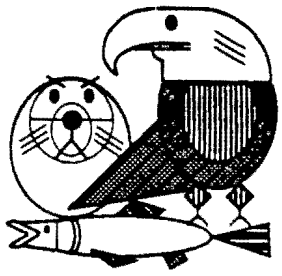
16.8.1 C


# *Exxon Valdez* Oil Spill Trustee Council

**Restoration Office**
**645 G Street, Suite 401, Anchorage, Alaska 99501-3451**
**Phone: (907) 278-8012 Fax: (907) 276-7178**

## MEMORANDUM



**To:** Participants in the 1996 Restoration Workshop

**From:** Molly McCammon, Executive Director

**Date:** January 12, 1996

**Subj:** Preliminary Revised Recovery Objectives in Chpt. 5 of the Restoration Plan

---

Pages 5 and 32 of the *Restoration Plan* (November 1994) note that the plan is a dynamic document, subject to being updated based on new information. The attached document is a preliminary working draft revision of part of Chapter 5--Goals, Objectives, and Strategies. Specifically, we propose to update the information presented on the Injury and Recovery Status of injured resources and services and to refine their Recovery Objectives based on the insights gained as a result of the projects in the annual work plans.

The following document is not a formal public review draft. At this time, we are inviting principal investigators and other participants in this workshop to review the draft for scientific accuracy and to provide comments and suggestions for improvements. To that end, there will be a series of concurrent sessions at 10:30 a.m. on Thursday (the 18th) to discuss possible revisions. These "break-out" sessions will be organized by subject clusters. Please read the discussions for the resources or services in which you are interested and then attend the appropriate break-out session or sessions. Specific locations of the different groups will be announced Thursday morning.

It is a challenge to develop realistic and measurable recovery objectives and to make sure that they are based on careful assessments of injuries to resources and services and our best understanding of current recovery status. Please help us by offering your comments and suggestions.

If you want to submit any comments following the workshop, please send them to Stan Senner at the Restoration Office no later than January 25.

attachment

[*Note: This table is from p. 32 of the* Restoration Plan. *Proposed text is shaded.* ~~*Text proposed to be deleted is struck out.*~~*]*

**Table 2. Resources and Services Injured by the Spill**

| INJURED RESOURCES | | | Lost or Reduced SERVICES |
|---|---|---|---|
| **Biological Resources** | | **Other** | |
| Recovered<br>**Bald eagle**<br><br>**Recovering**<br>~~Bald eagle~~<br>~~Black oystercatcher~~<br>Common murre<br>Intertidal organisms<br>~~(some)~~ (all)<br>~~Killer whale~~<br>Mussels<br>Pink salmon<br>Sediment<br>Sockeye salmon<br>~~(Red Lake)~~ (all systems)<br>Subtidal organisms<br>~~(some)~~ (all) | **Not Recovering**<br>~~Common murre~~<br>Harbor seal<br>Harlequin duck<br>~~Intertidal org.~~<br>~~(some)~~<br>Killer whale<br>(AB pod)<br>Marbled murrelet<br>Pacific herring<br>Pigeon guillemot<br>~~Pink salmon~~<br>Sea otter<br>~~Sockeye salmon~~<br>~~(Kenai & Akalura systems)~~<br>~~Subtidal organisms~~<br>~~(some)~~ | Archaeological resources<br>Designated wilderness areas<br>~~Sediment~~ | Commercial fishing<br>Passive uses<br>Recreation and Tourism including sport fishing, sport hunting, and other recreation uses<br>Subsistence |
| **Recovery Unknown**<br>Black oystercatcher<br>Clams<br>Common loon<br>Cutthroat trout<br>Dolly Varden<br>Kittlitz's murrelet<br>River otter<br>Rockfish | | | |
| | | | |

**Amending the List of Injured Resources and Services.** The list of injured resources and services will be reviewed as new information is obtained. For example, research and monitoring will hopefully show that recovery is beginning for many of the resources which currently show little or no signs of recovery. In addition, information may be submitted to add resources to the list. This information can include research results, assessment of population trends, ethnographic and historic data, and supportive rationale. Information that has been through an appropriate scientific review process is preferable. If data have not been peer reviewed, they should be presented in a format that permits and facilitates peer review. Information to change the list will be reviewed through the Trustee Council's scientific review process.

*[Note: This text is taken from Chapter 5 from the* **Restoration Plan.** *This is a WORKING DRAFT, presented here to participants in the 1996 Restoration Workshop to improve scientific accuracy and invite early suggestions and comments. Proposed text is shaded. ~~Text proposed for deletion is struck out.~~]*

*(January 12, 1996)*

## ARCHAEOLOGICAL RESOURCES

**Injury and Recovery**

The oil-spill area is believed to contain more than 3,000 sites of archaeological and historical significance. Twenty-four archaeological sites on public lands are known to have been adversely

affected by cleanup activities, or looting and vandalism linked to the oil spill. Additional sites on both public and private lands were probably injured, but damage assessment studies were limited to public land and not designed to identify all such sites.

Documented injuries include theft of surface artifacts, masking of subtle clues used to identify and classify sites, violation of ancient burial sites, and destruction of evidence in layered sediments. In addition, vegetation has been disturbed, which has exposed sites to accelerated erosion. The effect of oil on soil chemistry and organic remains may reduce or eliminate the utility of radiocarbon dating in some sites.

Assessments of 14 sites in 1993 suggest that most of the archaeological vandalism that can be linked to the ~~*Exxon Valdez* oil~~ spill occurred early in 1989, before adequate constraints were put into place over the activities of oil spill clean-up personnel. Most vandalism took the form of "prospecting" for high yield sites. Once these problems were recognized, protective measures were implemented that successfully limited additional injury. In 1993, only two of the 14 sites visited showed signs of continued vandalism, ~~and the link between~~ but it is difficult to prove that this recent vandalism was related to the spill. ~~and the *Exxon Valdez* oil spill remains highly problematical~~. Oil ~~samples have not yet been analyzed, but oil~~ was visible in the intertidal zones of two of the 14 sites monitored in 1993, and hydrocarbon analysis has shown that the oil at one of the sites was most probably from the *Exxon Valdez* spill. Hydrocarbon levels at the second sites were not sufficient to permit identification of the source or sources of the oil.

Monitoring of archaeological sites in 1994 and 1995 found no evidence of new damage from vandalism. The presence of oil is being determined in sediment samples taken from four sites in 1995.

None of the archaeological artifacts collected during the spill response, damage assessment, or restoration programs is stored within the spill area. These artifacts are stored in the University of Alaska Museum in Fairbanks and in the Federal Building in Juneau. Native communities in the spill area have expressed a strong interest in having them returned to the spill area for storage and display.

The Alutiiq Archaeological Repository in Kodiak, whose construction costs were partly funded by the Trustee Council, is the only physically appropriate artifact storage facility in the spill area. In 1995 the Trustee Council approved funds for development of a comprehensive community plan for restoring archaeological resources in Prince William Sound and lower Cook Inlet, including strategies for storing and displaying artifacts at appropriate facilities within the spill area.

**Recovery Objective**

Archaeological resources are nonrenewable: they cannot recover in the same sense as biological resources. Archaeological resources will be considered to have recovered when spill-related injury ends, looting and vandalism are at or below prespill levels, and the artifacts and scientific data which remain in vandalized sites are preserved (e.g., through excavation, site stabilization,

or other forms of documentation). ~~Artifacts and data are typically preserved through excavation or other forms of documentation, or through site stabilization, depending on the nature of the injury and the characteristics of the site.~~

## BALD EAGLES

### Injury and Recovery

The bald eagle is an abundant resident of coast lines throughout the oil-spill area. Prince William Sound provided year-round and seasonal habitat for about 5,000 bald eagles. Carcasses of 151 eagles were recovered following the oil spill, and ~~Two hundred to 300~~ about 250 bald eagles are estimated to have died in Prince William Sound as a result of ~~may have been killed in~~ the oil spill. There were no estimates of mortality outside the Sound, but there were deaths throughout the oil-spill area.

In addition to direct mortalities, productivity was reduced in oiled areas of Prince William Sound in 1989. Productivity was back to normal in 1990 and 1991, and an aerial survey of adults in 1995 indicated that the population has returned to or exceeded its prespill level in Prince William Sound. ~~However, population estimates made in 1989, 1990, and 1991 indicate that there may have been an increase in the Prince William Sound bald eagle population since the previous survey conducted in 1984. Productivity decreased in 1989, but appeared to have recovered by 1990. Because population and productivity appear to have returned to prespill levels, bald eagles may have already recovered from the effects of the spill.~~

### Recovery Objective

Because the Prince William Sound population and productivity are at or above prespill levels, the bald eagle has recovered from the effects of the Exxon Valdez oil spill. ~~Bald eagles will have recovered when their population and productivity return to prespill levels.~~

## BLACK OYSTERCATCHERS

### Injury and Recovery

Black oystercatchers spend their entire lives in or near intertidal habitats and are highly vulnerable to oil pollution. An estimated 1,500-2,000 oystercatchers live in south-central Alaska. Only nine carcasses of adult oystercatchers were recovered following the spill, but estimated mortality may have been as high as, but probably did not exceed, 20 percent in the spill area.

In addition to direct mortalities, breeding activities were disrupted by the oil and clean-up activities. In comparison with black oystercatchers on the largely unoiled Montague Island, oystercatchers at heavily oiled Green Island had reduced hatching success in 1989 and their

chicks gained weight more slowly during 1991-93. Interpretation of these data on reproductive performance, however, are confounded by lack of prespill data. Productivity and survival of black oystercatchers in Prince William Sound have not been monitored since 1993, and the recovery status of this species is not known. ~~Within Prince William Sound, an estimated 120 to 150 black oystercatchers, representing 12-15 percent of the total estimated population, died as a result of the spill. Mortality outside of Prince William Sound is unknown. Black oystercatchers are recovering, although they may still be exposed to hydrocarbons when feeding in intertidal areas.~~

**Recovery Objective**

Black oystercatchers will have recovered when the Prince William Sound population returns to ~~attain~~ prespill levels and reproduction is within normal bounds. An increasing population trend and comparable hatching success and growth rates of chicks in oiled and unoiled areas will indicate that recovery is underway. ~~reproductive success of nests and growth rates of chicks raised in oiled areas are comparable to those in unoiled areas.~~

## CLAMS

**Injury and Recovery**

**The magnitude of impacts on clam populations varies with the species of clam, degree of oiling, and location. However, data from the lower intertidal zone on sheltered beaches suggest that** little-neck clams and, to a lesser extent, butter clams ~~on sheltered beaches~~ were killed or suffered slower growth rates as a result of the oil spill ~~by oiling~~ and clean-up activities. ~~In addition, growth appeared to be reduced by oil, but determination of sublethal or chronic effects is awaiting final analyses.~~ In communities on the Kenai Peninsula, Kodiak, and Alaska Peninsula, concern about the effects of the oil spill on clams and subsistence uses of clams remains high.

**Recovery Objective**

Based on prespill data or comparisons of oiled and unoiled sites, clams will have recovered when populations and productivity have returned to levels that would have prevailed in the absence of the oil spill ~~(prespill data or unoiled control sites)~~.

## COMMON LOONS

**Injury and Recovery**

Carcasses of 395 loons of four species were recovered following the spill, including at least 216 common loons. Current population sizes are not known for any of these species, but, in general, loons are long-lived, slow-reproducing, and have small populations. Common loons in the oil-spill area may number only a few thousand, including only hundreds in Prince William Sound. Common loons injured by the spill probably included a mixture of resident and migrant birds, and their recovery status is not known.

**Recovery Objective**

No realistic recovery objective can be identified without more information on injury to and the recovery status of common loons.

## Common Murres

**Injury and Recovery**

About 30,000 carcasses of oiled birds were picked up following the oil spill, and 74 percent of them were common and thick-billed murres (mostly common murres). Many more murres died than were actually recovered, and it is estimated that the spill-area population declined by about 40 percent, including colonies at Resurrection Bay, the Chiswell, Barren, and Triplet islands, and Puale Bay. In addition to direct losses of murres, there was evidence that the timing of reproduction was disrupted and productivity reduced. Interpretation of the effects of the spill, however, is complicated by incomplete prespill data and by indications that populations at some colonies were in decline before the oil spill.

Postspill monitoring of productivity at index colonies indicates that reproductive timing and success were again within normal bounds by 1993. Numbers of adult murres were last surveyed in 1994 [check] and, at that time, had not returned to prespill levels.

~~Productivity of common murres shows signs of recovery at some injured colonies (Barren Islands, Puale Bay) but postspill population counts are still lower than prespill estimates and show no sign of recovery.~~

**Recovery Objective**

Common murres will have recovered when populations ~~trends are increasing significantly~~ at index colonies have returned to prespill levels and when productivity is sustained within normal bounds. Increasing population trends at index colonies will be further indication that recovery is underway. ~~in the spill area and when reproductive timing and success are (Normal bounds will be determined by comparing productivity data with information from other murre colonies in the Gulf of Alaska and elsewhere.)~~

## Cutthroat Trout

**Injury and Recovery**

Prince William Sound is at the northwestern limit of the range of cutthroat trout, and few stocks are known to exist within the sound. Local cutthroat trout populations rarely number more than 1,000 each, and the fish have small home ranges and are geographically isolated. Cutthroat trout, therefore, are highly vulnerable to exploitation, habitat alteration, or pollution. Following the oil spill, cutthroat trout in a small number of oiled index streams grew more slowly than in unoiled streams, possibly as a result of reduced food supplies or exposure to oil, and there is concern that reduced growth rates may reflect reduced survival. The difference in growth rates

persisted through 1991. No studies have been conducted since then, and the recovery status of this species is not known. ~~Cutthroat trout have grown more slowly in oiled areas than in unoiled areas. Insufficient data are available to determine whether they are recovering.~~

**Recovery Objective**
Cutthroat trout will have recovered when growth rates within oiled areas are comparable to those for unoiled areas, after taking into account geographic differences.

## Designated Wilderness Areas

**Injury and Recovery**
The oil spill delivered oil in varying quantities to the waters adjoining the seven areas within the spill area designated as wilderness areas and wilderness study areas by Congress. Oil also was deposited above the mean high-tide line in these areas. During the intense clean-up seasons of 1989 and 1990, thousands of workers and hundreds of pieces of equipment were at work in the spill area. This activity was an unprecedented imposition of people, noise, and activity on the area's undeveloped and normally sparsely occupied landscape. Although activity levels on these wilderness shores have probably returned to normal, at some locations there is still residual oil.

**Recovery Objective**
Designated wilderness areas will have recovered when oil is no longer encountered in these areas and the public perceives them to be recovered from the spill.

## Dolly Varden

**Injury and Recovery**
Like the cutthroat trout, there was evidence that Dolly Varden ~~have grown~~ grew more slowly in oiled streams ~~areas~~ than in unoiled streams ~~areas~~, and there is concern that reduced growth rates reflect reduced survival. However, no data have been gathered since 1991, and the recovery status of this species is not known. ~~Insufficient data are available to determine whether they are recovering.~~

**Recovery Objective**
Dolly Varden will have recovered when growth rates within oiled streams ~~areas~~ are comparable to those ~~for~~ in unoiled streams ~~areas~~, after taking into account geographic differences.

## Harbor Seals

### Injury and Recovery

Harbor seal numbers were declining in the Gulf of Alaska, including in Prince William Sound, before the oil spill. *Exxon Valdez* oil impacted harbor seal habitats, including key haul-out areas and adjacent waters, in Prince William Sound and as far away as Tugidak Island, near Kodiak. An estimated 300 seals died in Prince William Sound as a direct result of the spill, and this was 6-15 percent of the estimated prespill population. Based on comparisons of surveys in 1988 and then in 1989 after the oil spill, seals in ~~the~~ oiled areas had declined by 43 percent, compared to 11 percent in ~~the~~ unoiled areas.

Unfortunately, seals in both oiled and unoiled parts of Prince William Sound have continued to decline since the spill. For the period 1989-1994, the average estimated annual rate of decline, adjusted for time of day and other factors, is about 6 percent. Possible factors for this long-term decline include disease and the amount or quality of food. ~~Counts made during the molt at trend count sites in Prince William Sound from 1990 to 1993 indicate that numbers may have stabilized. However, counts during pupping have continued to decline. It is not known which counts are the best indicator of population status. If the conditions that were causing the population to decline before the spill have improved, normal growth may replace the animals that were lost. However, if conditions continue to be unfavorable, the affected population may continue to decline.~~ Harbor seals are a key subsistence resource in the oil-spill area ~~Prince William Sound~~. Subsistence hunting is ~~both~~ affected by the declining seal population and, in turn, may be affecting the recovery of harbor seals ~~status~~.

### Recovery Objective

Recovery will have occurred when harbor seal population trends are stable or increasing.

## HARLEQUIN DUCKS

### Injury and Recovery

Harlequin ducks feed in intertidal and shallow subtidal habitats where most of the spilled oil was initially stranded. More than 200 harlequin ducks were found dead in 1989, mostly in Prince William Sound; many more actually died throughout the spill area. Since the oil spill occurred in early spring, before wintering harlequins had left the oil-spill area, the impacts of the oil spill may have extended beyond the spill area. The geographic extent of these impacts is not known.

Bile samples from harlequin ducks and Barrow's and common goldeneye collected in eastern and western Prince William Sound and in the western Kodiak Archipelago in 1989-90 had higher concentrations of hydrocarbon metabolites than a small number of samples from harlequins and goldeneye collected at Juneau. Prespill data on harlequin populations and productivity are poor and complicated by possible geographic differences in habitat quality. However, the summer population in Prince William Sound is small, only a few thousand birds, and there continues to be concern about poor reproduction and a possible decline in numbers of molting birds in western versus eastern parts of the Sound. ~~There are indications of reduced densities of harlequin ducks in the breeding season; a declining trend in the summer, postbreeding~~

~~population; and very poor production of young in western Prince William Sound.~~

**Recovery Objective**

Harlequin ducks will have recovered when breeding and postbreeding season densities and production of young return to ~~estimated~~ prespill levels. ~~or when there are no differences in these parameters between oiled and unoiled areas.~~ A normal population age- and sex-structure and reproductive success appropriate to the habitat in western Prince William Sound will indicate that recovery is underway.

## Intertidal Organisms

**Injury and Recovery**

Portions of 1,500 miles of coastline were oiled by the spill, and both the oil and intensive clean-up activities had significant impacts on the flora and fauna of the intertidal zone, the area of beach between low and high tides. With tidal action, oil penetrated deeply into cobble and boulder beaches, and, even with intensive clean up activities, persists in some beaches today. The most significant impacts occurred in middle and upper intertidal zones on sheltered rocky shores, which is where the greatest amounts of oil were stranded.

Small invertebrates like limpets, barnacles, and marine worms were less abundant at oiled versus unoiled index sites in Prince William Sound, Kodiak Island, and on the Kenai and Alaska peninsula coasts. The size, coverage, and reproductive potential of seaweed *Fucus gardneri* (known as rockweed or popweed) also was reduced following the spill. Although numbers of many species of invertebrate fauna have increased following the spill, recovery of *Fucus* in the upper intertidal zone is lagging. Full recovery of *Fucus* is crucial for recovery of the intertidal ecosystem, since many invertebrates depend on the cover provided by this seaweed. Many intertidal resources are important to subsistence users, as well as to sea and river otters, black oystercatchers, harlequin ducks, and pigeon guillemots.

~~The lower intertidal zone and, to some extent, the middle intertidal zone are recovering. However, injuries persist in the upper intertidal zone, especially on rocky sheltered shores. Recovery of this zone appears to depend, in part, on the return of adult *Fucus* in large numbers.~~

**Recovery Objective**

~~Each intertidal elevation (lower, middle, or upper) will have recovered when community composition, population abundance of component species, age-class distribution, and ecosystem functions and services in each injured intertidal habitat have returned to levels that would have prevailed in the absence of the oil spill.~~ Intertidal communities will have recovered when community composition on oiled shorelines is similar to that which would have prevailed in the absence of the spill. Indications of recovery are the reestablishment of keystone species, such as *Fucus*, and provision of adequate, uncontaminated food supplies for top predators in intertidal and nearshore habitats.

## KILLER WHALES

### Injury and Recovery

About ___ killer whales in _ "resident" pods regularly use Prince William Sound within their ranges. Other whales in "transient" pods enter the Sound less frequently. There has been particular concern in Prince William Sound about the resident AB pod, which numbered 36 animals prior to the spill. Fourteen whales disappeared from this pod in 1989 and 1990, during which time no young were recruited into the population. Although four calves were added to the AB pod during 1992-94, surveys in 1994 and 1995 indicate the loss of five more whales. The link between these losses and the oil spill is only circumstantial, but the apparent mortality of killer whales in Prince William Sound following the spill far exceeds rates for pods in British Columbia and Puget Sound over the last 20 years. The AB pod may never regain its former size, but overall numbers of resident killer whales in Prince William Sound are at or exceed prespill levels. ~~Thirteen whales disappeared from one killer whale pod in Prince William Sound between 1988 and 1990. The injured pod is growing again.~~

### Recovery Objective

Pending further evaluation of the status of the AB pod, no specific recovery objective can be identified at this time. ~~Killer whales will have recovered when the injured pod grows to at least 36 individuals (1988 level).~~

## ~~MARBLED~~ MURRELETS, MARBLED AND KITTLITZ'S

### Injury and Recovery

The northern Gulf of Alaska, including Prince William Sound, is a key areas in the distributions of two poorly studied species of seabirds, marbled and Kittlitz's murrelets. The world population of Kittlitz's murrelet is believed to number only a few tens of thousands of birds, many of which are in the oil-spill area. The marbled murrelet is federally listed as a Threatened species in Washington, Oregon, and California; it is also listed as Threatened in British Columbia.

The marbled murrelet populations in Prince William Sound was ~~were~~ in decline before the spill. The causes of the prespill decline are unknown, but may be related to changing food supplies. The oil spill probably increased the ~~prespill~~ rate of decline for this species in the spill area, although the incremental injury is difficult to estimate. ~~The population of marbled murrelets may be stabilizing or even increasing since the spill.~~ Carcasses of nearly 1,100 *Brachyramphus* murrelets were found after the spill, and it is estimated that as much as __ percent of the Prince William Sound marbled murrelet population was killed by the spill. Population estimates for murrelets are highly variable, and postspill boat surveys do not yet indicate any statistically significant increase in numbers of marbled murrelets in Prince William Sound. The recovery status of Kittlitz's murrelet is not known.

### Recovery Objective

Marbled murrelets will have recovered when population trends are stable or increasing. No recovery objective can be identified for Kittlitz's murrelet at this time.

## MUSSELS

### Injury and Recovery

Mussels are an important prey species in the nearshore ecosystem throughout the oil-spill area, and beds of mussels provide physical stability in the intertidal zone. For these reasons, mussel beds were purposely left alone during *Exxon Valdez* clean-up operations.

In 1991, high concentrations of relatively unweathered oil were found in the mussels and underlying byssal mats in certain dense mussel beds. ~~In 1991, relatively high concentrations of oil were found in mussels and in the dense underlying mat (byssal substrate) of certain oiled mussel beds. The beds were not cleaned nor was oil removed after the spill.~~ The biological significance of oiled mussel beds is not known, but they ~~Oiled mussel beds~~ are potential pathways of ~~sources of fresh (unweathered)~~ oil contamination for local populations of harlequin ducks, black oystercatchers, river otters, and juvenile sea otters, all of which feed to some extent on mussels and show some signs of continuing injury. ~~The extent and magnitude of oiled mussel beds are unknown.~~ At least __ [70-?] mussel beds in Prince William Sound are known to still have oil residue; 12 beds were cleaned on an experimental basis in 1994. Mussel beds along the outer Kenai Peninsula coast, the Alaska Peninsula, and Kodiak Archipelago were surveyed for the presence of oil in 1992, 1993, and 1995. Hydrocarbon concentrations in mussels and sediments at these Gulf of Alaska sites is generally lower than for sites in the Sound, but at some sites substantial concentrations persist.

Subsistence users continue to be concerned about contamination from oiled mussel beds. The Nearshore Vertebrate Predator project is focusing on mussels as a key prey species and component of the nearshore ecosystem.

### Recovery Objective

Mussels will have recovered when concentrations of oil in them are sufficiently low that they do not contaminate their predators. ~~their populations and productivity are at prespill levels and they do not contain oil that contaminates higher trophic levels.~~

## PACIFIC HERRING

### Injury and Recovery

Pacific herring spawned in intertidal and subtidal habitats in Prince William Sound shortly after the oil spill. As much as 10 percent of the intertidal spawning habitat and 40 percent of the herring staging areas in the Sound may have been contaminated by oil. Field studies conducted in 1989 and 1990 showed increased rates of egg mortality and larval deformities in oiled versus

unoiled areas. Laboratory studies confirm that these effects can be caused by exposure to *Exxon Valdez* oil, but the significance of these injuries at a population level is not known.

In 1992, Pacific herring biomass in Prince William Sound was at a record level. In 1993, however, there was an unprecedented crash of adult herring. A viral disease and fungus were the probable agents of mortality, and the connection between the oil spill and the disease outbreak is under investigation. Numbers of spawning herring in Prince William Sound have remained depressed through the 1995 season. Pacific herring are extremely important ecologically as well as commercially. Reduced herring populations could have significant implications for both their predators and their prey, and the closure of the herring fishery from 1993 through 1995 has had serious economic impact on people and communities in Prince William Sound.

~~Pacific herring studies have demonstrated egg mortality and larval deformities. Populations may have declined, but there is uncertainty as to the full extent and mechanism of injury. However, the stocks and dependent fisheries in Prince William Sound are not healthy, as indicated by the low spawning biomass in 1993 and 1994 and the resultant elimination of the fisheries in those years.~~

**Recovery Objective**

Pacific herring will have recovered when indicators of population health, such as reproduction, growth, and recruitment, are within normal bounds and free of oil-related effects within Prince William Sound. ~~populations are healthy and productive and exist at prespill abundances.~~

## PIGEON GUILLEMOT

**Injury and Recovery**

Although the pigeon guillemot is widely distributed, nowhere does it occur in large numbers or concentrations. Because guillemots feed in shallow, nearshore waters, both they and the fish they prey on are vulnerable to oil pollution. Like the marbled murrelet, the pigeon guillemot population in Prince William Sound was in decline before the spill. The causes of the prespill decline are unknown. It is estimated that 10-15 percent of the Gulf of Alaska population may have died in the spill, and declines along oiled shorelines in Prince William Sound were greater than along unoiled shorelines. Numbers of guillemots recorded on boat surveys are highly variable, and there is not yet any statistically significant evidence of a postspill population increase. The factors responsible for the guillemot's prespill decline may negate or mask recovery from the effects of the oil spill.

**Recovery Objective**

Pigeon guillemots will have recovered when the populations in Prince William Sound is ~~are~~ stable or increasing.

## PINK SALMON

### Injury and Recovery

About 75 percent of wild pink salmon in Prince William Sound spawn in the intertidal portions of streams and were highly vulnerable to the effects of the oil spill. Hatchery salmon and wild salmon from both intertidal and upstream spawning habitats swam through oiled waters and ingested oil particles and oiled prey as they foraged in the sound and emigrated to sea. As a result, three types of early life-stage injuries were identified: First, growth rates in juvenile pink salmon from oiled parts of Prince William Sound were reduced. Second, there was increased egg mortality in oiled versus unoiled streams. A possible third effect, genetic damage, is under investigation.

In the years preceding the spill, returns of wild pink salmon in Prince William Sound varied from a maximum of 21.0 million fish in 1984 to a minimum of 1.8 million in 1988. Since the spill, returns of wild pinks have varied from a high of about 14.4 million fish in 1990 to a low of about 2.2 million in 1992. There is particular concern about the Sound's southwest management district, where returns of both hatchery and wild stocks have been generally weak since the oil spill. Because of the tremendous natural variation in adult returns, however, it is difficult to attribute poor returns in a given year to injuries caused by *Exxon Valdez* oil. For pink salmon, mortalities of eggs and juveniles remain the best indicators of injury and recovery.

Evidence of reduced juvenile growth rates was limited to the 1989 season, but increased egg mortality persisted in oiled compared to unoiled streams through 1993. The 1994 and 1995 seasons were the first since 1989 in which there were no statistically significant differences in egg mortalities in oiled and unoiled streams. These data indicate that recovery from oil-spill effects is underway.

The Sound Ecosystem Assessment (SEA) Project is exploring physical and biological oceanographic factors that influence production of pink salmon and Pacific herring. These natural factors are likely to have the greatest influence over year-to-year returns in both wild and hatchery stocks of pink salmon.

~~Pink salmon studies have demonstrated egg mortality, fry deformities, and reduced growth in juveniles. Populations may have declined, but there is uncertainty as to the full extent and mechanism of injury. However, there is evidence of continued damage in some stocks from exposure to oil, and there were unexpectedly poor runs of both wild and hatchery stocks of pink salmon in Prince William Sound in 1992 and 1993. In 1994, runs were still depressed but exceeded forecasts.~~

### Recovery Objective

Pink salmon will have recovered when population indicators, such as growth and survival, are within normal bounds and there are no statistically significant differences in egg mortalities in oiled and unoiled streams for two years each of odd- and even-year runs in Prince William Sound. ~~populations are healthy and productive and exist at prespill abundance. An indication~~

~~of recovery is when egg mortalities in oiled areas match prespill levels or levels in unoiled areas.~~

## River Otters

### Injury and Recovery

River otters have a low density and an unknown population size in Prince William Sound, and, therefore, it is hard to assess oil-spill effects. Twelve otter carcasses were found following the spill. Studies conducted during 1989-1991 identified several differences between otters in oiled and unoiled areas in Prince William Sound, including biochemical evidence of exposure to hydrocarbons or other sources of stress, reduced diversity in prey species, reduced body size (length-weight), and increased territory size. However, sample sizes were small, and it is not clear that these differences are the result of the oil spill. The Nearshore Vertebrate Predator project, now underway, will shed new light on the status of the river otters. In 1995 the Alaska Board of Game used its emergency authority to restrict trapping of river otters in western Prince William Sound to ensure that the results of this study are not compromised by the removal of animals from study areas on Montague and Knight islands. ~~River otters in Prince William Sound have suffered sublethal effects from the spill and may continue to be exposed to hydrocarbons.~~

### Recovery Objective

The river otter will have recovered when biochemical indices of hydrocarbon exposure or other stresses and indices of habitat use are similar between oiled and unoiled areas of Prince William Sound, after taking into account any geographic differences. ~~Indications of recovery are when habitat use, food habitats and physiological indices have returned to prespill conditions.~~

## ROCKFISH

### Injury and Recovery

Very little is known about rockfish populations in the northern Gulf of Alaska. Dead adult rockfish were recovered following the oil spill, and chemical analysis of five specimens indicated that oil ingestion was the cause of death. Analysis of other rockfish showed exposure ~~were exposed~~ to hydrocarbons and ~~showed~~ sublethal effects. ~~Furthermore~~ In addition, closures to salmon fisheries apparently increased fishing pressures on rockfish, which may have adversely affected ~~be affecting their~~ the rockfish population. However, the original extent ~~and mechanism~~ of injury and the current recovery status of ~~to~~ this species are unknown.

### Recovery Objective

Without further study, a recovery objective cannot be defined.

## Sea Otters

### Injury and Recovery

Surveys of sea otters in the 1970s and 1980s indicate that the population was expanding and about 10,000 animals lived in Prince William Sound prior to the spill. About 1,000 sea otter carcasses were recovered following the spill; additional otters probably died but were not recovered. In 1990 and 1991, unusual proportions of prime-age adult otters were found dead and there was evidence of higher mortality of recently weaned juveniles in oiled areas. By 1992-93, mortality rates for juveniles had decreased, but were still higher in oiled than in unoiled parts of Prince William Sound.

Boat surveys conducted in March and July in 1993 and again in 1994 indicated a population of about 7,700 otters in the Sound, but there was no statistically significant evidence of a population increase following the spill (1990-1994). Comparison of recent surveys with prespill surveys suggests that recovery has not occurred in at least the most severely affected areas of the Sound, such as northern Knight Island. Recovery is probably underway in less affected areas. The Nearshore Vertebrate Predator project, which was started in 1995, should help clarify the recovery status of the sea otter in Prince William Sound.

~~Sea otters do not appear to be recovering, but are expected to eventually recover to their prespill population. Exactly what population increases would constitute recovery is very uncertain, as there are no population data from 1986 to 1989, and the population may have been increasing in Eastern Prince William Sound during that time. In addition, only large changes in the population can be reliably detected with current measuring techniques. However, there are recent indications that the patterns of juvenile and mid-aged mortalities are returning to prespill conditions.~~

### Recovery Objective

Sea otters will have recovered when the population returns to its prespill abundance and distribution. An increasing population trend and normal reproduction and age structure in oiled parts of Prince William Sound will indicate that recovery is underway. ~~Sea otters will be considered recovered when population abundance and distribution are comparable to prespill abundance and distribution, and when all ages appear healthy.~~

## Sediments

### Injury and Recovery

With tidal action, oil penetrated deeply into cobble and boulder beaches that are ~~relatively~~ common on ~~the rocky islands of~~ shorelines throughout the spill area, especially in sheltered habitats. Cleaning removed much of the oil from the intertidal zone but subsurface oil persisted in many heavily oiled beaches and associated subtidal sediments. ~~in mussel beds, which were avoided during the cleanup.~~ Subsurface oil persists in least at ___ locations in Prince William Sound and as far away as the Alaska Peninsula [check]. While much of this oil is probably not

biologically active, it is of great concern to residents in oil-spill communities, and there are sites where sheening still occurs.

Following the oil spill, chemical analyses of oil in sediments were conducted at a small number of index sites in Prince William Sound. At these sites, oil in sediments reached its greatest concentrations at water depths of 20 meters, although elevated levels of hydrocarbon-degrading bacteria (associated with elevated hydrocarbons) were detected at depths of 40 and 100 meters in 1990 in Prince William Sound. ~~Chemical analyses show that *Exxon Valdez* oil apparently did not reach deeper than 20 to 40 meters, although elevated activities of hydrocarbon-degrading bacteria were seen somewhat deeper in some cases.~~ By 1993, however, there was little evidence of *Exxon Valdez* oil and related microbial activity at most index sites in Prince William Sound, except at those associated with sheltered beaches that were heavily oiled in 1989. These index sites--at Herring, Northwest, and Sleepy bays--were among the ___ at which subsurface oiling is still known to occur (see above).

In 1995, a shoreline survey team visited 30 sites in the Kodiak Archipelago that had measurable or reported oiling in 1990 and 1991. The survey team found no oil or only trace amounts at these sites. The oiling in the Kodiak area is not persisting as it is at sites in Prince William Sound due to the higher energy settings on the islands, the state of the oil when it came ashore, and the smaller concentrations of initial oiling relative to the Sound.

**Recovery Objective**

Sediments will have recovered when ~~contamination causes no negative effects to the spill ecosystem~~ residues of subsurface oil at sheltered sites that were previously heavily oiled are declining or are biologically harmless.

## SOCKEYE SALMON

**Injury and Recovery**

Commercial salmon fishing was closed in Prince William Sound and in portions of Cook Inlet and near Kodiak in 1989 to avoid any possibility of contaminated salmon being sent to market. As a result, there were higher-than-usual numbers (i.e., overescapement) of spawning sockeye salmon entering the Kenai River, Red and Akalura lakes on Kodiak Island, and other lakes on Afognak Island and the Alaska Peninsula. Initially these high escapements may have produced an overabundance of juvenile sockeye that consumed huge quantities of zooplankton, thus destroying planktonic food webs in the nursery lakes. Although the exact mechanism is unclear, the result was lost sockeye production as shown by declines in the returns of adults per spawning sockeye.

The effects of the 1989 overescapement of sockeye salmon have persisted in the Kenai River system through 1995. Although the overall escapement goal for that system was met in 1995, there is concern that the initial overescapement will continue to affect post-spill year-classes and that sockeye returns are yet not sufficient to fulfill the commercial, recreational, and subsistence

demands on sockeye salmon in the Kenai River system.

Production of zooplankton in both Red and Akalura lakes on Kodiak Island has returned to normal. There continues to be some problem in the rate of production of sockeye fry in Red Lake, which may be linked to the overescapement at the time of the oil spill. Continuing low adult escapements at Akalura Lake are more likely the result of a mixed stock fishery harvest in the Kodiak vicinity than a result of the earlier overescapement.

~~Sockeye salmon in Red Lake, Akalura Lake, and lakes in the Kenai River system declined in population because of adult overescapement in 1989. The Red Lake system may be recovering because the plankton has recovered and fry survival improved in 1993. However, Akalura Lake and the Kenai River lakes have not recovered: smolt production has continued to decline from these lakes. In the Kenai River lakes, for example, smolt production has declined from 30 million in 1989 to 6 million in 1990 and to less than 1 million in 1992 and 1993.~~

**Recovery Objective**

Sockeye salmon in the Kenai River system and Red and Akalura lakes will have recovered when adult returns-per-spawner are within normal bounds. ~~affected lakes will have recovered when populations are able to support overwinter survival rates and smolt outmigrations comparable to prespill levels.~~

## Subtidal Organisms

**Injury and Recovery**

Oil that was transported down to subtidal habitats apparently caused changes in the size and species composition of plant and animal populations below lower tides. Different habitats, including eelgrass beds, kelp beds, and deep water, were compared at oiled and unoiled sites. The greatest effects were detected at oiled sites with sandy sea bottoms under eelgrass beds, at which there were reduced numbers and diversity of helmet crabs, amphipods, and other crustaceans and mollusks. There also were sublethal effects on the eelgrass itself. Organisms living in sediment at depths of 3-20 meters were especially affected. Some opportunistic, such as *Musculus* mussels, a variety of polychaetes, and juvenile cod, apparently increased in numbers at oiled sites. Differences in oiled and unoiled sites were less evident by 1993.

~~Certain subtidal organisms, like eelgrass and some species of algae, appear to be recovering. Other subtidal organisms, like leather stars and helmet crabs, showed little signs of recovery through 1991.~~

**Recovery Objective**

Subtidal communities will have recovered when community composition in oiled areas, especially in association with eelgrass beds, is similar to that which would have prevailed in the absence of the spill. Indications of recovery are the return of keystone species, such as certain amphipods and other oil-sensitive crustaceans. ~~Subtidal communities will have recovered when~~

~~the community composition, age-class distribution, population abundance of component species, and ecosystem functions and services in each injured subtidal habitat have returned to levels that would have prevailed in the absence of the oil spill.~~

## Services

### Commercial Fishing

**Injury and Recovery**

Commercial fishing is a service that was injured through injury to commercial fish species (see individual resources) and also through fishing closures. In 1989, closures affected fisheries in Prince William Sound, lower Cook Inlet, upper Cook Inlet, Kodiak, and Chignik. These fisheries opened again in 1990. Since then, there have been no spill-related district-wide closures, except for the Prince William Sound herring fishery, which was closed in 1993 and has remained closed since then due to the collapse of the herring population. These closures, including the on-going closure of the herring fishery in Prince William Sound, harmed the livelihoods of persons who fish for a living and the communities in which they live. To the extent that the oil spill continues to be a factor that reduces opportunities to catch fish, there is on-going injury to commercial fishing as a service.

On this basis, the Trustee Council continues to make major investments in projects to understand and restore commercially important fish species that were injured by the oil spill. These projects include: supplementation work, such as fertilizing Coghill Lake to enhance its sockeye salmon run and construction of a barrier bypass at Little Waterfall Creek; development of tools that have almost immediate benefit for fisheries management, such as otolith mass marking of pink salmon in Prince William Sound and in-season genetic stock identification for sockeye salmon in Cook Inlet; and research such as the SEA Project and genetic mapping which will enhance the ability to predict and manage fisheries over the long-term.

~~Continuing injuries to commercial fishing may cause hardships for fishermen and related businesses. Each year that commercial fishing remains below prespill levels compounds the injury to the fishermen and, in many instances, the communities in which they live or work.~~

~~The Trustee Council recognizes the impact to communities and people of the Prince William Sound region resulting from the sharp decline in pink salmon and herring fisheries in past years. In 1994, the Trustee Council committed over six million dollars to help address these issues through the development of an ecosystem based study for Prince William Sound. Some of the pink salmon and herring problems may be unrelated to the spill. However, the Council will continue to address these important problems.~~

**Recovery Objective**

Commercial fishing will have recovered when the commercially important fish species have recovered and opportunities to catch these species are not lost or reduced because of the

~~effects of the oil spill. population levels and distribution of injured or replacement fish used by the commercial fishing industry match conditions that would have existed had the spill not occurred. Because of the difficulty of separating spill-related effects from other changes in fish runs, the Trustee Council may use prespill conditions as a substitute measure for conditions that would have existed had the spill not occurred.~~

[NOTE: THE FOLLOWING HAS NOT BEEN REVISED.]

**Restoration Strategy**

The primary method for restoring commercial fishing is to restore the species that are fished commercially, such as pink salmon, Pacific herring, and sockeye salmon. These species are discussed elsewhere in this chapter. Three additional parts of the strategy for restoring commercial fishing are the following:

*Promote recovery of commercial fishing as soon as possible.* Many communities that rely on commercial fishing will be significantly harmed while waiting for commercial fish resources to recover through natural recovery alone. Therefore, an objective of restoration is to accelerate recovery of commercial fishing. This objective may be accomplished through increasing availability, reliability, or quality of commercial fish resources, depending on the nature of the injury. For resources that have sharply declined since the spill, such as pink salmon, and Pacific herring in Prince William Sound, this objective may take the form of increasing availability in the long run through improved fisheries management. Another example is providing replacement fish for harvest.

*Protect commercial fish resources from further degradation.* Further stress on commercial fish resources could impede recovery. Appropriate protection can take the form of habitat protection and acquisition if a resource faces loss of habitat. The Trustee Council can also contribute to the protection of commercial fish species by providing information needed to improve their management.

*Monitor recovery.* Monitoring the recovery of commercial fishing will track the progress of recovery, detect major reversals, and identify problems with the resources and resource management that may affect the rate or degree of recovery. Inadequate information may require managers to unduly restrict use of the injured resources, compounding the injury to commercial fishing.

## PASSIVE USE

**Injury and Recovery**

Passive use of resources includes the appreciation of the aesthetic and intrinsic values of undisturbed areas, the value derived from simply knowing that a resource exists, and other nonuse values. Injuries to passive uses are tied to public perceptions of injured resources. [NOTE: THIS SAYS ALMOST NOTHING ABOUT INJURY. IS THERE ANYTHING TO SAY? PERHAPS A REFERENCE TO THE VALUATION SURVEYS DONE FOLLOWING THE SPILL?]

**Recovery Objective**
Passive uses will have recovered when people perceive that aesthetic and intrinsic values associated with the spill area are no longer diminished by the oil spill.

[NOTE: THE FOLLOWING HAS NOT BEEN REVISED.]
**Restoration Strategy**
Any restoration strategy that aids recovery of injured resources, or prevents further injuries, will assist recovery of passive use values. No strategies have been identified that benefit only passive uses, without also addressing injured resources. Since recovery of passive uses requires that people know when recovery has occurred, the availability to the public of the latest scientific information will continue to play an important role in the restoration of passive uses.

## Recreation and Tourism

**Injury and Recovery**
The spill disrupted use of the spill area for recreation and tourism. Resources important for wildlife viewing and which are still injured by the spill include killer whale, sea otter, harbor seal, ~~bald eagle,~~ and various seabirds. Residual oil exists on some beaches with high value for recreation, and its presence may decrease the quality of recreational experiences and discourage recreational use of these beaches.

Closures of sport hunting and fishing also affected use of the spill area for recreation and tourism. Sport fishing resources include salmon, rockfish, Dolly Varden, and cutthroat trout. The Alaska Board of Fisheries restricted sport harvest of cutthroat trout in Prince William Sound in 1991[?], and those restrictions remain in place. Harlequin ducks are hunted in the spill area. The Alaska Board of Game restricted sport harvest of harlequin ducks in Prince William Sound in 1991, and those restrictions remain in place.

Recreation was also affected by changes in human use in response to the spill. For example, displacement of use from oiled areas to unoiled areas increased management problems and facility use in unoiled areas. Some facilities, such as the Green Island cabin and the Fleming Spit camp area, were injured by clean-up workers.

In the years since the oil spill, there has been a general, marked increase in visitation to the spill area. There are still locations within the oil-spill area, however, avoided by recreational users because of the presence of residual oil.

**Recovery Objective**
Recreation and tourism will have recovered, in large part, when the fish and wildlife resources on which they depend have recovered, recreation use of oiled beaches is no longer impaired, and facilities and management capabilities can accommodate changes in human use.

[NOTE: THE FOLLOWING HAS NOT BEEN REVISED.]

### Restoration Strategy

*Preserve or improve the recreational and tourism values of the spill area.* Habitat protection and acquisition are important means of preserving and enhancing the opportunities offered by the spill area. Facilities damaged during cleanup may be repaired if they are still needed. New facilities may restore or enhance opportunities for recreational use of natural resources. Improved or intensified public recreation management may be warranted in some circumstances. Projects that restore or enhance recreation and tourism would be considered only if they are consistent with the character and public uses of the area. However, all projects to preserve and improve recreation and tourism values must be related to an injured natural resource. See Policy 9 in Chapter 2.

*Remove or reduce residual oil if treatment is cost effective and less harmful than leaving the oil in place.* Removal of residual oil from beaches with high value for recreation and tourism may restore these services for some users. However, this benefit would have to be balanced against cost and the potential for further disruption to intertidal communities.

*Monitor recovery.* Monitor the recovery of resources used for recreation and tourism. Also monitor changes in recreation and tourism in the spill area.

## SUBSISTENCE

### Injury and Recovery

Before the oil spill, the Alaska Department of Fish and Game had documented 15 predominately Alaskan Native communities (with about 2,200 people) in Prince William Sound, lower Cook Inlet, Kodiak, and the Alaska Peninsula that relied heavily on subsistence resources, such as fish, shellfish, seals, deer, and waterfowl. Per capita subsistence harvest ranged from nearly 200 pounds to more than 600 pounds per year. Subsistence harvests of fish and wildlife in most of these villages declined substantially following the oil spill. The reasons for these declines included reduced availability of fish and wildlife to harvest, concern about possible health effects of eating contaminated or injured fish and wildlife, and disruption of lifestyles due to clean-up and other activities.

Subsistence foods were tested for evidence of hydrocarbon contamination during 1989-1994, and the results indicated that most resources contained no or very low concentrations of petroleum hydrocarbons. The U.S. Food and Drug Administration determined that eating foods with low levels of hydrocarbons posed no significant additional risk to human health, although, at the time, there were no guidelines for safe levels of human consumption of hydrocarbons in food. The Oil Spill Health Task Force advised subsistence users not to eat shellfish from beaches where oil can be seen or smelled on the surface or subsurface. Samples of ducks from the Chenega Bay area in 1994 showed that exposure to crude oil had decreased significantly compared to the exposure levels documented since 1990.

Residual oil exists on some beaches near subsistence communities. In general, subsistence

users remain concerned and uncertain about the safety of fish and other wildlife resources. Uncertainty about the safety of resources reduces their use and value for subsistence.

Surveys by the Alaska Department of Fish and Game indicate that in some communities subsistence resources appear to be harvested at prespill levels based on total pounds-per-person. It is important to note, however, that the composition of many diets has shifted to include more fish and fewer seals. Diet composition continues to be a serious concern to subsistence users.

Subsistence users say that maintaining their subsistence culture depends on uninterrupted use of fish and wildlife resources. The more time users spend away from subsistence activities, the less likely that they will return to these practices. Continuing injury to natural resources used for subsistence may affect the way of life of entire communities. There is particular concern that the oil spill disrupted opportunities for young people to learn subsistence culture, and that this knowledge may be lost to them in the future.

**Recovery Objective**

Subsistence will have recovered when injured resources used for subsistence are healthy and productive and exist at prespill levels. In addition, there is recognition that people must be ~~and when people are~~ confident that the resources are safe to eat. ~~One indication that recovery has occurred is when~~ and that the cultural values provided by gathering, preparing, and sharing food need to be ~~are~~ reintegrated into community life.

**[NOTE: THE FOLLOWING HAS NOT BEEN REVISED.]**

**Restoration Strategy**

The primary way of restoring subsistence is to restore injured resources used for subsistence, such as clams, harbor seals, Pacific herring, pink salmon, sea otters, and sockeye salmon. These are discussed elsewhere in this chapter. Four additional parts of the strategy to restore subsistence are the following:

*Promote recovery of subsistence as soon as possible.* Many subsistence communities will be significantly harmed while waiting for resources used for subsistence to recover through natural recovery alone. Therefore, an objective of restoration is to accelerate recovery of subsistence use. This objective may be accomplished through increasing availability, reliability, or quality of resources used for subsistence, or increasing the confidence of subsistence users. Specifically, if subsistence harvest has not returned to prespill levels because users doubt the safety of particular resources, this objective may take the form of increasing the reliability of the resource through food safety testing. Other examples are the acquisition of alternative food sources and improved use of existing resources. However, all projects to promote subsistence must be related to an injured natural resource. See Policy 9 in Chapter 2.

*Remove or reduce residual oil if treatment is cost effective and less harmful than leaving the oil in place.* Removing residual oil from beaches with high value for subsistence may improve the safety of foods found on these beaches. This benefit would have to be balanced against cost and the potential for further disruption to intertidal communities.

*Protect subsistence resources from further degradation.* Further stress on subsistence resources could impede recovery. Appropriate protection can take the form of habitat protection and acquisition if important subsistence areas are threatened. Protective action could also include protective management practices if a resource or service faces further injury from human use or marine pollution.

*Monitor recovery.* Monitor the recovery of resources used for subsistence. Also monitor subsistence harvest.

16.8.1 B

# 1996 Restoration Workshop

*Exxon Valdez* Oil Spill Trustee Council

January 16 – 18

Anchorage, Alaska



# General Information

**Slide Set-up:** The Whitby room in the lower level is equipped with a slide projector and screen for use in checking slides prior to your presentation.

**Break-out Rooms:** Two smaller rooms are reserved for use for smaller meetings throughout the workshop. These are the Quadrant and Adventure rooms on the lower level of the hotel. Please schedule your group's use of break out rooms with the staff at the registration table.

**Lunch:** A luncheon buffet will be available for pre-registered workshop participants only in the Aft Deck on Tuesday and Wednesday, courtesy of the Trustee Council. Thursday's lunch is on your own.

**Poster Session:** See Bill Hauser of the Alaska Department of Fish and Game for information on setting up posters. Setup before noon Tuesday in the Aft Deck. Take down by noon on Thursday.

**Faxes:** Incoming faxes can be sent to the Hotel Captain Cook at 907/278-5366. The cover sheet should specify that you are attending the Exxon Valdez RestorationWorkshop to help the hotel staff locate you.

**Photocopying:** Limited photocopies can be made by Restoration Office staff if you make arrangements a day ahead of when you need them. The hotel front desk staff will make photocopies for you at 25¢ per page. Ridgeways copy center is across the street from the Cook, at 360 K St. (next to Cafe Del Mundo). They make copies for 8¢/page. Hours ar 8 AM – 5 PM.

**Messages:** A message board will be near the registration desk. Please remember to check for your messages.

16.8.1 A

# ESKIMO TRADITIONAL KNOWLEDGE AS A BASIS FOR SCIENTIFIC STUDIES OF THE BOWHEAD WHALE (BALAENA MYSTICETUS) AS CONDUCTED BY THE NORTH SLOPE BOROUGH *



This presentation has four basic parts. The first section is a brief overview of the North Slope Borough (people, land, animals, etc.). The second section of the presentation focuses upon those aspects of Eskimo traditional knowledge that are important to the bowhead whale research program of the North Slope Borough . The important traditional knowledge areas mentioned are: a) the widely held Eskimo view that the bowhead whale population was much higher in 1978 than the 600-2000 that scientists estimated it to be, b) the idea that bowheads are not "afraid of" ice and will swim "into" ice covered waters, c) that spring migrating bowheads pass Pt. Barrow on a "wide front" and don't just confine themselves to the open water of a lead, d) that bowheads can break ice to breathe, e) that bowheads are sensitive to man made noise and for example can be deflected by noise coming from a drillship or a marine seismic exploration vessel, and f) that some bowheads in the spring leave the area of St. Lawrence Island and go up the Chukotka coast and therefore do not come near the census station at Point Barrow.

The third section of the presentation briefly discusses how Eskimo traditional knowledge is formulated. This body of knowledge, as it pertains to the bowhead whale, was developed over many generations by hunters out on the ice making direct observations of the whales and the environment. From generations and generations of observations it is reasonable to conclude that hunters who are "close to the environment" would be able to learn much about a hunted animal (such as the bowhead) regarding population size, behavior in ice, responses to noise, etc.

The fourth section of the presentation briefly discusses how the North Slope Borough's research program was designed to "test" the aspects of traditional knowledge mentioned above. Traditional knowledge relating to the bowhead census (population size, passing on a "wide front", not afraid of ice, and breaking ice to breathe) was "tested" (and found valid) during the many years that the bowhead censuses have been conducted. Traditional knowledge regarding bowhead sensitivity to man made noise was validated when studies near offshore drilling platforms showed bowhead whales avoiding the noisy area around the drilling ship. Traditional knowledge regarding some bowheads going north along the Chukotka coast during the spring was validated by recent observations made by Native observers in Chukotka that are assisting us.

---

* Presented at the 1996 Restoration Workshop (January 16-18, 1996, Anchorage, Alaska) sponsored by the Exxon Valdez Oil Spill Trustee Council.
An abstract of an invited paper, presented by: Thomas F. Albert, V.M.D., Ph.D. of the Department of Wildlife Management, North Slope Borough, Box 69, Barrow, Alaska 99723.