RESTORATION PLANNING
FOLLOWING THE
EXXON VALDEZ OIL SPILL

August 1990 Progress Report

Prepared by the
Restoration Planning Work Group

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Alaska Departments of Fish and Game, Natural Resources, and Environmental Conservation;
U.S. Departments of Agriculture, Commerce, and Interior;
and the U.S. Environmental Protection Agency

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CHAPTER I
INTRODUCTION

The March 24, 1989 grounding of the tanker *Exxon Valdez* in Alaska's Prince William Sound caused the largest oil spill in U.S. history. A slick containing about 11 million gallons of North Slope crude oil covered the western portion of the Sound and moved for more than 500 linear miles in Cook Inlet and along the northern Gulf of Alaska. More than 1,000 miles of shoreline were moderately to heavily coated, including state and national forests, refuges and parks. The spill damaged areas extremely rich in natural resources. It injured fish, birds, mammals, intertidal plants and animals and their associated habitats. The area's important historical and archaeological resources also were damaged as a result of oiling, cleanup activities and subsequent incidents of vandalism. The oil also affected recreational opportunities and aesthetic and psychological values.

Soon after the spill occurred, President Bush and Alaska Governor Cowper expressed the desire that the environment and economy of Prince William Sound and the Gulf of Alaska be restored. Full restoration of these natural resources and the services they provide is in turn the responsibility of the federal and state agencies which manage and protect them on behalf of the public. As authorized under federal law, the state and federal governments intend to present claims to the responsible parties for the injuries caused to natural resources and their uses. The funds received from these claims must be used to restore the natural resources and services injured by the spill.

Response, Damage Assessment and Restoration

Federal law provides authority for actions undertaken by federal and state governments following the *Exxon Valdez* oil spill. Section 107(f) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Section 311(f) of the Federal Water Pollution Control Act (Clean Water Act) provide for federal and state officials to act as trustees on behalf of the injured natural resources and to pursue recovery of damages for injury to and loss or destruction of those resources.

CERCLA applies to spills of hazardous substances other than oil, while the Clean Water Act applies to oil spills. Both laws are supplemented by the National Contingency Plan and the Natural Resource Damage Assessment (NRDA) regulations, which set out a suggested, but not mandatory, process for determining proper compensation to the public for injury to natural resources. In combination these laws and regulations provide the structure for the response, damage assessment and restoration activities following the *Exxon Valdez* oil spill.

Restoration is one component of this process. Combined with response and the NRDA, these efforts seek to minimize adverse impacts and compensate the public for natural resource injury and lost use values by restoring the resources and the services they provide.

Response activities include the initial emergency measures to contain the spilled oil and minimize adverse impacts, as well as the subsequent efforts to clean up oil from the spill area. The magnitude of and circumstances surrounding the *Exxon Valdez* oil spill resulted in relatively little of the spilled oil being contained. Consequently, cleanup activity has focused primarily on removing oil from the shoreline areas affected by the spill. At the time of this report, more than one year after the *Exxon Valdez* ran aground, cleanup efforts continue.

State and federal agencies initiated 72 scientific studies after the oil spill to determine the amount of damage. This damage assessment process, which continues in 1990, is designed to quantify the specific resource injuries and determine their corresponding monetary values. This monetary value includes "lost-use" and restoration costs. Claims for these damages will be presented to the responsible parties, and under federal law, the monies received must be used for restoration, replacement or acquisition of equivalent resources.

Definition of Restoration

Restoration follows the spill response and damage assessment process by planning for and, then, implementing activities to help restore the environment. Restoration is specifically defined under the NRDA regulations (43CFR11.14(ll)) as follows:

> "Restoration" or "rehabilitation" means actions undertaken to return an injured resource to its baseline condition, as measured in terms of the injured resource's physical, chemical, or biological properties or the services it previously provided...

Restoration actions fall into three categories - direct restoration, replacement, and acquisition of equivalent resources:

- **Direct restoration** refers to measures taken, usually on-site, to directly rehabilitate an injured resource.
- **Replacement** refers to substituting one resource for an injured resource of the same type.
- **Acquisition of equivalent resources** means the purchase or protection of resources that are the same or substantially similar to the injured resources in terms of ecological values, functions or uses.

In late 1989 an interagency Restoration Planning Work Group (RPWG) was established to develop and coordinate restoration planning activities for the *Exxon Valdez* oil spill.

The goal of the restoration planning effort is to identify appropriate measures that can be taken to restore the ecological health and uses of natural resources affected by the *Exxon Valdez* oil spill. Specific objectives include:

- Identify or develop technically feasible restoration options for natural resources and services potentially affected by the oil spill.
- Incorporate an "ecosystem approach" to restoration (i.e., where appropriate, broadly focus on recovery of ecosystems, rather than on individual components).
- Determine the nature and pace of natural recovery of injured resources, and identify where direct restoration measures may be appropriate.
- Identify the costs associated with implementing restoration measures, in support of the overall natural resource damage assessment process.
- Encourage, provide for and be responsive to public participation and review during the restoration planning process.

RPWG Includes representatives of the following agencies:

Alaska Department of Fish and Game (ADF&G)

Alaska Department of Natural Resources (ADNR)

Alaska Department of Environmental Conservation (ADEC)

U.S. Environmental Protection Agency (EPA)

U.S. Department of Agriculture (DOA)

U.S. Department of Commerce (DOC)

U.S. Department of the Interior (DOI)

(Individual representatives are listed in Appendix A)

Restoration planning leads to implementation of an approved restoration plan. It is important to understand, however, that a full damage assessment is not yet complete. At this time, therefore, RPWG is developing the broadest possible list of potential restoration activities for resources that may have been injured. Once the damage assessment process is complete, appropriate activities will be recommended and incorporated in a detailed restoration plan. Such a plan can be implemented only when restoration funds become available from the responsible parties. The figure on the opposite page gives a generalized overview of the restoration planning process.

This progress report summarizes RPWG activities to date. Public participation programs, the technical workshop, a scientific literature review and the feasibility studies are shown in the figure on the opposite page and described in Chapters II through V. These activities led to development of a preliminary list of potential restoration options that are presented as a series of matrices in Chapter VI. Future restoration planning activities, including the evaluation and selection of restoration options and development of a final restoration plan, are discussed in Chapter VII.

The public is encouraged to comment on this report and to share suggestions for restoration alternatives with RPWG. Additional reports will be prepared later in the process. Address comments and questions to:

Oil Spill Restoration Planning Work Group

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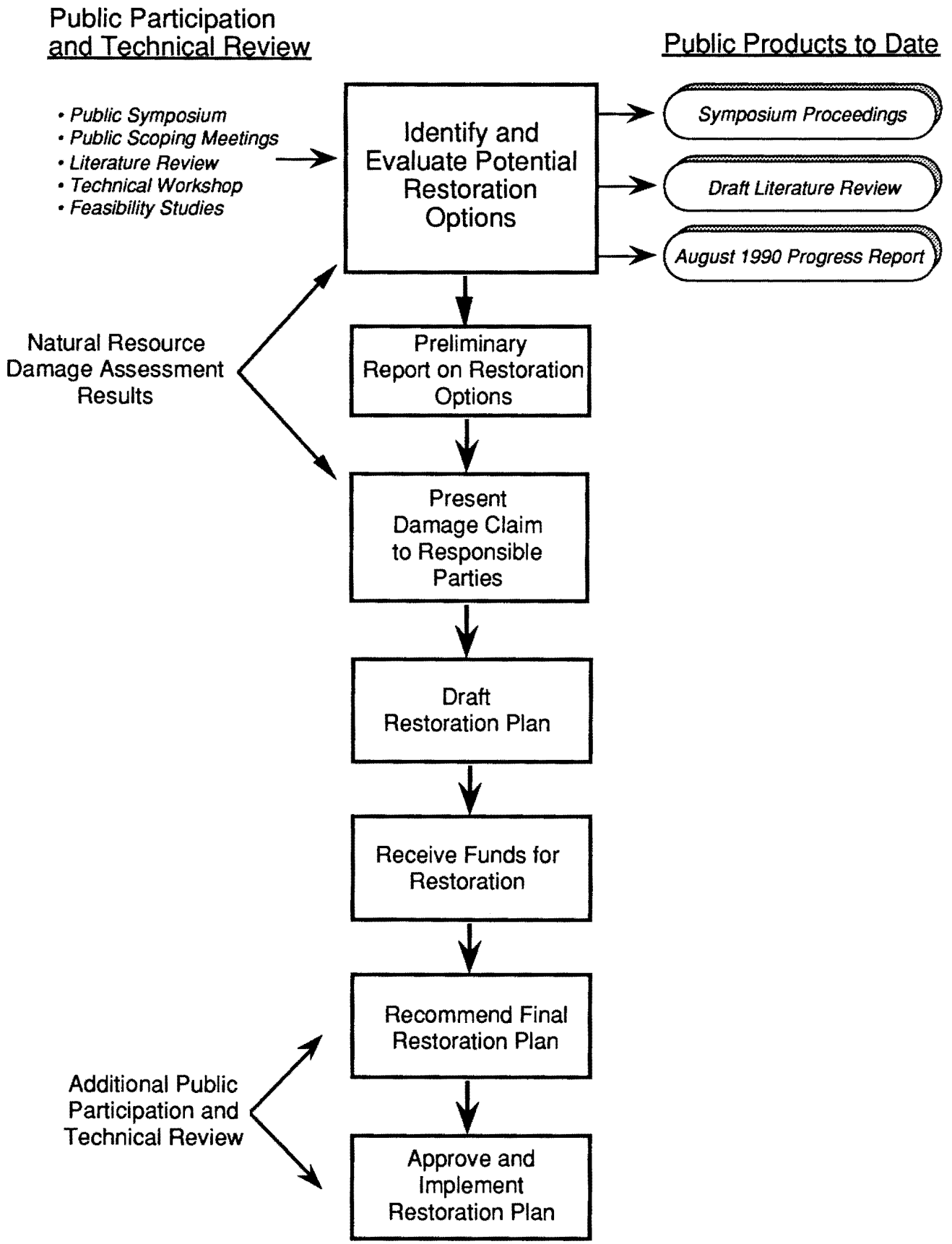
THE RESTORATION PLANNING PROCESS



CHAPTER II
PUBLIC PARTICIPATION

The restoration planning process emphasizes public participation. Active public participation provides the greatest potential for long-term benefits in both an environmental and social sense. Just as the spill impacted the social and economic nature of Prince William Sound, Cook Inlet and the Gulf of Alaska, restoration activities also will have social and economic effects. Public involvement throughout the restoration planning process is needed to responsibly balance potentially conflicting biological, social and economic objectives.

Given the importance of public participation, the RPWG began planning a variety of public activities and is continuing to identify ways to incorporate public comments and concerns into the planning process. In March, 1990 a public symposium was organized by RPWG as the first formal opportunity for the public and experts from within and outside of Alaska to express their views about what a restoration plan should entail. The proceedings from the symposium, containing the complete text of speakers' presentations, have been published separately. That report, titled Restoration Following the *Exxon Valdez* Oil Spill: Proceedings of the Public Symposium is available from RPWG.

Soon after the symposium, RPWG initiated public scoping meetings in some of the communities that were directly affected by the *Exxon Valdez* oil spill. The purpose of these meetings was to identify injured resources and restoration options, and to gain a sense of the public's priorities for the restoration program. The communities visited were Cordova, Valdez, Whittier, Homer, Kodiak, Seward, Anchorage, and Kenai-Soldotna. The RPWG is planning to hold additional community scoping meetings in smaller coastal communities, as well as further discussions with individual citizens and interest groups. A limited number of meetings outside of Alaska are also being considered.

The following sections synthesize opinions expressed at the symposium and summarize oral comments from the public scoping meetings and other written comments received to date. These viewpoints should not be construed as representative of the positions or policies of state or federal governments.

Synthesis of Public Symposium

The Oil Spill Restoration Symposium was held on March 26-27, 1990 in Anchorage, Alaska. The symposium began with introductory statements by Dennis Kelso, Commissioner of the Alaska Department of Environmental Conservation, and Tom Dunne, Acting Regional Administrator of the U.S. Environmental Protection Agency. These opening remarks described the restoration planning process and its objectives. Three keynote speakers addressed the symposium on legal issues related to the damage assessment and restoration process, experiences with restoration of non-marine ecosystems and public participation in the planning process. A final keynote speaker provided an overview of restoration concepts.

Panel discussions comprised the remainder of the symposium. Sessions addressed direct and indirect restoration of six types of resources: coastal habitats, fisheries, marine and terrestrial mammals, birds, recreational uses and cultural resources. Panelists included experts on restoration in each of these six resource types, as well as representatives from various resource user groups, Alaska Native corporations, public land managers, environmental interest groups and the timber and tourism industries. All panel sessions included opportunities for questions and comments from the public, and an extended public comment session took place at the end of the symposium.

Restoration concepts and ideas discussed at the symposium can be grouped into three categories: broad restoration approaches and philosophies; recommendations for public participation during the restoration planning process; and, ideas addressing restoration of specific resources (i.e., fisheries, mammals, cultural resources, etc.). There was consensus among speakers and attendees that more specific comments on restoration cannot be given without public access to NRDA results. Major points from the symposium discussion are summarized below.

Broad Restoration Approaches and Philosophies

Most speakers called for a holistic, ecosystem approach to restoration. Such an approach will help ensure that the restoration program addresses the integrity of the environment and its many functions, uses and values. Without consideration of the ecosystem as a whole, a variety of impacts could be missed entirely.

Many speakers called for an assessment of the oil spill in terms of cumulative effects, both short- and long-term. They recommended long-term monitoring and research efforts to follow any restoration effort. An environmental trust fund was suggested by many as a way to ensure funding for long-term ongoing research and monitoring activities. A monitoring and research program was seen as critical for detecting subtle or long-term impacts that might not be apparent through the relatively short-term studies being conducted for the NRDA.

Many symposium participants expressed a strong preference for the use of restoration funds within the spill area or, at a minimum, within the state. There were some suggestions, however, that funds be used out of state in order to restore migratory resources harmed within the spill area. In addition, the need to use native fish stocks and species in any rehabilitation efforts was stressed.

One speaker strongly recommended that restoration be limited to the physical removal of oil, and that nothing else should be done so that nature could take its course. This speaker was concerned about the possibility of doing more harm than good through human intervention, and he emphasized the ability of the marine environment to recover naturally.

Many viewed the oil spill and subsequent restoration program as an opportunity to raise public awareness concerning oil spill prevention measures and changes in national energy policies and laws. There was consensus on the need for increased environmental education and natural resource interpretation to encourage better protection of those resources that were damaged by the spill. A specific idea was to establish a public restoration interpretive center. One person stressed that the public needs to be informed about the complexities of ecosystem relationships and the slow processes of recovery, and that this educational effort should be a continual and integral part of the restoration process.

Public Participation and the Planning Process

In general, many people felt that the public participation process needs to be refined based on past experience in the State of Alaska. The process itself should be as simple and flexible as possible, and not become overly bureaucratic. Speakers urged that the restoration process should foster cooperation and trust among scientists, government agencies and the public. In this sense, public participation was seen as an essential aspect of restoration planning, crucial to recognizing differences in social, ecological and cultural values throughout the spill area.

Several people suggested the formation of a citizen advisory committee to oversee public involvement. It was recommended that local input should be encouraged so that residents' knowledge of the affected area is not overlooked. It was also emphasized that Native Alaskans' interests must be met in the public process.

Many speakers expressed frustration that most NRDA information has not been made available to the public. Further, that which has been available has been conflicting and, therefore, counterproductive. Several people explained that the public cannot be expected to get involved without adequate information. It was recommended that the news media be contacted more often to better inform the public about the restoration effort.

Finally, several people commented that the advertising for the symposium was inadequate. One person suggested that such public forums should be held during nonbusiness hours to encourage maximum public involvement. A public meeting in Anchorage following the publication of the symposium proceedings was also suggested.

Specific Restoration Ideas

While one speaker strongly recommended that restoration actions be limited to the physical removal of oil, others supported an active restoration effort and presented ideas regarding specific resources.

Several ideas involved the rehabilitation of habitat. For example, beach rye grass could be reestablished in coastal areas affected by oil and cleanup activity, both to aid habitat recovery and to help prevent erosion. Actions to recover an existing fishery might involve increasing habitat complexity (e.g., addition of spawning channels) or enhancing food supply (e.g., lake fertilization). Active habitat restoration for birds might include enhancing productivity and survivorship through improvement of food sources and manipulation of habitats. One specific recommendation to enhance the island nesting habitat of seabirds was to reduce predators, specifically foxes, that had been introduced in past years as part of the fur trade.

In addition to habitat rehabilitation, efforts to accelerate recolonization may be appropriate for some species. It was stressed that recovery of the habitat must be assessed before species replacement occurs. An example of a recolonization effort is the use of hatchery and aquaculture techniques to help preserve wild populations of fish and shellfish. Reestablishing seabird colonies by reintroducing individuals in affected areas was also suggested. However, relocation of some marine mammal species, particularly seals and sea lions, was not recommended due to past experience showing that these marine mammals often attempt to return to the areas from which they were removed. Some noted that Prince William Sound may be well suited to natural recolonization from nearby populations.

Most speakers agreed that minimizing further disturbance from human activities was important for restoration of all injured resources and uses. This idea applied to bird nesting sites as well as marine mammal rookeries and haulouts. Many people felt that restoration funds should be spent to increase enforcement of existing laws prohibiting human disturbance due to hunting or poaching, violations of buffer distances or illegal fishing practices. Someone questioned whether local resource users will accept any changes in hunting and fishing policies that might result from restoration efforts. Many agreed that promoting nonharmful fishing methods both in Alaska and on a national and international level was important.

Most recreational use of the oil spill area is closely related to natural resources. Therefore, most speakers on the topic of recreation called for active restoration of recreational services through ecological restoration. A common theme was the need for protection of the land and changes in management policies to facilitate recovery. It was stressed that unified promotion was needed for Alaska tourism, since the public is getting mixed signals regarding the nature and extent of damages from the oil spill.

Archaeological sites need protection during cleanup and restoration activities, as well as possible stabilization through traditional archaeological restoration techniques, which should be compatible with the surrounding natural environment. In general, all speakers agreed that sensitive cultural resources should be restored with maximum participation of

Alaskan Native land managers and village representatives. Also, there is a strong need to address subsistence lifestyle issues, including obtaining more information on subsistence as an economy.

Almost all speakers agreed that a good way to help speed recovery for many resources would be through land protection. Most referenced direct acquisition of critical or important habitat, particularly in the case of marine mammals and birds. This included preservation of shoreline buffer strips in timber harvest areas to maintain water quality and protect breeding and other habitats important to wildlife.

Most often land protection was suggested as a way to acquire equivalent resources. For example, one recommendation was to acquire wetlands adjacent to the Kenai River, which is a prime salmon-producing river currently threatened with development. Many alternatives for this type of habitat protection were mentioned including direct acquisition, purchase of timber rights or oil lease options, as well as establishment of new wilderness areas, conservation easements, cooperative land management agreements and habitat conservation tax credits. Establishment of a rotating fund similar to that used by The Nature Conservancy was supported by many participants. Experts in land management stressed that these options may have social and economic impacts, which also must be assessed. Most attendees agreed that land acquisition outside the State of Alaska should be a last resort. The use of some type of endowment fund to support long-term acquisition and enhancement of natural resources was also supported.

Summary of Local Public Scoping Meetings and Written Comments

The public scoping meetings were held in the evenings in the larger communities directly affected by the oil spill (see table below). Presentations were made by members of the RPWG on the legal framework for restoration. Descriptions of the three basic categories of restoration (direct restoration, replacement and acquisition of equivalent resources) were given.

Initial Public Scoping Meetings

Location	Date	Location	Date
Seward	April 16	Cordova	April 17
Kenai/Soldotna	April 17	Homer	April 18
Valdez	April 18	Anchorage	May 17
Kodiak	May 21	Whittier	May 31

Summary of Public Comments

This summary includes comments voiced at the scoping meetings, and written comments received from the public during the period from April through June, 1990. The community(s) from which the comment originated is listed in parentheses after each comment. An asterisk (*) following the community name indicates that it was a written comment.

Prevention

- Use restoration funds for prevention of future oil spills. (all towns)
- Install a satellite communications system for research-response vessels to quickly direct the vessels to remote spills. (Homer)
- Establish a legislative action trust fund. (Kodiak)
- Establish a harbor authority to regulate and monitor vessels. (Anchorage)
- Provide public education for all ages about laws and regulations of oil exploration and transportation so that everyone understands the pitfalls prior to another accident. This will support informed voting and lobbying and thus prevent more oil disasters. (Homer*)

Cleanup

- Conduct special cleanup activities that minimize the impact on the beaches and enhance natural restoration in pristine areas. (Homer)
- Fund local research on cleanup and restoration techniques. (Homer)
- Clean and restore oiled recreation areas that have been scheduled for "no treatment." (Whittier)
- Do not begin restoration until cleanup is completed in accordance with local and Native Alaskan land manager standards. (Whittier)
- Determine effects of oil and effectiveness of different cleanup techniques in different ecosystems as a first step. (Anchorage)
- Discontinue removal of oil-injured sea otters and birds; let them die in peace. (Homer*)
- Stop the use of Inipol fertilizer. (Kodiak, Homer*)
- Use less disruptive cleaning techniques on previously untouched coastlines. (Homer*)
- Continue to clean beaches and areas of impact; however, use research information to identify most efficient and least toxic methods. (Homer*)
- Remove loads of garbage from Exxon and volunteer cleanup sites. (Homer*)
- Thoroughly clean areas; indications that biologists and Exxon officials say that everything is all right are upsetting. (Homer*)

- Clean up all bays that trap and hold oil, such as Herring and Marsha Bays on Knight Island, Nuka Island Passage and Knight Island Passage. Conduct physical removal and replacement of heavily oiled beaches and continue use of bioremediation. (Seward*)

Natural Resource Damage Assessment

- Delay restoration planning until data from the damage assessment studies are available. (Cordova, Homer, Anchorage)
- Provide sufficient government funds to carry out adequate damage assessment. (Cordova)
- Monitor Exxon's damage assessment activities to assure quality. (Cordova)
- Support and implement fishery studies for the Kenai Peninsula that have been cancelled from the NRDA program. (Homer)
- Guarantee that damage assessment and research information be available to the public so that restoration can be planned accordingly. (Homer*)

Research and Monitoring

- Set aside ecosystem research areas, establish long-term research for baseline information, and allow no public use. Fund long-term monitoring and research. (Seward, Cordova, Valdez, Homer, Kodiak)
- Establish a trust fund for long-term restoration, recovery, acquisition and enhancement projects. (Homer, Kodiak, Whittier)
- Involve local people in monitoring to restore public trust. (Whittier)
- Provide in-the-field research and monitoring vessels to combine research, recovery, restoration and prevention. (Homer)
- Study effects of boat distance from eagles and seal haulout and pupping areas, etc.. Then, educate the public. (Valdez)
- Fund research on whales, Dall and harbor porpoises, as well as the impacts of hatchery fish on wild stocks. (Valdez)
- Fund research on impacts of fishing and oil on sea lions. Fund research to identify the cause of sea lion population decline. (Homer)
- Identify subsistence lifestyle impacts and make information about food quality more available. (Kodiak)
- Conduct river otter research for outer coast of Kenai Peninsula and Islands. (Homer*)
- Study salmon internal organs for toxic effects of crude oil. (Homer*)
- Study the ocean floor where dispersants were used. (Homer*)

- Provide useful research and information through regional institutions, such as The Prince William Sound Science Center. (Cordova*)
- Quantify loss of fish rearing habitat to the maximum extent possible and restore areas to their historic fish production levels and environmental state. (Homer*)
- Carry out research and monitoring in backwater marshes and lagoons. (Port William*)
- Continue studies on impacts to sockeye salmon in Cook Inlet so that the damage to fisheries resources will not go unobserved. Both commercial and sport fisheries are the backbone of Alaska's economy and lifestyle. (Soldotna*)

Natural Recovery

- Keep in mind that people may not be able to accept John Teal's comment, at the public symposium, that the best thing we can do to restore coastal habitats is to do nothing. (Cordova)
- Avoid physical restoration; better to leave the Sound alone. Do not establish permanent research stations and boat moorings that will increase public use. (Valdez)
- Be aware that natural processes will be largely responsible for restoration; it will take decades. Do not be deceived into believing that restoration can be accelerated substantially through the expenditure of large amounts of money. (Fairbanks*)
- Need to closely monitor the changes that will be taking place over time. (Fairbanks*)

Management Practices

- Limit human use when and where it competes with wildlife for the reduced number of non-oiled beaches. (Cordova, Anchorage, Valdez)
- Limit use of recreational areas previously used by relatively low numbers of people, such as the outer coast of the Kenai Peninsula. Discourage use through tourism boards. (Homer*)
- Manage increased use of areas of the Sound introduced to many people during cleanup - this increased use could have greater long-term impact than the spill. (Cordova)
- Provide increased protection of archaeological sites. Return artifacts removed by Exxon archaeologists. (Kodiak)
- Be careful not to increase impact with replacement projects, such as building new public-use cabins in non-oiled areas. (Anchorage)
- Support tree planting efforts in areas which have been or will be logged, for example, Afognak Island. (Homer)
- Replant forests to make up for *Exxon Valdez* paperwork. (Whittier)

- Harvest rockweed in non-oiled areas and supply as feed for deer in oiled areas during the winter season. (Whittier)
- Remove introduced predators at seabird nesting colonies to enhance recovery of these colonies. (Homer)
- Manage recreation to reduce human impacts, for example, expand existing facilities rather than construct new facilities. (Homer)
- Change fish and game regulations to curtail human-use impacts on the Sound. (Valdez)
- Shift orientation of the Alaska Department of Fish and Game from consumptive use and harvest; shut down fishing seasons in the Sound for at least two to three years; and, close the river otter and mink trapping season. (Valdez)
- Begin restoration work this year; by the time lawsuits are settled it may be too late to take effective actions. (Anchorage)
- Purchase some limited entry permits to reduce pressure on fishery resources and protect marine mammals and birds. (Anchorage, Cordova)
- Protect humpback and orca "rubbing" beaches on Perry and Knight Island. (Valdez)
- Designate the Sound as a national monument. (Valdez)
- Stop oil exploration and development in the Arctic National Wildlife Refuge. (Homer*)
- Stop offshore and coastal drilling. (Homer*)
- Sacrifice some areas to heavy use so that other areas can be preserved. (Valdez)
- Limit additional commercial development in the Sound; it is already overused. However, must also find some way to provide more economic opportunities for Native Alaskan communities. (Valdez)
- Preserve timbered slopes to protect marbled murrelet nesting areas. (Homer)
- Provide funding to state parks for managing increased numbers of tourists. (Homer*)
- Keep open a National Park Service office to provide information on Katmai. (Kodiak)
- Prohibit state land sales in Iliamna area and create a new wildlife refuge. (Anchorage)
- Restrict logging, mining and fishing in Prince William Sound. (Anchorage)
- Keep areas such as Passage Canal and Port Wells as stocking, natural areas to help repopulate the more damaged adjacent areas. Close or limit drag fishing. (Anchorage).
- Ban hydroelectric development at Nellie Juan. (Whittier)

- Require logging and oil companies to provide restoration plans before conducting their activities. (Whittier)
- View the vast Gulf of Alaska as a limited resource to be protected. (Homer*)
- Discourage mountain bike use in the outer coast of the Kenai Peninsula. (Homer*)
- Discontinue selling lumber to Japan for use as computer paper. (Homer*)
- Discontinue forest destruction for the benefit of few; monopolization of resources should become less profitable. (Homer*)
- Support legislative action for:

  - Statutory state and federal habitat protection for critical habitats, as well as marine and estuarine sanctuary and wilderness designations;

  - Restrictions on development activities that could have a negative impact on the recovery of habitat and wildlife populations in oil-affected areas. (Valdez*)
- Organize agency survey work in small, efficient teams to avoid distress of wildlife. Consult knowledgeable, local residents on safety, operations and damage information advice. (Kodiak*, Port Williams*)
- Provide immediate and complete restoration to fisheries setnet sites in the Sound, especially Main Bay. Complete restoration of bird rookeries in the Sound and the Barren Islands. (Seward*)

Public Information

- Dispel fears of tourists and subsistence users by providing information on contamination or lack of contamination: use direct mail to registered voters, work with state tourism groups and contact journalists outside Alaska. (Kodiak)
- Provide substantial funds for the Seafood Marketing Institute to redevelop damaged markets. (Homer*)
- Mail information flier to all area residents. (Cordova)
- Make the literature review available to local libraries; acquire the most relevant publications. (Valdez)
- Provide information to help restore fish markets devastated by the Exxon spill. (Homer*)
- Keep the public fully informed of what is involved in restoration of the areas affected by the spill. Stress the complexity of ecosystem relationships affected by the spill and the slow processes of recovery. It is important for a public information program to be an integral part of the restoration plan. (Fairbanks*)

- Establish a unified tourism information program; the various tourism groups and chambers of commerce should work together. ADEC and ADFG information has been damaging to tourist perceptions in Shuyak Island area; authenticated information, not rumors, is needed. (Port Williams*, Kodiak*)
- Contact oil-affected area residents concerning food sample analyses. Fear of tainted meat and other foods is rampant and responses have not been received from agencies regarding requests to analyze samples. (Port Williams*, Kodiak*)

Hatchery and Enhancement Programs

- Favor commercial species to help restore economic activities. (Cordova)
- Construct new salmon hatcheries and carry out enhancement programs, such as lake fertilization. (Homer*)
- Expand existing hatcheries to prevent further impacts to wilderness. (Homer)
- Carry out stream enhancement work in areas where salmon fry are dying. Bring closed state hatcheries on line for replacement. (Kodiak)
- Use available wild-stock enhancement techniques where wild stocks have been affected; do not add hatchery stocks. (Homer)
- Direct replacement efforts towards halibut and black cod. (Whittier)
- Reestablish fish and wildlife to affected areas using NRDA information and services of governmental and private conservation groups. (Homer*)
- Continue maintenance and operation of the Fisheries Rehabilitation, Enhancement and Development (FRED) Division projects in outer Kenai Peninsula area. These facilities also can be used for incubation and reintroduction of salmon fry and smolt to areas that have become barren due to oil in the intertidal areas and salmon spawning beds. (Homer*)
- Do not favor hatcheries due to negative impacts to wild fish and cost of hatchery programs. (Cordova, Valdez)
- Fund the Paint River fish ladder and stocking program. (Homer*)
- Fund the Chalatna Lake Stocking Program. (Anchorage*)

Facilities

- Fund underutilized facilities, such as the Institute of Marine Sciences, instead of new facilities, such as the Prince William Sound Science Center. (Seward)
- Enhance existing facilities to further oceanographic research. Enhance or create educational institutions and public ocean information centers. (Homer)

- Establish a local laboratory where subsistence users can bring tissue samples for analysis at affordable prices. (Kodiak)
- Form an international wildlife rehabilitation center in the Gulf of Alaska. (Anchorage*)

Education

- Restore public trust in the oil industry and resource agencies; suggestions were: change resource management practices and use ad campaigns to show the public what is actually happening. (Seward)
- Support public education, such as forums about oil spills, environmental protection and energy conservation programs run by paid volunteer coordinators in spill areas. Hire a contractor to go to schools. (Seward, Homer)
- Fund production of a Prince William Sound Conservation Alliance brochure to educate boaters on environmental protection. (Valdez)
- Expand oil-spill curriculum developed in Cordova to include information on restoration and oil spill prevention. (Valdez)
- Provide library materials. (Kodiak)
- Provide "talking" guides and fliers to tour-boat operators to explain to visitors the importance of maintaining distance from wildlife. This would reduce pressure on captains to take people closer to wildlife. (Valdez)
- Publish a booklet "50 Simple Things You Can Do to Save the Sound." (Valdez)
- Fund the traveling exhibition entitled "Darkened Waters" for display throughout the United States. (Homer*)

Local Economies

- Hire local personnel for restoration projects to increase public trust. (Seward)
- Hire Native Alaskans to clean oil from beaches on or near the culturally significant areas identified by the Chugach Corporation. (Wasilla*)
- Benefit the entire community by proceeding with environmentally-based financial and economic restoration. (Kodiak)

Acquisition

- Acquire development rights along the Kenai River to retain its fisheries productivity and map the Kenai River drainage for baseline management information. (Kenai)
- Acquire timber rights in the Sound and Kodiak; there are willing sellers. Action should be taken soon, before valuable tracts are gone. (Cordova, Kodiak, Anchorage)

- Acquire timber rights: 300+ foot buffer zone around streams and areas visible from the coast; buy inholdings or timber rights that are within the state and national parks; buy net operating losses (NOLs) of timber sales; support a change in the law to prevent further sale of NOLs. (Homer)
- Purchase or buy back permanent logging rights for habitat protection of salmon streams. (Homer*)
- Create an Iliamna wildlife refuge by purchasing conservation easements on private Native land. (Anchorage)
- Protect marbled murrelets by purchasing lands bordering Kachemak Bay that are proposed for logging in the immediate future. (Homer*)
- Purchase wetlands and development rights adjacent to the Kenai River and complete inventory and mapping of wetlands adjacent to the river. (Soldotna*)
- Select acquisition of equivalent resources because that is the most cost-effective option; if oil remains, restoration and replacement activities are likely to be a waste of money. (Cordova)
- Strike a balance between loss of intrinsic values, use and habitat; people are skeptical that there are many direct restoration projects that can be done. (Anchorage)
- Acquire resting and breeding (haulout/rookery) areas for sea lions and seals. (Cordova, Homer)
- Acquire and protect otter and mink denning areas which require more than streamside habitat. (Valdez)
- Research, acquire and protect nesting and roosting habitat for lesser and greater yellowlegs, great blue herons, marbled murrelets and yellow-billed loons. (Valdez)
- Acquire private lands where there are seabird colonies. (Homer)
- Research and acquire migratory bird habitat along the Pacific flyway; become involved in an international effort to protect habitat in South American countries. (Homer)
- Acquire private lands on Middleton Island. (Homer)
- Restore the wilderness experience by acquiring new, unspoiled areas. (Homer)
- Retain upland old-growth forest for deer so further loss of their food base does not occur. (Anchorage)
- Allow a tax write-off in return for a conservation easement; call it a net operating loss. Require the spiller to purchase the easement soon after the spill. (Anchorage)
- Establish national and international protected wetlands for birds. (Homer*)
- Provide major funding for Save the Rainforest International. (Homer*)

- Acquire Gull Island in Kachemak Bay for management by the U.S. Fish and Wildlife Service to protect murres. (Homer*)
- Support habitat acquisition from private land owners. (Valdez*)
- Acquire lands in the Sound to set aside as wildlife refuges, especially bird and sea lion rookeries. Give protection status to Barren Island group, Gore Point, Ruggles Island and Cape Fairfield. (Seward*)

Other Sources of Contamination

- Remove mine tailings and mining and logging debris in and around the Sound. (Cordova)
- Take inventory of and clean up old dump and military sites. (Kodiak)
- Eliminate use of plastics. Clean up plastics. (Cordova, Homer)
- Use restoration funds to educate skippers, provide garbage tenders for at-seas collection, fund municipal recycling programs (especially for oil), set up small local response teams to deal with small spills. There is concern about the gradual decline in environmental quality in the Sound owing to marine pollution such as dumping of oil, fuel and garbage from boats. Several participants felt that prevention of further damage is important so that the natural healing capacity of local ecosystems would be enhanced. (Valdez)
- Provide financial assistance to communities for waste-disposal facilities. (Valdez, Homer, Anchorage, Kodiak)
- Research more efficient ways to use energy. (Valdez)

Funding

- Match restoration funds with agency monies to operate monitoring programs, which would be run in a cooperative format by agencies or through a contractor. (Seward)
- Spend money now and obtain reimbursement from damage claim funds when available. (Anchorage)
- Buy back Bristol Bay oil leases with federal monies received from lease sales rather than from restoration funds. (Anchorage)
- Tax state residents and oil producers to develop a restoration funding source. (Anchorage)
- Use funds in oil-affected areas only. (Kenai)
- Manage trust fund so that money will be available 20-50 years from now when coastal habitats are healthy enough to support restoration activities. (Cordova)
- Guarantee that state lawsuit monies will be applied to restoration. (Anchorage)

- Settle out of court and get on with restoration; litigants will be far apart on monetary value. (Anchorage)
- Set up a fund for mitigation of wetlands in the affected zones. (Kenai)
- Guarantee that the restoration fund is regenerating itself with interest or the money will be gone in six months. (Homer*)
- Restrict expenditures of restoration monies to:

  - Restoration and/or protection in oil-impacted area;

  - Restoration and/or protection outside the of the area for species which depend on oil-impacted area;

  - Assessment and research of resident or migratory species using oil-impacted zone; and,

  - Development of educational displays to inform public about effects of oil on the marine environment and prevention of oil spills. (Valdez*)
- Discourage use of funds for construction or development projects, such as mooring buoys, tent platforms, marine parks facilities, land-based research stations and hatcheries in undeveloped oil-affected areas. (Valdez*)
- Support a restoration endowment fund to assure the long-term availability of monies dedicated to enhancement of the natural environment affected by the spill. (Fairbanks*)

Public Involvement

- Meet to review recommendations with regional planning and advisory groups. (Kenai, Whittier)
- Include different interest groups in local advisory boards; let the groups submit lists of recommended representatives; select carefully, based on references. (Valdez)
- Set up meetings in Native Alaskan villages. It is important to get Native Alaskan viewpoints on restoration and economic diversification. (Anchorage, Whittier)
- Hold more discussions of environmental issues in coastal communities. (Homer*)
- Contact landowners, business operators and residents located in the Sound itself. (Cordova*)
- Mandate citizen and industry advisory process to reduce potential for the restoration process to go awry. (Anchorage*)
- Coordinate oil spill restoration with local people and Alaskan Natives. These people should have as much or more input and decision-making power as the "professionals." (Anchorage*)
- Provide access to the NRDA Trustees. (Kodiak, Homer, Whittier)
- Use science rather than politics to guide decisions. (Anchorage)

CHAPTER III
TECHNICAL WORKSHOP

To gather scientific input for the restoration planning process, a technical workshop was held April 3-5, 1990 in Anchorage, Alaska. The three-day workshop provided the first opportunity for a general exchange of ideas on restoration among scientists and resource managers. This workshop was closed to the public because litigation-related damage assessment information had to be discussed.

Participants in this workshop included members of RPWG, federal and state resource managers, investigators conducting damage assessment studies and technical experts from academic institutions or the private sector. These technical experts were selected based on their experience in restoration of natural resources or their knowledge of a particular resource (e.g., marine mammals). Most participants had direct experience with these resources in Alaska.

Results of Workshop

Workshop participants identified potential restoration projects and discussed these ideas in terms of effectiveness, feasibility and applicability to the spill area. An overview of available damage assessment results helped guide the discussions.

The workshop was divided into six sessions: coastal habitat, fish and shellfish, birds, terrestrial and marine mammals, cultural resources and recreational uses. Each of the sessions discussed restoration alternatives which might be effective in addressing potential injuries to particular resources. The groups were instructed to identify a broad range of restoration options. The matrices in Chapter VI - Development of Restoration Options reflect the potential restoration alternatives discussed at the technical workshop.

To address uncertainties about the effectiveness of specific restoration options, workshop participants developed a list of potential feasibility studies or demonstration projects. These studies were designed to evaluate candidate restoration alternatives for their likely effectiveness, feasibility and applicability to the spill area. Projects which were subsequently initiated during the summer of 1990 are described in Chapter V - Feasibility Studies. In addition, workshop participants identified other information needs that may be helpful to the development of a comprehensive restoration plan.

CHAPTER IV
LITERATURE REVIEW

A review of scientific literature is one of the first steps in any environmental planning effort. Relevant literature supports the planning process by identifying approaches that have potential for success, as well as actions to avoid. Although it is expected that relatively few "off-the-shelf" oil spill restoration techniques will be identified for sub-arctic application, it is recognized that a variety of approaches to restoration have been developed to address different types of environmental disturbances. Some of these may be useful for restoration following the *Exxon Valdez* oil spill.

A preliminary computerized literature search focusing on potential ecological restoration techniques following oil spills was one of the first activities conducted by RPWG. Also a computerized search of literature on restoration of cultural resources and recreational uses is planned. This chapter summarizes our initial literature review. Appendix B lists the most pertinent references identified. A report listing all identified references, with abstracts, will be available from RPWG.

Search Criteria

The initial literature search sorted several computerized databases. Each database contained references from several different publications. Sorting was done by specifying subject identifiers or "keywords". Only references containing the chosen keywords were listed. Those databases searched and the specific keywords used are shown in the following tables.

LITERATURE DATABASES SEARCHED

Databases	Dates of References
Aquatic Science Abstracts	1978-1989
BIOSIS Previews	1969-1990
Environmental Bibliography	1974-1989
ENVIROLINE	1970-1989
Pollution Abstracts	1970-1990
NTIS	1964-1990

INITIAL SUBJECT IDENTIFIERS AND KEYWORDS

- Oil, crude oil, petroleum, fuel oil, gasoline or oil spill
- Restore, establish, reestablish, replant, rehabilitate, create, build, mitigate or construct(ion)
- Recover(y) or succession
- Ecologic effect, ecologic impact, biological impact, aquatic impact, terrestrial impact, environmental impact or environmental effect
- Marine, estuarine, salt marsh, ocean, beach, shore, tidal, subtidal, intertidal or reef
- Reservoir, lake, stream, marsh, river, wetland or freshwater
- Habitat, seagrass, eelgrass, algae or macroalgae

Results

After deleting citations that were not directly relevant, the computerized literature search produced a list of approximately 450 publications. The RPWG then reviewed these titles and abstracts, and identified approximately 200 of the most relevant publications for acquisition and detailed review. Articles were selected based on several information needs, including:

- Techniques potentially applicable to sub-arctic conditions;
- Restoration of the same resources as those that may have been damaged by the *Exxon Valdez* spill;
- Creation of new aquatic habitats (by dredge-and-fill techniques, construction of artificial reefs, etc.);
- Success of organisms grown in or transplanted to oil-contaminated substrates;
- Approaches and techniques for long-term monitoring studies.

The selected documents are listed in Appendix B.

The literature search conducted to date is only a preliminary one, and environmental restoration is a growing field. Consequently, literature review will be a continuing aspect of the restoration planning process. Future efforts will include reviews of accessible government documents and other "grey" literature.

CHAPTER V
FEASIBILITY STUDIES

Feasibility studies are used to evaluate the practicability of restoration techniques in cases for which there is uncertainty of success or benefit, given the particular species and environment within the oil-spill area. Such studies also help determine the cost of implementing full-scale restoration projects and help evaluate associated environmental impacts and benefits.

Many ideas for restoration projects have been suggested—and continue to be suggested—as a result of public participation and technical consultations. Evaluating these ideas will be a long and involved process, and it is important to move quickly to test promising methods for which the technical feasibility is in question.

Five Restoration Feasibility Studies are currently in progress. Factors considered in selecting these studies included:

- Relationship to NRDA studies and injured natural resources;
- Identified public concern;
- Ability to implement the study in time for the 1990 field season;
- Reasonable likelihood of success; and,
- Cost relative to the funds available for feasibility studies.

Of the five Restoration Feasibility Studies, three concern direct restoration of intertidal and supratidal shoreline communities. The remaining two support acquisition of equivalent resources. The 1990 Restoration Feasibility Studies are summarized below and will be described in more detail in the 1990 State/Federal Natural Resources Damage Assessment Plan for the *Exxon Valdez* Oil Spill. It is anticipated that additional feasibility studies will be conducted in 1991; however, implementation of future feasibility studies is subject to the availability of funds. Also, note that feasibility studies are conducted to assess techniques for which there is uncertainty of success. Therefore, feasibility studies alone may not reflect the mix of restoration projects that will be recommended in a restoration plan.

Restoration Feasibility Study Number 1: Reestablishment of *Fucus* in Rocky Intertidal Ecosystems

Species of the marine alga *Fucus* are critical structural components of the intertidal ecosystem on rocky shores in the oil spill area. Qualitative evidence indicates that *Fucus* was damaged by both the spilled oil and cleanup efforts. If the natural recovery of *Fucus* can be enhanced through the dispersal of spores or transplants, it will benefit the associated flora and fauna on intertidal rocky shores. This study will involve field tests to develop and demonstrate the feasibility of a *Fucus* restoration project and will document the natural recovery of *Fucus* under various conditions. The U.S. Environmental Protection Agency is the lead agency.

Restoration Feasibility Study Number 2: Reestablishment of Critical Fauna in Rocky Intertidal Ecosystems

Certain faunal species are key components of intertidal rocky ecosystems. Examples include grazers, such as limpets (e.g., *Diodora*), and predators, such as starfish (e.g., *Leptasterias*). Recolonization rates for these organisms, and for the alga *Fucus*, may limit the natural rates of recovery for entire communities. This feasibility study will compare the rates of recovery in communities with and without such species as limpets, and will evaluate techniques for enhancing recolonization rates. The U.S. Forest Service is the lead agency.

Restoration Feasibility Study Number 3: Identification of Potential Sites for Stabilization and Restoration with Beach Wildrye

Beach wildrye (*Elymus mollis*) was affected by both spilled oil and cleanup activities, and is extremely important in the prevention of erosion in the coastal environment. Erosion can lead to the destabilization and degradation of cultural and recreational sites and wildlife habitats. There are well established techniques for restoring rye grasses on coastal dune systems. This study will identify sites at which damage has occurred and restoration activities appear to be feasible. The Alaska Department of Natural Resources is the lead agency.

Restoration Feasibility Study Number 4: Identification of Upland Habitats Used by Wildlife Affected by the Oil Spill

A variety of marine birds, waterfowl and other bird and mammalian species were killed by the spill or injured by contamination of their prey and habitats. Many of these species are dependent on

aquatic or intertidal habitats for such activities as feeding and resting, but they also use upland habitats in forests, along streams or above the tree line. Through the public scoping process and technical consultations, many people have suggested that protection of upland habitats from further degradation may be an important way to help wildlife recover from the effects of the oil spill. This study will explore the linkages between wildlife affected by the oil spill and upland habitats, focusing in 1990 on marbled murrelets (*Brachyramphus marmoratus*) and harlequin ducks (*Histrionicus histrionicus*). The U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game are the lead agencies.

Restoration Feasibility Study Number 5: Land Status, Uses, and Management Plans in Relation to Natural Resources and Services

Through the scoping process, members of the public have suggested a wide variety of projects to acquire the equivalent of injured resources. Examples are the acquisition of timber or development rights, conservation easements, recreational and cultural sites, inholdings within state and federal areas and buffer strips along streams and coasts. Habitat protection may also be the best means of providing for the long-term restoration of wildlife populations. To begin identifying and evaluating potential restoration projects of this type, this study will summarize existing information about the current status, uses and management plans of both public and private lands. The Alaska Department of Natural Resources is the lead agency.

1990 Technical Support Projects

Three Restoration Technical Support Projects are also being carried out in 1990. The first project will support development of detailed plans for potential feasibility studies in 1991, including, but not limited to:

- "Natural recovery" monitoring;
- Pink salmon stock identification;
- Herring stock identification/spawning site inventory;
- Artificial habitat construction for fish and shellfish;
- Alternative recreation site/facility identification;
- Historic site/artifact restoration; and,
- Forage fish availability.

A second Restoration Technical Support Project will develop and implement a peer review process. Peer review will improve the scientific quality of feasibility studies and potential restoration projects.

The third and final Restoration Technical Support Project will assess and summarize existing beach segment survey data. This will help to identify sites for future feasibility studies and restoration projects.

CHAPTER VI
DEVELOPMENT OF RESTORATION OPTIONS

Development of a plan to "restore, replace or acquire the equivalent" of the natural resources and services injured by the oil spill requires consideration of a wide range of alternative field projects, management actions and resource acquisitions. The goal of such a plan will be to provide decision-makers with the information necessary to restore injured resources and services to their baseline conditions. This can occur only after a full assessment of damages has been completed.

To date, the restoration planning process has been identifying the widest possible array of alternatives, based on suggestions from the public, technical experts and the literature. Although RPWG will continue to invite ideas about restoration alternatives throughout the planning process, it now can begin to organize the ideas suggested to date and to gather the information necessary to evaluate them.

To that end, RPWG has developed a series of summary tables, or matrices, that portray potential restoration alternatives in relation to categories of potentially injured resources. Although the matrices are broadly inclusive, they do not cover suggestions that are unrelated to the goals of the restoration program (e.g., ideas for legislation pertaining to future oil spills). Also, for convenience, many individual recommendations have been combined into single alternatives; and there is still considerable overlap among the various items and matrices.

The potential restoration alternatives are presented largely without regard to geography, because most options are potentially applicable to more than one site or geographic area. In general, direct restoration projects would be implemented on-site, at one or more localities within the oil-impacted area. In contrast, projects which replace or acquire equivalent resources may take place beyond the spill area.

Matrices are provided for each category of potentially injured resource: mammals, coastal habitats, fish and shellfish, birds, cultural resources and recreational uses. A final matrix includes potential restoration approaches that may apply to multiple resource categories.

The cells of the matrices have been left blank. Future reports may include, within these cells, information necessary to evaluate specific restoration options relative to particular resources. Readers are encouraged to use these matrices to help organize their own thinking about potential restoration alternatives. Suggestions about information to complete these matrices, as well as additional options and other ways to evaluate them are welcome and invited.

FISH AND SHELLFISH

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources								
	Salmon	Herring	Sport fish	Groundfish, including halibut	Rockfish	Other fish	Shrimp and crab	Molluscs	Other invertebrates
a. Natural recovery - no action									
b. Improve productivity in stream / lake habitats by construction of fishways, fertilization, and other means of enhancement									
c. Supplement spawning substrates									
d. Construct artificial habitat structures									
e. Mariculture and shore / intertidal habitat enhancements									
f. Control predators on fish eggs and juveniles									
g. Enhance wild stocks / populations rather than hatchery stocks (e.g., egg boxes, etc.)									
h. Preserve wild gene pools and local populations through hatchery techniques									
i. Construct new hatcheries and / or expand existing hatcheries to provide additional fish for stocking programs									
j. Transplants to augment natural recoveries									
k. Catalog and protect spawning habitats									

FISH AND SHELLFISH

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources								
	Salmon	Herring	Sport fish	Groundfish, including halibut	Rockfish	Other fish	Shrimp and crab	Molluscs	Other invertebrates
l. Protect upland habitats (e.g., timbered slopes) to maintain water quality in streams and nearshore habitats									
m. Map baseline management information and acquire development rights to fisheries habitats in and along rivers									
n. Buy back limited entry fishing permits to reduce pressure on resources									
o. Change management emphases / harvest practices (e.g., focus on "terminal" rather than mixed stock fisheries)									
p. Redirect fisheries efforts to alternative species to encourage recovery of affected species									
q. Restrict high-seas interceptions to provide more control over fish mortality									
r. Close or restrict individual fisheries to speed natural recoveries									
s. Identify and catalog individual stocks to enable more targeted management actions									
t. Improve ecological and harvest data to enable better management decisions									
u. Increase public relations and quality assurance efforts to redevelop damaged markets									
v. Conduct long-term research / monitoring program on populations and ecology									

BIRDS

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources						
	Loons	Grebes	Shearwaters and petrels	Cormorants	Sea ducks	Mergansers	Other waterfowl
a. Natural recovery - no action							
b. Augment natural reproduction through captive breeding (as a source of eggs or young), fostering and related techniques							
c. Stabilize eroded beach / supratidal habitats used by nesting birds							
d. Mariculture of shellfish to supplement prey base							
e. Provide artificial nest sites / substrates to enhance productivity or redirect nest activities to alternative sites							
f. Acquire nesting habitats and colony sites							
g. Protect watershed areas necessary to maintain water quality and habitats that sustain the avian prey base							
h. Restrict logging on timbered slopes, streamsides, and coastal perimeters that serve as nesting / resting habitats							
i. Restrict hunting and reduce illegal "taking" of eggs and adult birds							
j. Eliminate introduced predators (e.g., foxes) from islands that are or were important for ground-nesting birds							
k. Restrict near-shore gillnet fisheries to minimize conflicts with bird populations							
l. Eliminate high-seas gillnet fisheries and the resulting incidental mortality to birds							
m. Acquire stopover / wintering habitats in the Pacific flyway							
n. Protect wetland habitats important to migratory birds, nationally and internationally							
o. Minimize disturbance from tourists, fishermen, researchers, and others through public education and law enforcement							
p. Conduct long-term research / monitoring program on bird populations, ecology, and prey							

BIRDS

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources									
	Bald eagle	Peale's Peregrine falcon	Black oyster-catcher	Other shorebirds	Gulls	Common murre	Puffins	Pigeon guillemot	Murrelets	Other birds
a. (continued)										
b. (continued)										
c. (continued)										
d. (continued)										
e. (continued)										
f. (continued)										
g. (continued)										
h. (continued)										
i. (continued)										
j. (continued)										
k. (continued)										
l. (continued)										
m. (continued)										
n. (continued)										
o. (continued)										
p. (continued)										

COASTAL HABITATS

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources				
	Supratidal Zone				
	Rocky, exposed	*Rocky, sheltered*	*Estuarine, sheltered (incl. marsh)*	*Coarse-textured cobbles / pebbles*	*Fine-textured sand / silt*
a. Natural recovery - no action					
b. Control of erosion by placement of rip-rap, re-establishing vegetation, and other methods					
c. Increase primary productivity in plant communities by fertilizing intertidal / supratidal habitats					
d. Hasten natural recovery of communities and ecosystems by transplanting or "reseeding" flora / fauna					
e. Acquisition / protection of upland areas to protect adjacent coastal habitats from degradation					
f. Establish new marine parks / sanctuaries to provide additional habitat protection					
g. Change management practices at selected sites / habitats (e.g., temporarily restrict access)					
h. Long-term research / monitoring program on such topics as residual oil in the environment, rates of natural recovery, and the character of subsequent ecosystems					

COASTAL HABITATS

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources									
	Intertidal Zone					Subtidal Zone				
	Rocky, exposed	*Rocky, sheltered*	*Estuarine, sheltered (incl. marsh)*	*Coarse-textured cobbles / pebbles*	*Fine-textured sand / silt*	*Silled fiords*	*Island points*	*Island bays*	*Eelgrass*	*Nereocystis (bulb kelp)*
a. (continued)										
b. (continued)										
c. (continued)										
d. (continued)										
e. (continued)										
f. (continued)										
g. (continued)										
h. (continued)										

RECREATIONAL USES

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Diminished Uses						
	Kayaks and canoes	Other pleasure boats	Charters, tour boats, etc.	Marine sport fishing	Freshwater sport fishing	Shellfishing	Trapping
a. Natural recovery - no action							
b. Rehabilitate prime recreation sites and units of the National Wilderness Preservation System							
c. Discourage new use of sites that were poorly known before the spill, or where continued use would slow recovery of oiled sites							
d. Provide alternative destinations (e.g., public-use cabins, camp sites) for recreation users							
e. Purchase private inholdings within public lands (e.g., parks, refuges, forests)							
f. Acquire key public access sites within privately-owned lands and along coasts / rivers							
g. Obtain development rights, easements, etc. (less than fee-simple title) on private lands							
h. Acquire / protect "threatened" wilderness / recreation areas within and outside of Alaska							
i. Establish new parks, refuges, and other protected areas							
j. Revise public-lands management plans to minimize further degradation of recreational resources							
k. Add field personnel / revise regulations in response to increased awareness of recreational opportunities following oil spill publicity and clean up							
l. Develop unified agency-private tourism / public information program							
m. Construct / maintain public interpretive facilities in oil-spill communities, perhaps associated with state or federal conservation units							
n. Publish brochure to educate recreational boaters about environmental protection							

RECREATIONAL USES

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Diminished Uses									
	Hunting, terrestrial mammals	Hunting, waterfowl	Public-use cabins / sites	Low-impact camping	Hiking and climbing	Berry picking, picnicking, etc.	Photography	Nature study	Existence values	Other recreation
a. (continued)										
b. (continued)										
c. (continued)										
d. (continued)										
e. (continued)										
f. (continued)										
g. (continued)										
h. (continued)										
i. (continued)										
j. (continued)										
k. (continued)										
l. (continued)										
m. (continued)										
n. (continued)										

CULTURAL RESOURCES

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources		
	Archaeological or historical sites	Burial sites	Other resources
a. Natural recovery - no action			
b. Inventory beach and upland sites for cultural resources			
c. Protect cultural sites from erosion or other degradation (e.g., stabilize sites by revegetation)			
d. Develop radiocarbon dating techniques for oiled artifacts			
e. Conduct inventory / produce brochure with photographs of artifacts originating from oil-spill area that are now in museum collections			
f. Return artifacts recently removed by archaeologists or clean-up workers			
g. Implement a "site steward" program that employs local residents to watch over cultural sites			
h. Improve enforcement of historic preservation laws			
i. Increase public education / improve law enforcement to reduce vandalism and looting of historical, archaeological, and burial sites			
j. Develop cooperative agreements / management plans for cultural resources involving the state, university, and Alaskan Native communities			
k. Assist in establishing interpretive museums / cultural projects in rural villages			
l. Encourage oral history and video tape projects concerning regional / local history and traditions			
m. Return Alaskan Native artifacts to public collections (e.g., from private collections)			

MULTIPLE RESOURCES AND VALUES

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources and Use Values								
	Coastal habitat	Fish and shellfish	Birds	Mammals	Cultural resources	Subsistence hunting / fishing	Recreational Uses	Intrinsic	Other
a. Natural recovery - no action									
b. Assist coastal communities and boat operators with environmentally-sound waste disposal and waste recycling programs to minimize cumulative effects of pollution									
c. Provide information about status / quality of local food resources (e.g., contaminant levels in shellfish)									
d. Provide local laboratory to which subsistence users can bring samples for contaminants analyses									
e. Buy "net operating losses" (NOLs) of timber sales or change laws to disallow NOLs									
f. Purchase development rights or provide tax incentives for not logging / developing private lands									
g. Preserve buffer strips along streams and the coast									
h. Restrict logging, mining, fishing, hunting, and hydroelectric developments to reduce cumulative effects to the environment									
i. Establish mobile veterinary pathology unit									
j. Require timber, oil, and other industries to provide restoration plans before resource extraction begins									
k. Initiate reforestation programs wherever logging has occurred (e.g., Afognak Island) to minimize cumulative effects of pollution									
l. Determine whether old community and military dump sites add to cumulative effects									

MULTIPLE RESOURCES AND VALUES

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources and Use Values								
	Coastal habitat	*Fish and shellfish*	*Birds*	*Mammals*	*Cultural resources*	*Subsistence hunting / fishing*	*Recreational Uses*	*Intrinsic*	*Other*
m. Reduce chronic oil pollution associated with boats, harbors, and the transportation of petroleum to minimize cumulative effects									
n. Eliminate use of plastics and remove plastic debris to protect the marine environment									
o. Remove mining and logging debris to minimize cumulative effects of pollution									
p. Review "glacier ice" industry for possible management changes									
q. Establish fund to support the mitigation of losses of wetland habitats									
r. Review management plans to assess whether land use designations should be changed									
s. Establish stronger regulations, improved planning, and better response in order to minimize additional effects from future spills									
t. Reduce energy consumption through improved efficiency and conservation in order to reduce the potential for future oil spills									
u. Designate Prince William Sound as a national recreation area or national monument									
v. Buy back Bristol Bay oil leases									
w. Establish trust fund to support future needs for land / habitat acquisition									
x. Help develop economic base for rural village residents (including analysis of subsistence economies)									

MULTIPLE RESOURCES AND VALUES

Matrix of Potential Restoration Approaches

Potential Restoration Approaches	Categories of Potentially Injured Resources and Use Values								
	Coastal habitat	*Fish and shellfish*	*Birds*	*Mammals*	*Cultural resources*	*Subsistence hunting / fishing*	*Recreational Uses*	*Intrinsic*	*Other*
y. Sponsor symbolic observance of the oil spill (e.g., a public event or monument)									
z. Encourage hands-on public participation in implementing selected restoration projects in the field									
aa. Buy back and redistribute limited entry fishing permits to improve local economies									
bb. Publish booklet with suggestions about what individuals can do to benefit the environment affected by the spill (e.g., recycle marine boat oil)									
cc. Develop education program to foster discussion about oil and the environment (e.g., what are the laws and issues?)									
dd. Develop interpretive / museum programs on the oil spill, the status of the environment, and restoration									
ee. Develop / expand oil-spill curriculum materials for schools to include the restoration program									
ff. Establish trust fund to support restoration from long-term impacts of the oil spill									
gg. Enhance and support facilities / institutions in oil-spill communities that can carry out or provide logistical support for monitoring / research programs									
hh. Establish Long-Term Ecological Research sites (a program sponsored by the National Science Foundation) and provide funds to support research / monitoring at those sites									
ii. Support and equip fleet of marine vessels to conduct research / monitoring activities									
jj. Establish trust fund to support long-term research / monitoring									

CHAPTER VII
FUTURE RESTORATION PLANNING ACTIVITIES

Restoration planning activities will continue to identify potential measures to restore the natural resources and services affected by the *Exxon Valdez* oil spill. The RPWG will evaluate these individual measures, while maintaining a focus on the environment as a whole. To succeed, the process necessarily draws upon the expertise of scientists, economists, local residents, Native Alaskans and other interested and knowledgeable people.

Public Participation

Public participation is fundamental to developing a successful restoration plan. Therefore, RPWG will continue and expand its efforts to involve the public in the planning process. Additional public scoping meetings will be held specifically to encourage the participation of Alaskan Natives. Other possibilities include: creation of public advisory committees, publication of a restoration newsletter, production and distribution of short video tapes explaining the restoration process and additional public meetings inside and outside of Alaska.

Technical Review

Restoration feasibility studies will continue to be an important means of evaluating alternatives identified through the restoration planning process. For example, one of the 1990 Technical Support Projects is designed to identify 1991 Restoration Feasibility Studies. Pending availability of funds, these studies will be conducted during next year's field season. In addition, promising 1990 studies could be continued or expanded. Some projects might be tested more widely, including sites outside of Prince William Sound.

Additional technical workshops with key scientists are being planned. These workshops will help develop and review restoration feasibility projects for 1991. They also will begin to develop an overall monitoring plan to evaluate restoration and recovery. As described in the 1990 Technical Support Projects (Chapter V), a scientific peer review process is being designed and will be integrated into these efforts to ensure effective and efficient progress toward a restoration plan.

Identification and acquisition of pertinent literature will continue. These efforts will expand the ecological search done to date and identify information on cultural resources and recreational uses, as well.

Development of a Final Restoration Plan

All of the activities outlined above lead toward development of a final restoration plan. The final plan will take into account results from the NRDA, other technical input and comments and concerns received from the public. Once restoration funds become available from the responsible parties, the final restoration plan will be implemented. Throughout the process there will be continuing opportunities for public participation.

APPENDICES

APPENDIX A

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APPENDIX B

List of Relevant References from the Initial Literature Review

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