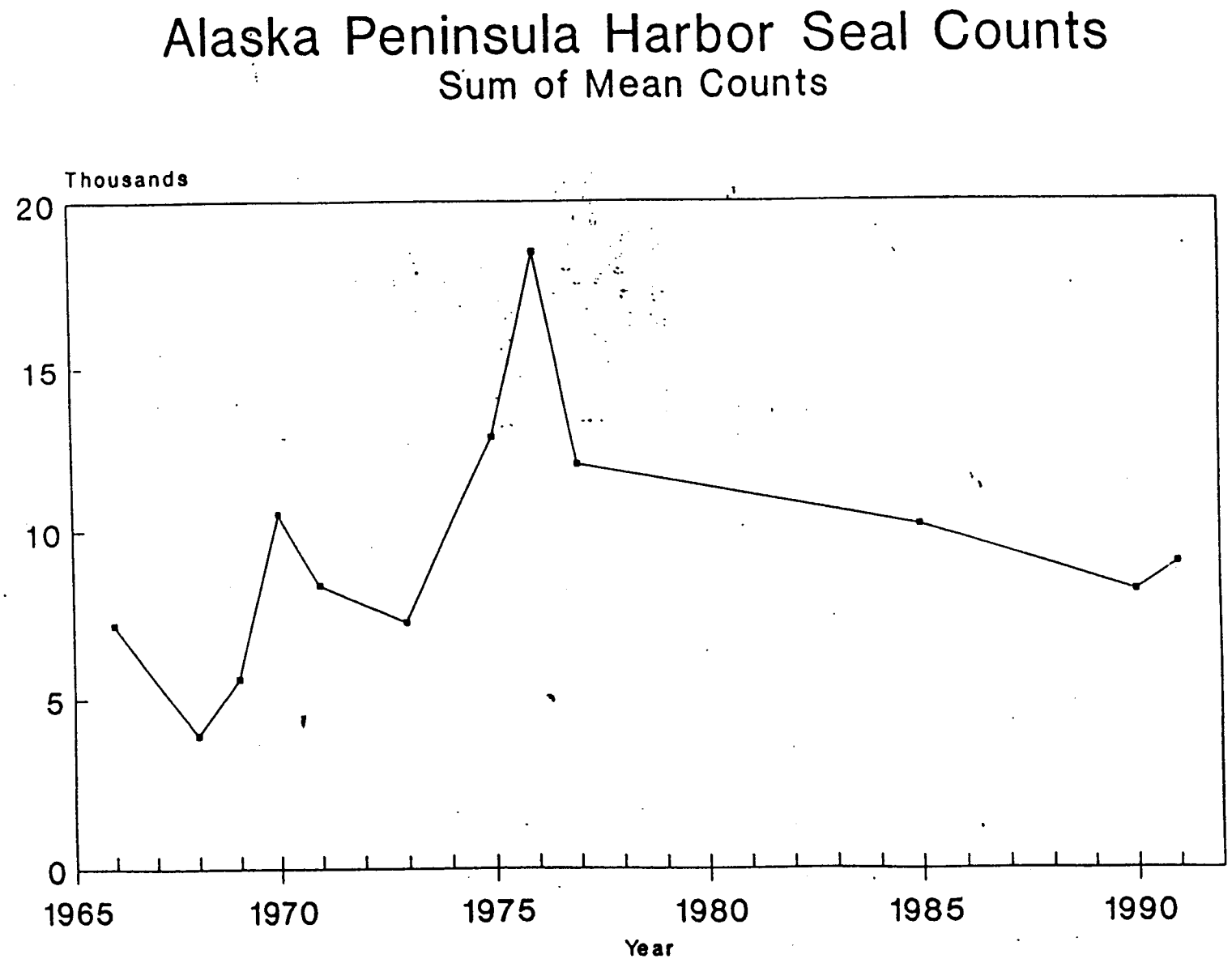

Figure 1. Mean counts of harbor seal at four sites in the southeastern Bering Sea. Counts were made during aerial surveys in June 1965-1991 (from Loughlin 1992).

estimated at 13,000 or more harbor seals in the early 1970s (Calkins *et al.* 1975). Twenty-five terrestrial haulout sites in central and eastern Prince William Sound were surveyed in 1983, 1984, and 1988 - 1994, by the ADFG and the NMFS (Figure 2). Between 1984 and 1988, the number of seals counted at those sites declined by about 12% per year (Pitcher 1989). In 1989, after the *Exxon Valdez* oil spill, the count was down another 24% (Frost and Lowry 1994a). Since then, the annual change has fluctuated between -16% and +18%.

While all 25 sites repeatedly surveyed between 1983 and 1994 were terrestrial haulouts, harbor seals use at least 26 additional sites in the Sound, and over half of the seals in the Sound are found on glacial ice haulouts (Loughlin 1992; Burns 1994). The NMFS' 1991 survey included counts at those additional 26 sites in northern and western Prince William Sound (Loughlin 1992). In 1992 and 1993, the sites in northern and western Prince William Sound were again surveyed, generally following the same procedures that ADFG established for other trend count surveys. Those surveys yielded a 17% increase in seals counted from 1991 to 1992 and a 21% decrease from 1992 to 1993 (Burns 1994).

Lower Cook Inlet

Calkins (1980) concluded that observations of harbor seals in lower Cook Inlet were inadequate in the late 1970s for estimation of overall numbers. Harbor seal haulouts in Cook Inlet were surveyed in 1992 by the NMFS. In Lower Cook Inlet from Anchor Point south to approximately the Barren Islands, 1,983 harbor seals were counted ashore (Loughlin 1993). Corrected for seals in the water, the surveys suggested a population of 2,380 - 3,966 in lower Cook Inlet.

Copper River Delta

The ADFG surveyed the Copper River Delta in July 1973 and counted 1,349 harbor seals (Pitcher and Vania 1973). The NMFS surveyed the Copper River Delta five times in late August 1991 and obtained counts ranging from 2,640 to 4,182 (Loughlin 1992).

Gulf of Alaska

In 1992, the NMFS aerial survey of the Gulf of Alaska counted 7,823 harbor seals ashore (Loughlin 1993). That count appears to have included about one half of the total number of seals in the area judging from a comparison of aerial and ground-based counts at the southwest beach on Tugidak Island. The maximal number of seals seen from the air on the southwest beach was 563; on the same day, a ground-based crew counted 1,075 seals on that beach (Loughlin 1993).

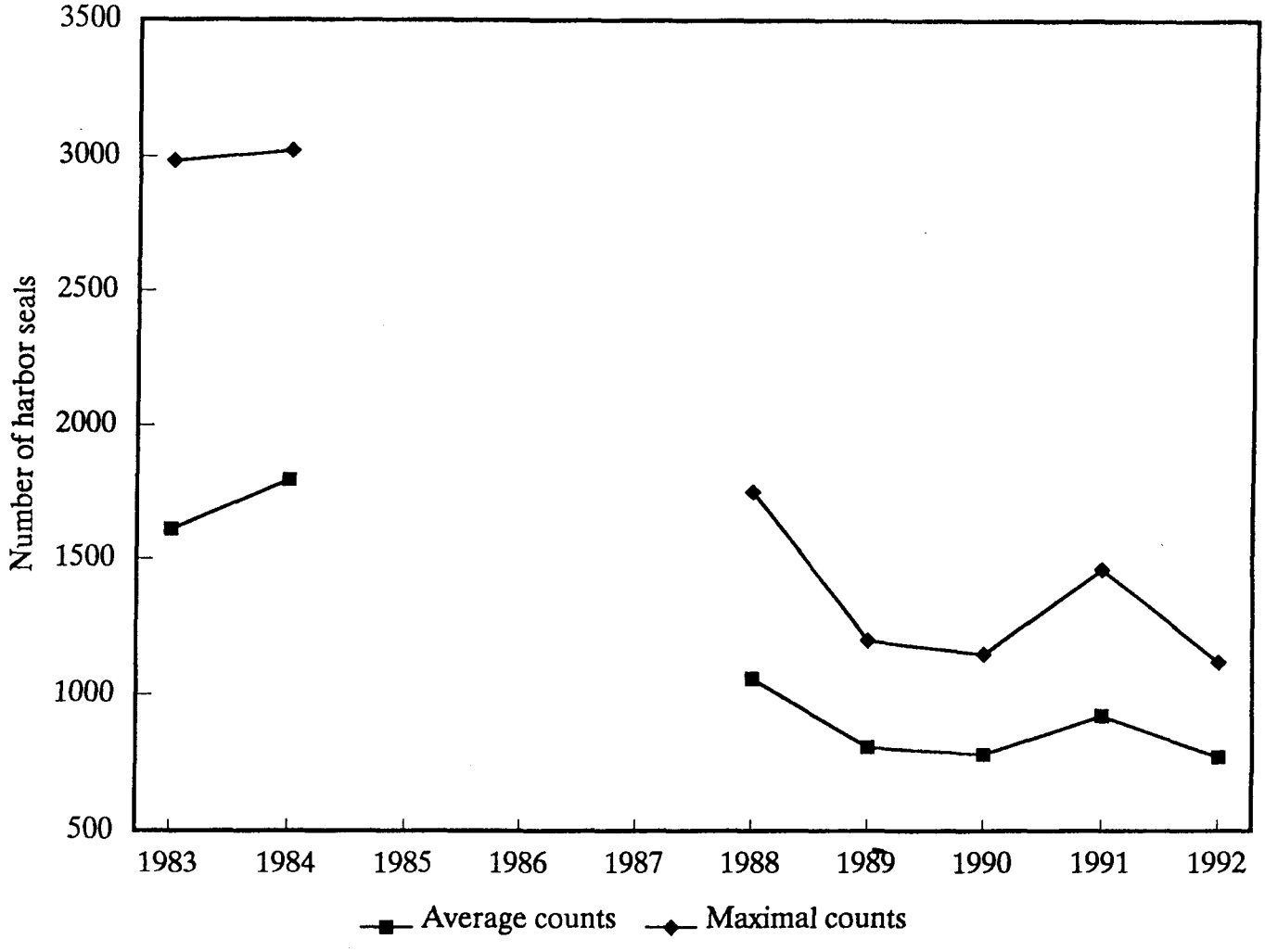

Figure 2. Average and maximal numbers of harbor seal counted at 25 sites in Prince William Sound in 1983, 1984, and 1989-1992 (Pitcher 1988; Loughlin 1992). Counts were made from airplanes.

A dramatic decline is evident in counts in the Kodiak archipelago over the past 20 years (Pitcher 1990). The most reliable data come from ground counts on the southwestern shore of Tugidak Island, where over 9,000 harbor seals came ashore to molt in 1976. Over the next 12 years, the numbers using that beach decreased by 72-85% (Pitcher 1990). Both mean and maximal counts indicated that the number of seals ashore when the seals were molting in late August and early September declined by more than 20% per year between 1976 and 1982; they declined at less than 10% per year from 1982 to 1994. Data from aerial surveys elsewhere in the Kodiak archipelago suggest that similar rates of decline have occurred throughout the region (Pitcher 1990; Loughlin 1993).

Southeast Alaska

In September 1993, the NMFS conducted an aerial survey of harbor seal haulout sites in southeast Alaska (Loughlin 1994). Although the survey was the first attempt to survey all of southeast Alaska, it included two regions surveyed in the 1980s by ADFG (Pitcher 1989). No significant difference was observed in the number of seals counted at sites near Sitka in 1983, 1984, and 1993. The number of seals counted in the vicinity of Ketchikan was significantly less in 1993 than in 1983, 1984, and 1988. Loughlin (1994) was unable to conclude whether fewer seals actually were present in 1993 or if the lower counts reflected the fact that the 1993 surveys were conducted later in the molt season when proportionately fewer seals haul out. During the same survey of southeast Alaska in 1993, only 500 seals were observed in Johns Hopkins Inlet, whereas 4,500 were observed there three weeks earlier (Loughlin 1994; Mathews and Kelly, *in press*). The Ketchikan area was surveyed again in August 1994 and indicated an increase in harbor seal numbers since the 1980s. Apparently, the low number of seals observed in 1993 was the result of seasonal changes in distribution or behavior and not a population decline.

Aleutian Islands

A complete survey of harbor seals in the Aleutian Islands was conducted in summer 1994 and currently is being analyzed. The ADFG estimated that in the early 1970s there were 85,000 harbor seals occupying the waters of the Aleutian Islands (Pitcher 1985). Burns and Gol'tsev (1984) reported that the densities of harbor seals in the Aleutian Islands were high relative to many other parts of the range. They attributed a low pregnancy rate (75%) among mature females in the Aleutian Islands to low exploitation and a stationary population at carrying capacity.

Oil Spill Effects

Eleven dead harbor seals examined after the *Exxon Valdez* oil spill appeared to have been killed by oil contamination. ADFG biologists estimated that there were 302 fewer harbor seals in the oiled portions of Prince William Sound after the spill. It is not known how many of those seals died or moved away. Aerial survey data suggested that the spill added to a pre-existing population decline. Oil remaining in Prince William Sound after the spill might diminish harbor seal foods and may weaken the seals, making them vulnerable to other causes of mortality.

Harbor seals were exposed to oil both in the water and on land after the *Exxon Valdez* spilled nearly 11 million gallons of crude oil in northeastern Prince William Sound. In May 1989, 81% of the 585 seals observed in oiled areas were classified as oiled (Frost and Lowry 1994a).

Assessing the effect of the spill on harbor seals was made difficult by incomplete knowledge of the seals' behavior, population size, distribution, and behavior in Prince William Sound. That seal numbers in the Sound were declining before 1989 complicated estimating the number killed as a result of the spill.

Observed Mortality

In the months immediately following the spill (April through early July), 18 recently dead harbor seals were examined, 11 of which showed signs of oil contamination. When condition of the carcass permitted, complete necropsies were conducted and histopathological samples were collected. Toxicological samples were taken from all carcasses (Frost and Lowry 1994a).

Of the carcasses recovered, 13 were pups. Two pups had died after one month in the rehabilitation center, four premature pups were found dead in April, and seven pups were found dead during the normal pupping period; five of the latter were oiled. Those carcasses and the ratio of pups to adults on oiled and nonoiled sites suggested "that pup mortality occurred and that the proportion of pups at oiled sites was significantly lower than normal because of the *Exxon Valdez* oil spill (Frost and Lowry 1994a; Frost *et al.* 1994a).

Five adult and subadult animals also were examined. Injuries to two adult and one subadult seal included internal hemorrhage, conjunctivitis, mild intermyelinic edema in the brain, pyometra and peritonitis (probably associated with an *in utero* infection and abortion), and pneumonia. The two other seals found dead appeared to have died from traumatic impact (Frost and Lowry 1994a;

Frost *et al.* 1994a). One seal shot by a subsistence hunter was turned over for examination; it was unoiled and showed no signs of illness. During 1990 and 1991, no new reports of dead harbor seals were received.

Necropsied seals exhibited a variety of pathological conditions, including hemorrhage of internal organs, severe dermatitis, conjunctivitis, and emaciation. Histopathological examination in three seals suggested the presence of nerve damage in the brain, while in four seals no significant lesions were found. Many of the carcasses recovered were decomposed or partially scavenged, and the number of seals that died as a direct result of the oil spill is unknown (Frost and Lowry 1994a).

Estimated Mortality

Frost and Lowry (1994a) estimated that there were 302 fewer harbor seals in the oiled portion of the Sound than would have been expected without the spill. They based that estimate on pre-spill and post-spill counts of seals in a portion of the oiled and unoiled sites. They concluded that it was likely that the missing seals had died, but it has been suggested that some of the seals may have moved away (Bonner 1994; Hoover-Miller 1994; J. J. Burns, personal communication). If all of the missing seals were killed, then the mortality resulting from the spill was equivalent to between 5% and 9% of the estimated number of seals in Prince William Sound.

The effect of the spill on harbor seals in Prince William Sound also was examined by comparing counts at the 25 sites repeatedly surveyed (Figure 2). The number of seals observed at oiled and unoiled sites decreased substantially in 1989, and the rate of decrease at oiled sites was almost four times as great as at the unoiled sites (Frost *et al.* 1994a). If it is assumed that the seals were faithful to those sites, then changes in those counts might reflect overall population changes. The counts, however, appear to vary greatly independently of the spill. While the number of observed seals decreased substantially in 1989, large increases and decreases were observed in other years. The increases in counts between some years exceeded the rate that could be attributed to annual births, and suggested that the sites experienced high rates of immigration or changes in haulout behavior between years.

Indirect Effects

Crude oil persisting in the environment may not kill harbor seals directly but may make them more vulnerable to other sources of mortality. Seven of eight unoiled harbor seals showed abnormalities in their brain cells that may have resulted from inhalation of fumes from the spill (Frost *et al.* 1994b). Such indirect effects are extremely difficult to evaluate. Hydrocarbons are readily absorbed through the skin and respiratory tract and can accumulate in body fluids and tissues, although seals are able to metabolize and excrete hydrocarbons (Engelhardt *et al.* 1977). Hydrocarbons toxic to humans and other predators could accumulate in seals exposed to oil over long periods (Risebrough 1978; Gaskin 1982). Some of the seals collected in oiled areas in 1989 and 1990 showed elevated hydrocarbon concentrations in the blubber, indicating that the seals were unable to metabolize all the hydrocarbons they encountered (Frost *et al.* 1994b).

It is not possible to quantify the number of seals made ill by oil contamination and, thereby, more susceptible to predation, drowning, or disease (Frost and Lowry 1994a). Contact with oil potentially can damage prey populations important to harbor seals (Pitcher and Calkins 1979).

Clean up activities following the oil spill resulted in a large increase in the number of people, boats, and planes in Prince William Sound and significant disturbance to harbor seals (Frost and Lowry 1994a). Disturbances caused resting seals to leave haulouts and may have increased the frequency of mother-pup separations and subsequent abandonment. Two of the seals found dead after the spill appeared to have been hit by boats, perhaps related to the increased boat traffic associated with the clean up effort.

Subsistence Harvests

Harbor seals are the most common marine mammal harvested by Native Alaskans. The estimated takes in Prince William Sound and lower Cook Inlet were 431 and 444 in 1992 and 1993, respectively. Those takes were approximately 4-8% of the population and likely would be sustainable if the population was healthy. The population is declining for unknown reasons, however, and the harvests will add to the decline.

Harbor seals have been harvested by Alaska Natives for thousands of years (Jochelson 1925). In at least some areas, the availability of harbor seals appears to have depended, in part, on the status of sea otter populations. The occurrence of harbor seal remains is positively correlated with sea otter remains in prehistoric Aleut middens, probably because the seals' fish prey were more abundant when

kelp beds flourished as a result of sea otter predation on herbivores (Simenstad *et al.* 1978). Today, harbor seals are the most common marine mammal in the overall subsistence harvests of Native Alaskans.

Statewide Subsistence Harvest

The Division of Subsistence of the ADFG has surveyed the subsistence take of harbor seals by Alaska Natives at selected communities on an irregular basis since 1984. In 1992 and 1993, with locally hired research assistants, the size, seasons, geographical distribution, and age and sex composition of the statewide harvest were determined through systematic interviews with hunters and users of marine mammals (Wolfe and Mishler 1993; 1995).

Communities throughout the state were grouped into nine regions. In 1992, 2,105 households in 65 coastal communities were surveyed; the estimated subsistence take of harbor seals was 2,867 with a 95% confidence range between 2,317-3,677. In 1993, 2,087 households in 60 communities were surveyed. The estimated subsistence take was 2,729 seals with a 95% confidence range between 2,513-3,464 seals (Wolfe and Mishler 1993; 1995).

For the state as a whole, the overall size and timing of the harvest was similar between 1992 and 1993; however, the number of seals taken varied between regions. In both years, the largest take was by Tlingit and Haida hunters in southeast Alaska. In 1992 and 1993, southeast Alaska hunters accounted for 58% and 59%, respectively, of the statewide take. The second largest take was by communities in the North Pacific Rim region, which comprised 15% and 16% of the statewide take in 1992 and 1993, respectively. Harbor seals were hunted during all months, with a peak during October-December in 1992 and two seasonal peaks in March-April and August-December in 1993 (Wolfe and Mishler 1993; 1995).

Harvests in Prince William Sound and Lower Cook Inlet

In the North Pacific Rim region (including the communities of Chenega Bay, Cordova, Nanwalek, Port Graham, Seldovia, Seward, Tatitlek, and Valdez), an estimated 431 harbor seals were taken in 1992. The number of seals harvested per Alaska Native in the region was 0.20 with the highest number taken in October through December. In 1993, the total take was 444 seals or 0.27 per capita. Again, the highest number was taken from October through December. Adult seals comprised 68% of the take, and more than twice as many males as females were reported taken.

Assuming a combined harbor seal population in Lower Cook Inlet and Prince William Sound of 5,481 - 9,730 (Table 1), the 1992 and 1993 subsistence harvest was equivalent to 4 - 8% of the population. A healthy harbor seal population would be able to grow in spite of such a harvest. The population in the Gulf of Alaska, however, has been declining for reasons that are not known. Whatever the cause, the harvests will increase the rate of the decline. The actual effect of the harvest on the population trend cannot be predicted accurately due to incomplete knowledge of the population size, other sources of mortality, and rates of movements between areas.

Among the North Pacific Rim communities, the harbor seal take (harvested and struck and lost) in 1992 was highest in Tatitlek (171) and second highest in Cordova (113). In 1993, the largest takes again were by Cordova (153) and Tatitlek (123). The greatest per capita take statewide was by Tatitlek in 1992; in 1993, Tatitlek's take was the second highest per capita.

Harbor seal harvests declined in four communities after the *Exxon Valdez* oil spill (Table 2). In Chenega Bay and Tatitlek, harvests were greatly reduced in 1989 and subsequently increased but have remained below pre-spill levels. Nanwalek and Port Graham both harvested the fewest seals in 1990, the year after the spill. For these communities, 1992 and 1993 harvest estimates were similar to the one pre-spill harvest estimate made in 1987.

Table 2. Harbor seals harvested in four North Pacific Rim communities (from Wolfe and Mishler 1994). *

Year	Nanwalek	Port Graham	Chenega Bay	Tatitlek
1984			186	
1985			154	
1986				
1987	29	32		393
1988				473
1989	27	17	16	113
1990	9	10	57	76
1991	18	30	28	114
1992	28	36	43	153
1993	30	32	61	109

*Harvested numbers do not include seals struck and lost.

Recovery Goals and Objectives

The Marine Mammal Protection Act - The 1994 amendments to the Marine Mammal Protection Act required the NMFS to determine the Potential Biological Removal level for harbor seals. The NMFS calculated the PBR level for the Gulf of Alaska to be 558 seals. Because the calculated PBR level is less than the estimated number of harbor seals taken by fisheries and subsistence hunters (868), the stock is designated "strategic." If the NMFS also determines that the stock is depleted, it will have authority to limit subsistence harvests.

The MMPA states that marine mammal populations should be maintained within their OSP range when consistent with the primary objective of maintaining "the health and stability of the marine ecosystem." Unfortunately, scientific knowledge of harbor seals is inadequate for determining their OSP range or for assessing adequately the health and stability of the ecosystem. The decline of harbor seal, Steller sea lion (*Eumetopias jubatus*), and sea bird populations in the Gulf of Alaska suggest ecosystem changes, but we can do little more than guess that food has somehow become limiting (Merrick *et al.* 1987; Hatch *et al.* 1993; Kelly 1993; Springer 1993; Wooster 1993).

The 1994 amendments to the MMPA included provisions for assessing marine mammal stocks with particular reference to their incidental take in commercial fisheries. In those amendments, the NMFS was directed to determine PBR levels, whether human takes exceeded those levels, and whether fishery takes are insignificant and approaching zero for all marine mammal stocks. The NMFS documented only 5 harbor seals killed incidentally in commercial fisheries in the Gulf of Alaska and the Bering Sea but, nonetheless, was required to calculate PBR levels (National Marine Fisheries Service 1994b,c). In their most recent (9 February 1995) draft stock assessment for harbor seals in the Gulf of Alaska, the NMFS based their calculations on corrected aerial survey counts, the default maximal net productivity rate of 12% for pinnipeds, and a recovery factor of 0.5 (set low because of the "uncertain population status"). Thus, they determined that the PBR level for the proposed Gulf of Alaska stock was the estimated population size (18,585) multiplied by the maximal net rate of productivity divided by two (12%/2) multiplied by 0.5 = 558 seals. The PBR level is less than the combined estimated annual take by commercial fisheries (35) and subsistence hunters (833), thus placing the stock in the strategic category. If the final stock assessment includes the strategic classification, the NMFS will form a

team charged with finding ways to reduce the level of incidental take in fisheries. Until the population begins to recover from its current decline, it may be necessary to consider reducing the subsistence harvest.

If the NMFS further determines that the harbor seal stock is depleted, that is below its OSP level, it will have authority to limit subsistence harvests.

***Exxon Valdez* Oil Spill Trustee Council - Among its restoration projects, the Trustee Council has sponsored aerial surveys to assess harbor seal population trends and a study of harbor seal movements and diving behavior.**

The *Exxon Valdez* Oil Spill Trustee Council initiated restoration projects after the oil spill. Harbor seal projects have centered on continued aerial surveys to assess population trends, a study of harbor seal movements and behavior using satellite linked radio tags and time-depth recorders, and studies of the health and nutritional condition of seals (Frost and Lowry 1994b). Studies in 1995 also will investigate stock identity, feeding habits, and causes of mortality.

In 1991 through 1993, a total of 15 adult harbor seals (11 males and 4 females) and 5 sub-adults (4 males and 1 female) were fitted with satellite-linked time depth recorders. Twelve seals were tagged during spring and eight in the fall. Satellite tags remained operational for about 60-107 days. On average, seals moved minimal distances of 5-10 km per day. Seven of ten seals only hauled out at their capture site during the study. Two seals did not return to the site where they were tagged, and one seal hauled out almost equally at the tagging site and a nearby location. Seals hauled out more often as the season progressed (from May to July), and it appeared that they spent 30%-40% of their time hauled out (Frost and Lowry 1994b).

Tagged seals mainly dove to less than 50 meters (58%), often to between 50 and 150 meters (39%), and rarely to greater than 150 meters (3%). Deep dives occurred more frequently in May, and by seals larger than 50 kg.

The data on seal diving will provide useful inferences on the locations and depths of feeding. Data also are needed on the quantities of different prey species consumed in order to assess the influence on the harbor seal population of changes in fish stocks. Unfortunately, at present there are no adequate methods for quantifying feeding by harbor seals.

Subsistence Harvest and Recovery Goals - Biological studies, population and harvest monitoring, and reducing harvest levels might contribute to restoration of the harbor seals in the Gulf of Alaska. Research and management actions will be most successful when conducted jointly by subsistence hunters and scientific researchers.

It is clear that harbor seals in the Gulf of Alaska, including Prince William Sound and Lower Cook Inlet, have declined in numbers in the last decade. It is less clear what initiated the decline and if and for how long it might continue. It is unlikely that the subsistence harvest started the decline, but the oil spill and the subsistence harvest contributed to the decline once it started. The importance of harbor seals as a subsistence resource and the mandates of the MMPA underscore the need to protect the population from depletion.

Scientific studies, population and harvest monitoring, and modifying harvest levels and composition might help restore the harbor seal population in the Gulf of Alaska. Research and management actions will be most successful when conducted jointly by subsistence hunters and scientific researchers. A draft conservation plan for harbor seals in Alaska listed eight actions that might be undertaken (Kelly 1993). A modified outline of those actions might serve to focus discussion.

Outline of Conservation Actions

1. Involve Alaskan Native subsistence hunters in the management of harbor seals in Alaska.

    11. Invite representatives of the Indigenous People's Council for Marine Mammals, the Alaska Sea Otter Commission, and other Native groups to participate in planning and implementing conservation measures pertaining to harbor seals.

    12. Consult with representatives of the Native communities to determine the most effective way to manage harbor seals in Alaska.

2. Determine the boundaries, if any, between separate stocks of Pacific harbor seals.

    21. Continue molecular studies of the extent and frequency of gene flow between Pacific harbor seals in different areas.

    22. Synthesize available data pertaining to movements and philopatry of Pacific harbor seals.

    23. Evaluate the potential for measuring stock discreteness by tagging and telemetry studies.

    24. Document harbor seal distributions known to subsistence hunters.

3. Determine and monitor the status and trends of the Pacific harbor seal population.

    31. Update the estimate of harbor seal numbers in Alaskan waters.

        31a. Complete the analysis of recent survey data from the Aleutian Islands.

    32. Evaluate potential methods for on-going monitoring of harbor seal numbers in Alaska.

        32a. Refine methods for determining the variance associated with minimal population size estimates.

        32b. Assess the effectiveness of trend-site counts and other possible indices of population level.

    33. Establish methods and schedules for long-term monitoring of population levels throughout Alaska.

        33a. Develop long-term monitoring of harbor seal haulouts by local observers.

34. Monitor the health, demography, and productivity of Pacific harbor seals.

34a. Develop methods for monitoring the age and sex composition of the Pacific harbor seal population.

34b. Document the demography and reproductive status of harvested harbor seals by analyzing reproductive tracts and teeth.

34c. Evaluate the contribution and availability of forage fishes to the diet of each age class of harbor seals.

34d. Analyze harbor seal body condition by blubber thickness and blood chemistry.

34e. Monitor the contaminant loads in harbor seals.

34f. Archive tissue samples in the Alaska Marine Mammal Tissue Bank and the University of Alaska Fairbanks Museum.

4. Define the OSP range for the harbor seal population.

41. Estimate the current MNPL for harbor seals.

42. Estimate the current level of K for harbor seals.

43. Improve estimates of parameters needed to calculate the MNPL and K level for harbor seals.

44. Determine the management actions to be taken if the harbor seal population approaches or reaches the bounds of OSP.

5. Monitor the subsistence harvests of harbor seals to ensure that they are consistent with the MMPA.

51. Continue state-wide survey of harbor seal harvests.

52. Develop and implement long-term program for monitoring subsistence harvests employing local researchers.

52a. Review 1992 and 1993 subsistence harvest data to determine the frequency with which harvest should be monitored in each community.

52b. Develop a protocol for monitoring the number and demography of harbor seals harvested and to collect teeth for aging and other tissue samples.

52c. Implement a monitoring program using local researchers according to the schedule and protocols developed under Tasks 52a. and 52b..

52d. Establish mechanisms for timely analysis and reporting of subsistence harvest data.

52e. Establish local harvest level guidelines to ensure future availability of harbor seals in all regions.

6. Identify and monitor essential habitats of Pacific harbor seals.

61. Improve understanding of the biological significance of terrestrial and ice haulout sites for Pacific harbor seals.

61a. Compare seasonal use patterns and productivity of harbor seals at terrestrial and ice haulout sites.

61b. Determine and compare demographic composition of harbor seals on major haulout sites by season.

62. Improve understanding of the harbor seal's marine habitat and its influence on population dynamics.

62a. Use telemetry and other means to determine the locations and depths of important feeding areas for adult harbor seals.

62b. Develop methods for determining important feeding areas and depths for juvenile harbor seals.

62c. Assess and monitor the distribution and status of harbor seal prey.

7. Protect the harbor seal population from detrimental human activities.

71. Identify threats at haul-out sites and develop appropriate regulations.

71a. Monitor the frequency of disturbance, reactions, and productivity of harbor seals on glacial haulouts.

71b. Monitor the frequency of disturbance, reactions, and productivity of harbor seals on terrestrial haulouts.

71c. Develop guidelines and regulations to protect harbor seals from detrimental disturbances at haulout sites.

72. Review accuracy of information on incidental takes of harbor seals and make recommendations for improvement.

73. Assess potential sources of pollutants that might effect harbor seals.

8. Coordinate local, state, federal, and international efforts to implement Conservation Plan provisions.

81. Establish and convene regular meetings of a conservation team.

82. Designate and support a harbor seal conservation coordinator.

83. Coordinate conservation activities with Canadian, Russian, and Japanese officials and scientists.

84. Develop a geographic information system (GIS) for Pacific harbor seals and their habitat.

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SEA OTTERS

Biological Background

Sea otters live in the near shore waters of the North Pacific Ocean. In Alaska, they occur along the outer coast of southeast Alaska; northward into Prince William Sound, Cook Inlet, and the southern Bering Sea; and westward throughout the Aleutian Islands. They consume 23 to 37% of their body weight (70 - 100 lbs. for adults) per day, mainly in bottom-living invertebrates. Clams, crabs, and mussels are important food sources in Prince William Sound.

Sea otters are mustelids, members of the same family of carnivores as weasels, mink, marten, wolverines, badgers, and river otters. Adult female sea otters reach lengths of 4 1/2 feet and weigh up to 70 pounds, and adult males reach almost 5 feet and 100 pounds (Kenyon 1969). Sea otters reproduce throughout the year with a peak in breeding from September to November in Alaska (Kenyon 1969; Garshelis *et al.* 1984). A single pup is born, and some females are capable of pupping annually, but several factors (i.e., physical condition, weather, location, duration of previous lactation) may prolong the reproductive interval (Rotterman and Simon-Jackson 1988).

Before the excessive commercial harvests of the 18th and 19th centuries, sea otters ranged around the rim of the North Pacific Ocean and southern Bering Sea from Hokkaido, Japan to Baja California, Mexico (Lensink 1960; Kenyon 1969). By 1910, the sea otter was absent from most of its aboriginal range, and was found scattered in small groups from the Kurile Islands east to Prince William Sound, Alaska and central California (Kenyon 1969). From those isolated remnants, the sea otter made a significant recovery, repopulating many previously inhabited areas In the present century, natural population expansion and translocations have resulted in recolonization of much of Kamchatka and the eastern North Pacific Ocean southward from Alaska. Within the latter region, recolonization has occurred at Vancouver Island and central to southern California (Riedman and Estes 1990).

In Alaska, small numbers of sea otters apparently survived along the western Aleutian Islands, the Alaska Peninsula, Shumagin and Kodiak islands, the east side of the Kenai Peninsula, and in the southern portion of Prince William Sound (Lensink 1962; Pitcher 1975). Most of the intervening areas have been recolonized naturally, and southeast Alaska has been repopulated with translocated sea otters.

Sea otter movements may occur in response to changes in food availability, social dynamics, and/or weather. In Prince William Sound,

movements by adult females with pups typically are within radii of 20 miles, while movements by young males average 29 miles (Rotterman and Simon-Jackson 1988).

Sea otters have high energy demands for individual maintenance and growth. Their metabolic rates are more than 3 times that of a terrestrial mammal of equal size (Barabash-Nikiforov *et al.* 1968; Estes and Smith 1973). In order to sustain these high energy requirements, sea otters ingest an estimated 23 to 37% of their body weight in food per day, depending on their activity, reproductive condition, the water temperature, and weather (Kenyon 1969; Costa 1978). Harbor seals, in contrast, consume 6 to 14% of their body weight per day (Ashwell-Erickson 1981). To meet their energetic demands, sea otters spend between 11 and 60% of their time foraging (Estes *et al.* 1986; Ralls and Siniff 1990).

Sea otters mainly feed in near shore areas but may forage at depths of 120 feet or more (Kenyon 1969; Estes 1980). They mostly consume slow, bottom-dwelling marine invertebrates and sometimes sluggish species of fish. Food choice varies with location, the length of time an area has been occupied, and individual feeding preferences (Estes *et al.* 1982; Riedman and Estes 1988; Riedman *et al.* 1989, 1993). Table 3 lists prey reported for sea otters in Prince William Sound. Calkins (1978) found clams to be the most frequent prey in Montague Strait in 1971, as did Garshelis *et al.* (1986) at Green Island, Simpson Bay, Nelson Bay, and Orca Inlet in 1980 and 1981. In those areas, crabs were of secondary importance, but were nonetheless eaten in large quantities at some sites. Garshelis *et al.* (1986) estimated that adult sea otters in Nelson Bay consumed an average of 14 crabs per day, while subadult otters averaged 10 crabs per day. In total, those otters consumed an estimated 370,000 Dungeness crabs per year in Nelson Bay in the early 1980s (Garshelis *et al.* 1986). In 1989-1990, sea otters in Port Valdez predominantly ate mussels (*Mytilus edulis*) and rock jingles (*Pododesmus cepio*), which have fewer calories than clams or crabs (Anthony 1994).

Sea otter predation strongly influences the species composition of rocky subtidal communities (Estes and Palmisano 1974; Dayton 1975; VanBlaricom and Estes 1988), and sea otters have become a textbook example of a "keystone" predator (Kitching 1986). In rocky subtidal communities, sea otter predation decreases the size and density of herbivorous invertebrates (especially sea urchins), favoring the growth of kelp and other algae (Simenstad *et al.* 1978). Kelp beds provide habitat to various near shore fish species, which in turn, favor larger numbers of harbor seals.

Table 3. Food items reported for sea otters in Prince William Sound (Calkins 1978; Estes *et al.* 1981; Garshelis *et al.* 1986; Riedman and Estes 1990; Anthony 1994).

Barnacle	*Cirripedia*
Polychaete worm	*Euistyla* sp.
Snails	*Notoacmaea persona*
Blue mussel	*Mytilus edulis*
Greenland cockle	*Serripes groenlandicus*
Nuttall's cockle	*Clinocardium nuttalli*
Clams	
Frail macoma	*Macoma* sp.
Stained macoma	*Macoma inquinata*
Arctic hiatella	*Hiatella arctica*
Kennerley venus	*Humilaria kennerleyi*
Softshell clam	*Mya arenaria*
Truncated soft shell clam	*Mya truncata*
Pacific littleneck clam	*Protothaca staminea*
Butter clam	*Saxidomus giganteus*
Fat gaper	*Tresus capax*
Pacific razor	*Siliqua patula*
Rinkneck	*Spisula polynyma*
Rock jingle	*Pododesmus macroschisma*
Sea cucumber	*Cucumaria* sp.
Sea anemone	*Anthozoa*
Echiuran worm	*Echiurus echiurus*
Sea raspberry	*Eunephthya rubiformis*
Sea stars	
Sea star, 5 arms	*Asteroidea*
Mottled sea star	*Evasterias troschelii*
Sunflower star	*Pycnopodia helianthoides*
Green sea urchin	*Strongylocentrotus droebachiensis*
Crabs	
Helmet crab	*Telmessus cheirogonus*
Lyre crab	*Hyas lyratus*
Tanner crab	*Chionoecetes* sp.
Dungeness crab	*Cancer magister*
Shrimp	*Pandalus* sp.
Common Pacific octopus	*Octopus dofleini*
Fish	
Coho salmon	*Onchorhynchus kisutch*
Bird	*Aves*

In the absence of sea otters, those communities consist of more and larger sea urchins, hence less kelp, and fewer fish and harbor seals. Crabs and octopus also are more predominant in the absence of sea otters.

The influence of sea otters on the species composition of soft-bottom (sand, silt, or mud) communities is less clear, but they appear to greatly reduce densities of crabs and shallow-burying clams (Kvitek and Oliver 1988). More investigation of the effects of sea otters on soft-bottom communities is needed, and studies have been initiated by the ADFG and the National Biological Service (NBS) (Pitcher and Imamura 1990; National Biological Service, unpublished data). A large influx of sea otters into northeastern Prince William Sound in 1979 and 1980 was followed by a greater than 80% reduction in the density of Dungeness crabs and the commercial fishery subsequently was closed (Garshelis *et al.* 1986). Garshelis and Johnson (1993) suggested that the carrying capacity of Prince William Sound for sea otters was reduced by the uplift of clam beds in the 1964 Alaskan earthquake.

After depleting the initial standing stocks of preferred prey in an area, sea otters diversify their diet to include items of lower caloric value (Hines and Pearse 1982). Feeding on lower quality prey requires that sea otters increase the time spent feeding (Shimek and Monk 1977). Garshelis *et al.* (1986) observed that in habitats occupied for less than 3 years, high quality food was abundant, and sea otters spent significantly less time feeding than did those in areas that had been occupied for longer periods. Anthony (1994) examined habitat use in Port Valdez and found that sea otters there fed primarily on low calorie mussels in contrast to Simpson and Nelson Bays where they fed mainly on high calorie foods (crabs and clams).

Several predators of sea otters have been reported, but predation does not appear to be an important contributor to sea otter mortality. Possible predators include white sharks (*Carcharodon carcharias*), killer whales (*Orcinus orca*), brown bears (*Ursus arctos*), coyotes (*Canis latrans*), and bald eagles (*Haiaeetus leucocephalus*) (Kenyon 1969; Sherrod *et al.* 1975; Monnett and Rotterman 1988; Riedman and Estes 1990; B. Reid, personal communication).

Stock Identity

Available data are insufficient to determine whether there is more than one stock of sea otters in Alaska. The National Biological Service is conducting genetic studies to determine if more than one stock can be identified. At present, the USFWS assumes a single stock in Alaska.

The modern sea otter is thought to be represented by three subspecies: *Enhydra lutris lutris, E. l.* unnamed, and *E. l. nereis* (Merriam 1904; Barabash-Nikiforov *et al.* 1947; Wilson *et al.* 1991). A recent study suggested that all sea otters in Alaskan waters and south to Oregon are members of the subspecies *Enhydra lutris lutris* (Wilson *et al.* 1991). Originally, sea otters were distributed continuously around the rim of the North Pacific Ocean with the only significant gap between the Commander and Aleutian islands (Lensink 1962). While the population was fragmented by the commercial harvests, it now has recolonized most of its range in Alaska. Still, the question of possible stock separation is complicated by the fact that the waters of southeast Alaska were repopulated with animals translocated from the Aleutian Islands and Prince William Sound (Kenyon 1969; Jameson *et al.* 1982). The NBS currently is conducting an analysis of DNA sequence diversity in the three subspecies to further illuminate racial distinction and relationships. Presently, the USFWS recognizes only a single stock of sea otters in Alaska (U. S. Fish and Wildlife Service 1994 a,b).

Population Levels and Trends

North Pacific Ocean - Prior to their discovery by Russian fur hunters, sea otters in the North Pacific may have numbered as many as 300,000. Excessive harvests over the next 150 years decimated the population. Under international protection, sea otters have recovered in many areas during this century.

Sea otters are difficult to count and the actual population size is not known. In the late 1960s, Kenyon (1969) estimated that there were 30,000 sea otters occupying one fifth of their former range. From that, he extrapolated a pre-exploitation population of 100,000 - 150,000 sea otters. With approximately one half of the range reoccupied, however, Schneider (1978) estimated the population at 100,000 - 120,000, suggesting an original population of 200,000 - 240,000. Johnson (1982) thought the original population might have been as large as 300,000 sea otters.

Native North Americans have harvested sea otters for more than 2,500 years (Jochelson 1966). Sea otters were harvested for their pelts and, to a limited extent, for meat (Coxe 1787; de Laguna 1972; Sauer 1972; Davydov 1977; Merck

1980). In some areas of the Aleutian Islands, archaeological data suggested periodic, local extinctions of sea otter, perhaps the result of hunting by indigenous people (Simenstad *et al.* 1978). For the most part, Native leaders controlled harvests by limiting access to hunting grounds by outsiders and by limiting the number of otters permitted to each hunter (de Laguna 1972; Tikhmenev 1979).

Russian fur hunters learned of the sea otter grounds of North America from the voyage of Vitus Bering in 1741. For the next 150 years, Russian and other foreign hunters took thousands of sea otters from North America every year with peak harvests of about 12,000 per year (Scammon 1870; Hooper 1897; Khlebnikov 1973; Tikhmenev 1979). When international protection was afforded in 1911, as few as 1,000 - 2,000 sea otters remained in 13 small, scattered groups (Ogden 1941; Lensink 1960, 1962; Kenyon 1969).

Recovery proceeded unevenly; in Washington, British Columbia, and Alaska populations grew at 17 - 20% per year, while in California growth has been limited to 4 - 5% per year (Chapman 1981; Estes 1990b).

Alaska - The sea otter population is increasing throughout much of its range in Alaska. Currently, there are an estimated 14,000 sea otters in Prince William Sound. Up-to-date numbers are not available for Lower Cook Inlet, but in the 1980s there were an estimated 3,500 to 4,500 sea otters along the Kenai Peninsula and in Lower Cook Inlet.

By time the United States purchased Alaska in 1867, sea otter numbers apparently were increasing again in areas that had been regulated by the Russian-American Company (reviewed by Lensink 1962). That regulation ceased with the purchase, however, and the harvest immediately increased in the areas that had been protected. In the 1870s and 1880s, between 4,000 and 5,000 sea otters, half of them females, were harvested per year (Maynard 1898; Lensink 1962). In southeast Alaska, sea otters apparently were exterminated sometime before 1900 (Kenyon 1969), although unconfirmed reports of scattered individuals were reported subsequently (Lensink 1962; Kenyon 1969; de Laguna 1972). By then, sea otters in Prince William Sound and other regions also were scarce or absent, and few were being harvested (Hooper 1897).

The first protection under American jurisdiction was instituted in 1906 in the form of regulations prohibiting harvests within 9 miles of shore (Lensink 1962). In 1911, sea otter hunting was banned in offshore waters by an international convention signed by Japan, Russia, the United States, Canada, and Great Britain. Near shore hunting was banned two years later by the Alaska Territorial government. Over the next few decades, sea otter populations in

Prince William Sound and to the west began recovering, and large numbers were found in the western Aleutian Islands by 1935 (Kenyon 1969). In the early 1950s, the USFWS concluded that sea otters in the western Aleutian Islands were at or near the maximum the environment could support, and they began research and management activities with the intent of allowing a resumption of sea otter harvests (Kenyon 1969). At the same time, large portions of the sea otter's original range to the south remained uninhabited, and the USFWS and the ADFG attempted to translocate sea otters from the western Aleutian Islands and Prince William Sound to the Pribilof Islands and southeast Alaska as well as to Canada, Washington, and Oregon (Kenyon 1969; Jameson *et al.* 1982). Early attempts in the late 1950s failed, but as knowledge of sea otter behavior and physiology increased, successful methods of capturing and moving sea otters were developed, and several translocations were successful (Jameson *et al.* 1982).

Jurisdiction over sea otters passed to the State of Alaska when statehood was granted in 1959. In cooperation with the USFWS, the ADFG killed as many as 1,000 sea otters per year in the Aleutian Islands between 1962 and 1972 (Kenyon 1969; Calkins and Schneider 1985). Most of those sea otters were taken to test the feasibility of reinstituting a regular harvest and to provide specimens for biological studies (Kenyon 1969). In the late 1960s and early 1970s, sea otters at Amchitka Island sustained a harvest averaging 287 per year, and state biologists concluded that the sea otters could have sustained a harvest of two or three times that amount (Calkins and Schneider 1985). The number of sea otters at Amchitka Island in 1972 was conservatively estimated at 5,245 (Estes 1990b). Thus, a harvest rate of 5% was sustained and it was estimated that harvests of 11 - 16% would have been sustainable.

An additional 1,000 to 1,350 sea otters were killed in a test of a nuclear bomb at Amchitka in 1971 (Rausch 1973; Calkins and Schneider 1985).

In the mid 1980s, the ADFG estimated the Alaska population of sea otters at 100,000 - 150,000 (Calkins and Schneider 1985). The USFWS is attempting to census sea otters statewide, but at present believes the population to remain between 100,000 and 150,000 (U. S. Fish and Wildlife Service 1994a).

Southeastern Bering Sea - The ADFG estimated that there were between 11,700 and 17,200 sea otters north of the Alaska Peninsula in 1976 (Calkins and Schneider 1985). A survey there in 1986 yielded an estimate of just over 13,000 sea otters (Brueggeman 1988). A small group, perhaps numbering 30 sea otters, has been reported from the Pribilof Islands (U. S. Fish and Wildlife Service 1994a).

Prince William Sound - When the commercial harvests ceased, small numbers of sea otters apparently survived in the southern portion of Prince William Sound (Lensink 1962; Pitcher 1975). Garshelis *et al.* (1984) estimated that less than 50 sea otters were present in Prince William Sound by 1911. In the late 1940s and early 1950s, sea otters were reported in southern Prince William Sound in the vicinity of Montague, Hinchinbrook, Latouche, and Elrington islands (Lensink 1960, 1962). By the 1960s, those animals were still predominantly in the southern portion of the Sound (Lensink 1962; Pitcher 1975), but were gradually expanding their range to the north, east, and west.

Lensink (1962) surveyed Prince William Sound in 1959 and 1964 and estimated that 1,000 to 1,500 sea otters were present. Johnson (1987) suggested that a reduction in numbers in 1964 could have been due to the impact of the Great Alaska Earthquake or to an incomplete survey. From 1959, the Prince William Sound population grew at an average annual rate of 8.5% (Garrott *et al.* 1993).

By 1970, sea otters were colonizing Knight Island, Naked Island, and Port Gravina (Pitcher 1975). In 1973, the Prince William Sound population was estimated at 5,000 sea otters based on an aerial survey in which 2,015 sea otters were counted (Pitcher 1975). By 1974, they had reoccupied Sheep Bay, College Fjord, Harriman Fjord, and the northern Culross Island, Glacier Island, and Fairmount-Olsen Island areas (Pitcher 1975). In 1976, there were an estimated 4,000 to 6,000 sea otters in Prince William Sound (Calkins and Schneider 1985).

Virtually all of Prince William Sound (Figure 3) was recolonized by the early 1980s (Pitcher 1975; Garshelis and Garshelis 1984). In 1983, there were many sea otters in the vicinity of Orca Inlet, Sheep Bay, and Port Gravina and the range was expanding northeastward toward Valdez (Johnson 1987). In the summers of 1984 and 1985, sea otter densities in Prince William Sound ranged from 0.2 to 2.7 otters per km of shoreline with high densities along the northwestern shore of Montague Island, Green Island, Port Wells, and Orca Inlet (Irons *et al.* 1988).

Based on surveys from boats and airplanes and on telemetry studies, Garrott *et al.* (1993) estimated that over 16,000 sea otters were present in Prince William Sound prior to the *Exxon Valdez* oil spill in 1989, (Figure 4) and approximately 13,000 survived. In contrast, the USFWS (1994a) estimated 10,000 sea otters prior to, and 6,200 after, the oil spill. The discrepancy in post-spill numbers may in part be due to sampling errors. The USFWS's post-spill estimate resulted from boat surveys conducted in a randomly chosen 25% of the areas sampled by Irons *et al.* (1988) in 1984 and 1985. Garshelis and Johnson (1993) also surveyed by boat after the spill including in some of the same areas surveyed by the USFWS.

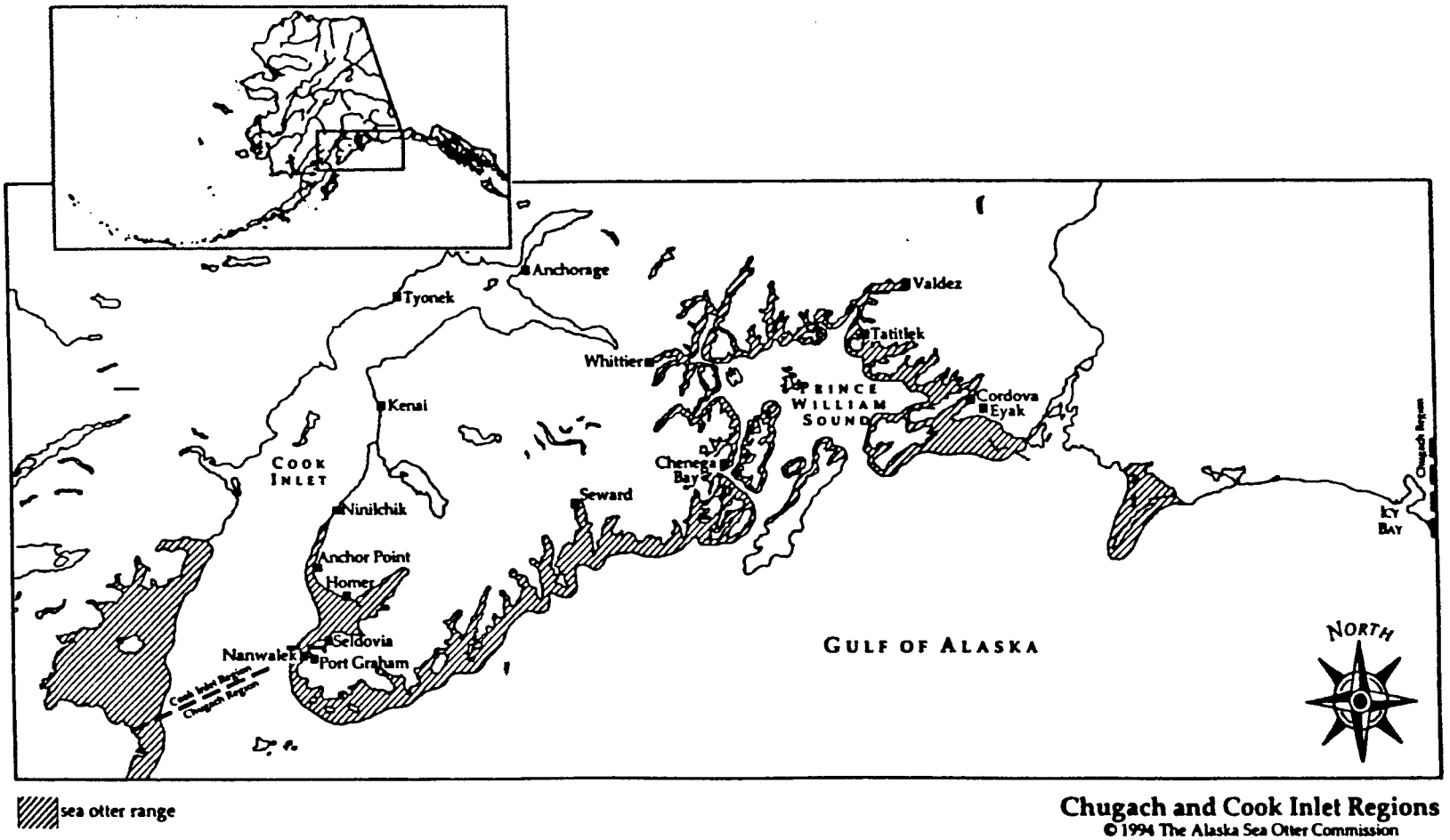

Figure 3. Distribution of sea otters in the Chugach and Cook Inlet Regions.

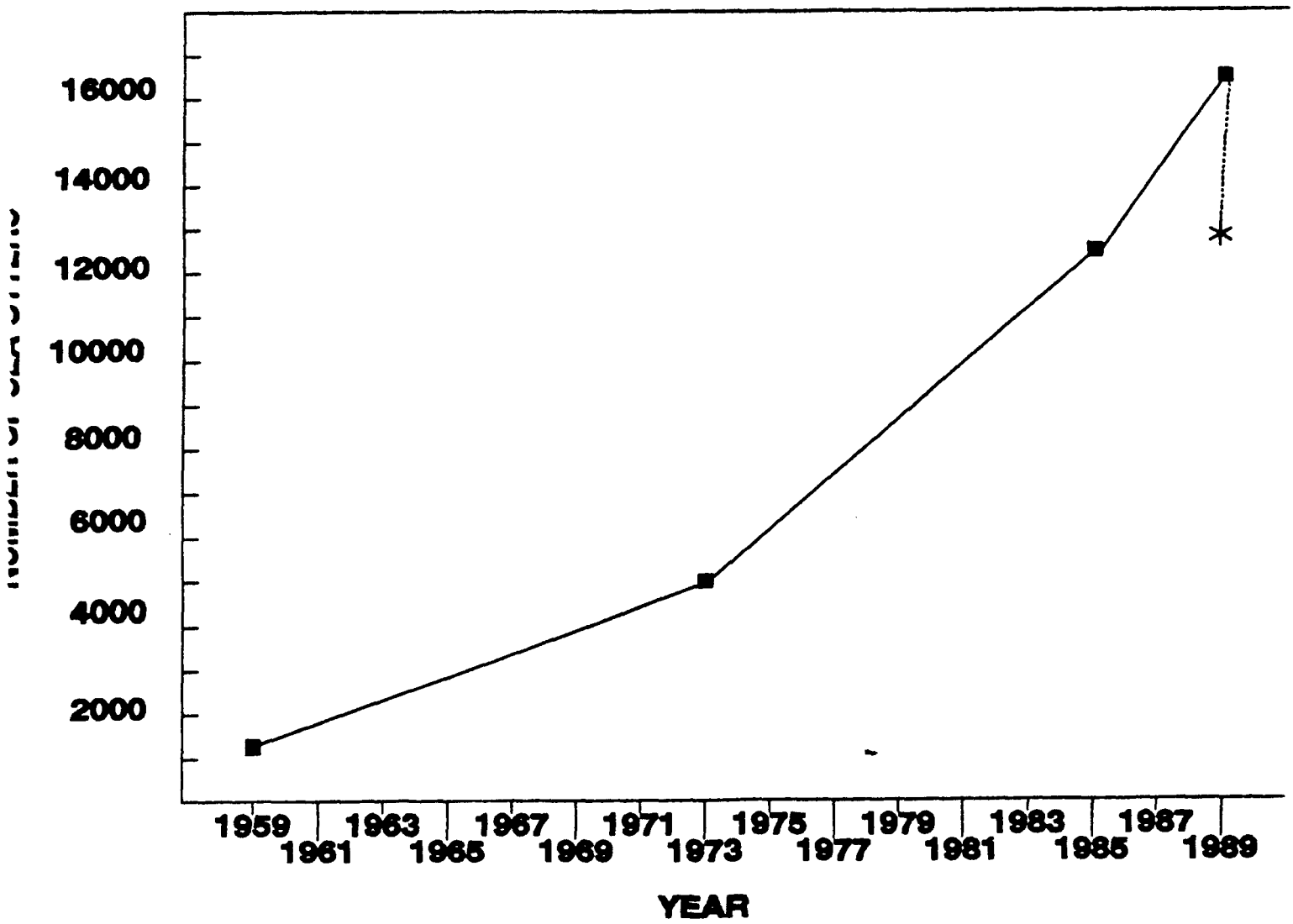

Figure 4. Sea otter population estimates in Prince William Sound including the post spill estimate (*) (after Garrott *et al.* 1993).

In the areas sampled by both groups, their estimates were within 3% of one another despite no communication between groups when the data were collected and analyzed. Nonetheless, Garshelis and Johnson's data indicated substantially higher numbers of sea otters in Prince William Sound overall in 1991 than did the USFWS data. Garshelis and Johnson (1993) further pointed out that the areas sampled by the USFWS, although randomly chosen as a subsample of areas surveyed in 1984-1985, happened to be non representative of the Sound as a whole. That is, extrapolating counts from that same subsampled area for the original 1984-1985 data resulted in a significant underestimate of the population in comparison to the complete 1984-1985 survey.

The NBS has been refining an aerial survey method for counting sea otters. The method involves observing from a low-flying aircraft and periodically circling to intensively search an area. Preliminary analysis of surveys conducted in August 1994 gave estimates of 5,260 sea otters in Orca Inlet and 9,092 sea otters in the rest of Prince William Sound (J. Bodkin, personal communication).

Lower Cook Inlet - Small numbers of sea otters apparently survived commercial harvests along the east side of the Kenai Peninsula (Lensink 1962; Pitcher 1975). Sea otters apparently persisted in Kamishak Bay in small numbers and began expanding their range to the north and south in the 1960s (Calkins 1980). By 1967, several hundred to one thousand sea otters abruptly appeared around Port Graham and Chugach Bay, but the numbers diminished over the next few years. Those sea otters probably came from the outer coast of the Kenai Peninsula (Calkins 1980). By 1970, sea otters occurred in small numbers along Kenai Peninsula from Cape Puget to Port Graham, and occasionally in Kachemak Bay. Calkins (1980) reported sea otters from Gore Point to Port Graham, expanding into Kachemak Bay and lower Cook Inlet. Lower Cook Inlet had been reoccupied by the early 1980s as far north as Ninilchik (P. Norman, personal communication). Calkins (1980) described increasing numbers around Port Graham and Chugach Bay. In 1980, the ADFG estimated 2,000 to 2,500 sea otters along the Kenai Peninsula and another 1,000 to 2,000 in Kamishak Bay and Shelikof Strait (Calkins 1980). The USFWS observed 2,300 sea otters along the Kenai Peninsula in 1989. How much of Cook Inlet will be colonized is unknown; seasonal sea ice, silt, and scarce food may limit expansion into the northern portion of the inlet. The current distribution is shown in Figure 3.

Copper River Delta - Sea otters apparently recolonized the Copper River Delta area from Prince William Sound (Pitcher 1975). One sea otter was seen in the Copper River Delta in 1950 and more than 150 were seen to the southeast of the delta eight years later (Lensink 1960, 1962). By 1986, there were at least 1,200 sea otters in the area (Simon-Jackson 1986).

Gulf of Alaska. -- Remnant populations survived the commercial exploitation in the Shuyak and Trinity islands of the Kodiak Archipelago (Rotterman and Simon-Jackson 1988). Lensink (1960) estimated 800 - 1,500 sea otters in the Kodiak Archipelago in 1960. Subsequent estimates for that region included 1,118 in the late 1960s (Kenyon 1969); 4,000 - 6,000 in 1976 (Calkins and Schneider 1985); 11,000 in 1989 (C. Gorbics, personal communication); and 13,200 in 1993 (U. S. Fish and Wildlife Service 1994a). The USFWS recently completed an aerial survey of the Kodiak Archipelago and their preliminary estimate was 6,100 sea otters (C. Gorbics, personal communication). That recent estimate included more sea otters in the near shore areas but vastly fewer in the offshore areas than did the 1989 estimate.

On the south side of the Alaska Peninsula and in the vicinity of the Shumagin Islands, the USFWS estimated a population of more than 27,000 sea otters (U. S. Fish and Wildlife Service 1994a).

Southeast Alaska - From 1965 - 1968, 412 sea otters were captured in the Aleutian Islands (367) and Prince William Sound (45) and moved to southeast Alaska. A survey seven years later suggested minimal population growth had occurred since the original releases (Schneider 1975). Subsequent growth was rapid, however, and counts between 1975 and 1988 indicated annual increases between 16 and 23% (Pitcher 1989). Whether the southeast Alaska population is still growing at 20% per year as suggested by the USFWS (U. S. Fish and Wildlife Service 1994a) or at a slower rate is not known. Applying a 20% growth rate to the number of sea otters counted in 1988 yields an estimated population of 11,500 sea otters in 1993. The USFWS estimates the current population in southeast Alaska at 7,000 sea otters (USFWS 1994a).

Aleutian Islands - Approximately 100 sea otters remained at Amchitka Island when the commercial harvests ceased in 1911 (Kenyon 1969). The population grew rapidly thereafter until the mid 1930s when it apparently exceeded the local carrying capacity. From Amchitka, sea otters recolonized other islands in the chain. At present, the USFWS estimates that the Aleutian Islands contain 25,000 -31,000sea otters with growth in some areas taking place at 17% per year (USFWS 1994a).

Oil Spill Effects

Over 900 sea otter carcasses (424 in Prince William Sound) were found after the *Exxon Valdez* oil spill. Many carcasses probably were not found, and the total kill in Prince William Sound was estimated at 500 - 5,000 sea otters. The population appears to be recovering rapidly.

Sea otters are highly sensitive to oil contamination because of their dependence on clean fur for insulation (Englehardt 1978; Geraci and St. Aubin 1980; Ralls and Siniff 1990). Exposure to oil causes their fur to mat, which releases the insulating layer of trapped air and decreases body core temperature (Williams *et al.* 1988). The probability of survival is good for sea otters only lightly oiled (less than 10% of the body surface) but poor when oil covers 20 to 30% of the body surface (Costa and Kooyman 1981, 1984; Siniff *et al.* 1982).

Oil spilled from the *Exxon Valdez* contaminated important sea otter habitat in the central and western part of Prince William Sound and spread along the Kenai Peninsula, the Kodiak Archipelago, and the Alaska Peninsula. Many sea otters were unable to escape the oil due to its rapid movement over a large area. As the oil was transported from Prince William Sound into the greater Gulf of Alaska, the volatile fractions of the crude oil evaporated and the oil conglomerated into weathered oil patches (DeGange and Lensink 1990). Thus, despite the increasing surface area affected by the spill, sea otters farther from the spill site had a lower risk of contamination than those encountering the oil soon after the spill. Some otters avoided contamination by taking refuge in the embayments along the convoluted shoreline of Prince William Sound (Bodkin and Weltz 1990; Garrott *et al.* 1993).

Lipscomb *et al.* (1993) examined 51 sea otters that died in the spill and found interstitial pulmonary emphysema and the associated hypothermia subcutaneous emphysema, gastric erosion and hemorrhage, hepatic and renal lipidosis, and centrilobular hepatic necrosis. Hypothermia, anemia, stress, and shock also were observed. Regardless of the degree of oiling, many of the sea otters examined after the oil spill died from shock (characterized by hypothermia, lethargy, and often hemorrhagic diarrhea), attributed to the combination of being oiled, captured, and handled (Ballachey 1993; Lipscomb *et al.* 1993; Rebar *et al.* 1993).

Observed Mortality

In the first four months after the spill, 904 sea otters were known to have been killed, 781 found dead, and 123 that died in captivity (Doroff *et al.* 1993). Most of the recovered carcasses came from Prince William Sound (424), but others were recovered from the Kenai Peninsula (167), and from the Kodiak Island - Alaska Peninsula region (190) (Doroff *et al.* 1993).

The spill appeared to affect reproductive females disproportionately. In Prince William Sound, 67% of the carcasses were adult females and 62% of those were pregnant and 15% lactating (Doroff *et al.* 1993).

Some of the carcasses recovered with oil on them may have been killed by other means and only drifted into the oil after death. Nonetheless, 93% of the carcasses recovered in Prince William Sound were oiled and believed to have been killed by the spill. Sea otters taken in to captivity after the spill died in proportion to the degree of oiling they suffered (Williams *et al.* 1990). Heavily oiled sea otters died more often (75%) than did those moderately oiled (41%) or lightly or nonoiled (25%).

Estimated Mortality

Undoubtedly, some sea otters killed by the spill were not recovered, and the total mortality exceeded the 904 carcasses recovered. Estimating the additional number of unseen mortalities is difficult, primarily because the number of sea otters in the affected areas before the spill was poorly known. When the spill occurred, the most recent counts of the sea otters in Prince William Sound were from an incomplete survey conduced in 1984 and 1985 (Irons *et al.* 1988). Those data indicated that in 1984-1985 there were about 5,808 sea otters in the area that was later oiled (Garrott *et al.* 1993). The population increased in that area by an estimated 12.7% between 1985 and 1989, so the estimated number in the oiled area just before the spill was 6,546 sea otters. From surveys conducted in 1989 after the spill, it was estimated that 3,898 sea otters remained in the oiled area. The number of sea otters killed, therefore, was calculated as the post-spill estimate subtracted from the pre-spill estimate (6,546 - 3,898 = 2,648).

Because the pre-spill and post-spill population sizes in the oiled area were estimated from incomplete surveys, a series of assumptions had to be made to calculate the number of sea otters killed. As a result of those assumptions, the calculated number of sea otters killed in Prince William Sound (2,648) may underestimate or overestimate the actual number. The actual number lost might be as low as 500 and as high as 5,000 sea otters (Garrott *et al.* 1993).

Outside of Prince William Sound, there were no pre-spill census data adequate for estimating the number of sea otters killed. Estimates of mortality outside of the Sound, therefore, had to be calculated by other means. Bodkin and Udevitz (*in press*) estimated the degree of oiling experienced by otters along the Kenai Peninsula from the distribution and density of oil and the distribution and density of sea otters (the intersection model). For each degree of oiling, they estimated a mortality rate based on observations of captive sea otters in the rehabilitation center. They calculated the mortality along the Kenai Peninsula to be about 500 - 700 sea otters.

Yet another method was used to estimate the overall mortality of sea otters in all areas affected by the spill. Doroff *et al.* (1993) released 25 tagged carcasses near Kodiak Island and observed that 5 (20%) were recovered on shore. Assuming that 20% of the sea otters killed in all areas of the spill were recovered, they calculated an overall kill of 4,028 sea otters. Applying that method to Prince William Sound, they calculated the kill in that region at 2,209, similar to the estimate (2,648) by Garrott *et al.* (1993). For the Kenai Peninsula, they calculated 868 sea otters killed, somewhat higher than the 500 - 700 estimated by Bodkin and Udevitz (*in press*).

Despite a substantial spill-related mortality, 70 - 80% of the sea otter population in Prince William Sound survived (Garrott *et al.* 1993). Results of two studies of sea otter recovery after the spill have been contradictory. Surveys by the USFWS indicated a 22% reduction in the number of sea otters in Prince William Sound between 1989 and 1990, essentially no change in 1991, and an increase of 13% per year in 1992 and 1993 (Burn 1993; Agler *et al.* 1994). Garshelis and Johnson (1993), on the other hand, found counts in the most heavily oiled regions of Prince William Sound one to two years later were equal to or greater than counts conducted by the same methods between 1977 and 1985. They suggested that, in the 1980s, clam stocks in the Sound were recovering from decreases brought about by uplift of their habitat during the 1964 earthquake. The increased stock of clams was thought to account for the apparent rapid recovery of sea otters after the spill.

Indirect Effects

Sea otters that were not killed directly by the spill might still have been weakened by exposure to the oil either directly or through contaminated food (Lipscomb *et al.* 1993; Williams *et al.* 1989). Populations of sea otter prey were reduced not only by exposure to oil but also by disruption of their habitat during the clean-up (Houghton *et al.* 1993a,b; Meacham and Sullivan 1993; Peterson

1993). Intertidal prey appear to have been more heavily contaminated than subtidal prey and, therefore, were most likely to adversely affect sea otters (Babcock *et al.* 1993; Doroff and Bodkin 1993). Conceivably, sea otters might detect and avoid contaminated prey (Calkins 1980).

The human response to the oil spill also was detrimental to sea otters. Animals sent from the rehabilitation centers to aquaria and released into the wild had a high mortality rate (Ballachey 1993; Estes 1990a). The stress of capture, transport, and prolonged captivity appears to have contributed to the mortality of sea otters at the rehabilitation centers (Osborn and Williams 1989). Estes (1990a) and Ames (1990) believed that the rescue effort extended too long after the spill, subjecting unoiled otters to the stresses of captivity and breaking mother-pup bonds. Anthony (1994) showed that sea otters subjected to high levels of human activity spent greater amounts of time feeding than expected.

Subsistence Harvests

Currently about 1% of the sea otters in Alaska are harvested annually by subsistence hunters. The USFWS estimates that a take 10 times as great could be sustained, assuming it was spread proportionately among possible subpopulations. Harvests in Prince William Sound have removed less than 3% of the sea otter population over the last two years. In Cook Inlet less than 1% of the population was harvested in each of those years.

Statewide Subsistence Harvest

In 1972, passage of the Marine Mammal Protection Act restored the right of Alaska Natives to hunt sea otters for food or the production of authentic handicrafts. Immediately after passage of the MMPA, however, few sea otters were taken by Alaskan Natives. The renewed opportunity to take sea otters was not widely communicated, so many people remained under the impression that harvest still was illegal. In addition, the nearly 100 year interruption in harvesting disrupted patterns of hunting and using sea otters. As sea otters have continued to increase in numbers and knowledge of the relevant laws and regulations has spread, however, harvests by Alaska Natives have increased. In 1993, Native harvest totaled 1,232 sea otters or 0.8 - 1.2% of the estimated statewide population (USFWS, unpublished data). The harvest was predominately of adults (84%) and mainly males (57%). Preliminary harvest figures for 1994, indicate a take of 704 sea otters.

According to the draft stock assessment for sea otters in Alaska, 10,000 sea otters could be safely removed from the population each year as long as the harvest was not concentrated in a few areas or on females (USFWS 1994b). For the purposes of calculating that PBR level, the USFWS assumed a conservative population size of 100,000, a recovery factor of 1, and a maximal rate of net productivity of 20% (Pitcher 1989; Estes 1990b).

Harvests in Prince William Sound and Lower Cook Inlet - In 1993, hunters in the Chugach region took 199 sea otters or 16% of the statewide take. The 1993 harvest in the Chugach region was equivalent to 1.4% of the most recent estimate of the Prince William Sound sea otter population (14,352). Hunters in the Cook Inlet region took 25 sea otters in 1993, or 2% of the statewide total. That take was equivalent to 1% of the most recent estimate of sea otters along the Kenai Peninsula (2,300) and probably less than 1% of the population in the entire Lower Cook Inlet region. In 1994, the harvest in the Chugach region increased to 369 or 2.6% of the estimated Prince William Sound population. In the Cook Inlet region 28 sea otters were tagged in 1994.

Recovery Goals and Objectives

The sea otter population in Alaska continues to grow. The greatest threat to the population is the potential for oil spills. Sea otter threats to crabs and shellfish populations might be minimized by increased sea otter harvests, but would require a waiver under the MMPA.

The Marine Mammal Protection Act

As understanding of the population biology of sea otters increases, it will be necessary to reconcile the MMPA mandates to maintain the health of the ecosystem and, when consistent, to maintain sea otter populations within their OSP range. Healthy ecosystems could be defined for either of the alternate stable communities that have been described for rocky subtidal communities and consideration will have to be given to the health of shellfish and crab populations and the people who depend on them. Mariculture is threatened by sea otter predation. In the case of a marine mammal strongly competing with people for food, it may be desirable to maintain the population closer to the lower end of their OSP range (Eberhardt 1977). Taking sea otters for the purposes of population control, however, would require a waiver under the MMPA.

Exxon Valdez Oil Spill Trustee Council

The greatest threat to sea otter conservation in Alaska is the potential for oil spills. Attempts to restore sea otters and their habitat after the *Exxon Valdez* oil spill may have been more injurious than helpful. Nonetheless, recent restoration expenditures included development of a marine mammal facility for rehabilitation and research at Seward.

The intersection model may be useful for predicting exposure of sea otters in future oil spills, but comprehensive surveys of sea otters in areas with the potential for oil spills also are needed (Bodkin and Udevitz *in press*). The NBS and the USFWS are conducting such surveys. The primary need is for better understanding of the population dynamics and ecology of sea otters in Alaska.

Subsistence Harvests and Recovery Goals

The current level of subsistence harvest is sustainable by the sea otter population. The potential exists, however, for sea otters to be locally decimated by an oil spill, thereby threatening the subsistence harvest. Restoration activities primarily involve research, and many of the research as well as management activities could involve subsistence hunters. An outline of potential research and management actions is presented for discussion.

Outline of Sea Otter Conservation Actions

1. Define the OSP range for sea otters in the Chugach and Cook Inlet regions.

    11. Evaluate the suitability of different approaches to determining numerical values of the OSP range for sea otters in the regions.

    12. Refine the estimate of the OSP range for sea otters in the regions.

        12a. Improve accuracy of population estimation methods.

        12b. Conduct ecological research to improve estimates of the population size of sea otters that can be supported by the environment in the regions.

        12c. Assess population status relative to the environment's carrying capacity by way of the sea otter's behavior, physical condition, reproduction, and population parameters.

        12d. Expand the biological sampling program for sea otters harvested by Alaska Natives.

2. Determine and monitor the distribution and size of the sea otter population in the Chugach and Cook Inlet regions.

    21. Monitor the distribution of sea otters in the regions.

    22. Develop methods for accurately surveying population size.

    23. Survey the sea otter population in the regions at two year intervals.

3. Establish PBR levels consistent with the MMPA.

    31. Calculate the PBR level based on the best available information.

    32. Develop a population model and refine estimates of sustainable harvest levels for the sea otter population in the regions.

    33. Review and update annually the sustainable harvest level for sea otters in the regions.

4. Monitor the harvest of sea otters in the Chugach and Cook Inlet regions to ensure that it is within sustainable levels.

5. Monitor the effects of sea otters on crab and shellfish populations in the Chugach and Cook Inlet regions.

    51. Continue and expand studies of sea otter community ecology in the regions.

52. Design and conduct surveys to document changes in catch per unit effort of crab and shellfish by subsistence and commercial fisheries.

53. Investigate possible mechanisms for limiting sea otter predation on selected crab and shellfish stocks.

54. Investigate and, as necessary, mitigate possible conflicts between sea otters and mariculture.

6. Identify and protect essential habitats for sea otters in the Chugach and Cook Inlet regions.

61. Determine and minimize rates of sea otter mortality in commercial and subsistence fisheries.

62. Investigate and minimize the potential for habitat destruction in the Chugach and Cook Inlet regions by oil and gas development, logging, mining, and other human activities.

7. Coordinate local, regional, state-wide, national, and international conservation efforts.

71. Determine local rights and responsibilities for sea otter management.

72. Continue inter-regional cooperation in sea otter management.

73. Continue and expand Native-State-Federal cooperation in sea otter management.

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