Comments at or related to
1996 Rest. Workshop

21.1.4

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Oil Spill Damage
Assessment and Restoration
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April 23, 1996

MEMORANDUM FOR: Molly McCammon
Executive Director

FROM: Bruce Wright
Bruce Wright
Program Manager

SUBJECT: Chapter 5

Chapter 5 of the Restoration Plan, Injury and Recovery and Recovery Objectives, has seen dramatic improvements by incorporating new scientific information, changes in organization, format and clearer presentation of the information. In the April 1996 version I found only one typo (although this was a quick review); in the killer whale section, page 10, paragraph 1, last line, misspelling of `perhaps'.

Thanks for considering my earlier comments. Keep up the good work.

cc: Stan Senner

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

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

42, 42

As a result of 1996 year data -

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.

EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

KILLER WHALES

Injury and Recovery

About 105 killer whales in 6 "resident" pods regularly use Prince William Sound within their ranges. Other whales in "transient" ~~herds~~ groups are observed in 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 within the larger pod 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.~~ Resightings of individuals within the AT transient group have declined since the study began in 1984. The decline was significantly accelerated following the oil spill.

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).~~ Reduction of mortality rate within AB pod to a level comparable with other major resident pods. Stabilization of rate of sightings of AT group whales.

~~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

NORTH GULF OCEANIC SOCIETY
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To: Stan Senner, EVOS Trustee Council
From: Craig Matkin

23 January 1996

Stan, sent a copy of my comments on Injury and Recovery section (for killer whales) to the Trustee Council a couple days ago... believe they were addressed to Eric Meyers. Let me know if you dont get them.

Also, I didn't comment on the listing of killer whales as "injured not recovering". I think this is appropriate but the AT group should be included or just drop the "AB pod" clarification.

Although you didnt ask for comments on recovery objectives, I provide these suggestions for you to take or leave:

It is clear that recovery of AB pod to 36 whales is not a reasonable objective at this time. However, the jury is out on the future of this pod. It may stabilize as two groups, reform into a single pod, or dissolve. There is no precedent, so I can't predict. It seems that these events will occur in the relatively short term future (within 5 years) and be accompanied by either continued abnormal mortality or a stabiliztion of the mortality rate. At some point you either establish that the pod has stabilized or that it is dysfunctional and no form of recovery is possible. I dont think we have clearly established either of these scenarios yet.

For the AT group it would be encouraging to see some stablization in their decline , both measured by the number of individuals sighted annually and by the rate of sighting of members of this group.

For both AB pod and the AT group I think the recovery objectives should be similar to those for harbor seals..... a stabilization in the rate of decline. Of course at some point there may be no possibility of stablization, but I dont think we are at that point yet.

DATE: 1996-01-22 TIME: 11:28
FROM: MHS:divoky@aol.com

X-MHSFile: ALCDBMBA
TO: MHS:stans@evro.usa.com
SUBJECT: workshop discussions
PRIORITY:

Stan,

I enjoyed the workshop last week and the opportunity to hear about the wide range of restoration research. I had good discussions about PSG's workshop with a number of people, although in most cases these were people who were at our workshop.

I am sending Ken and Craig copies of the Preliminary Revised Recovery Objectives. Do you want any further input on those and is 25 January the latest date you can receive them if you do? Also, when you do revise the objectives would it be okay to run a short piece in the PSG bulletin?

I have some information you may be able to use regarding the question about using two indicators of recovery (an increase in numbers and productivity within normal bounds). For Cooper Island Black Guillemots over a 20-year period of 1163 individuals recruited 954 were immigrants. While in the long-term immigration rate may depend to some extent on reproductive success, it is clear that even with little or no productivity rates of immigration can still be high. The increase from 15 to 200 pairs could have taken place with productivity being zero. Of course in such a scenario if immigration stopped the population would crash. So I would suggest that some measure of breeding productivity be included for guillemots - and perhaps for any other species where immigration could mask the health of a local population.

best,
George

Comments from Mundy

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

IS THIS OUR BEST ESTIMATE?

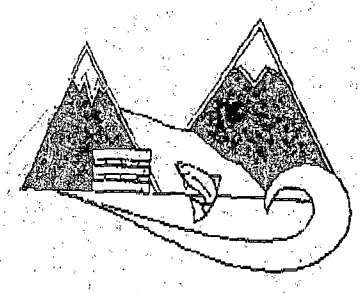
INTERTIDAL COMMUNITIES

Injury and Recovery

Over 600 miles of coastline were oiled in Prince William Sound, on the Kenai and Alaska Peninsulas, and on Kodiak Island. Both the oil and intensive clean-up activities had significant impacts on the flora and fauna of the intertidal zone, the area of shore between low and high tides. Intertidal resources are important to subsistence users, sea and river otters, Black Oystercatchers, Harlequin Ducks, Surf Scoters, Pigeon Guillemots, and other avian consumers. These impacts occurred at all tidal levels in all habitats throughout the spill affected region. Many species of algae and invertebrates were less abundant at oiled sites compared to unoiled reference sites, but other opportunistic species, including a small barnacle, oligochaete worms, and filamentous brown algae, colonized shores where dominant species were removed by the oil spill and clean-up activities. The abundance and reproductive potential of the common seaweed, *Fucus gardneri* (known as rockweed or popweed), was also reduced following the spill. At the wave-sheltered, bedrock shores that are common in Prince William Sound, full recovery of *Fucus* is crucial for the recovery of intertidal communities at these sites, since many invertebrates depend on the cover provided by this seaweed. *Fucus* has not yet fully recovered in the upper intertidal zone on shores subjected to direct sunlight, but in many locations, recovery of intertidal communities has made substantial progress. In other habitat types, such as estuaries and cobble beaches, many species did not show signs of recovery when they were last surveyed in 1991.

Recovery Objective

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 important species, such as *Fucus* in sheltered rocky sites, the convergence of community composition of ioled and unoiled shores, and the provision of adequate, uncontaminated food supplies for predators in intertidal and nearshore habitats.



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FACSIMILE TRANSMITTAL SHEET

FAX NUMBER: 907-465-6447

OFFICE NUMBER: 907-465-6441

DATE: 1/24/96

TO: STAN SPANNER

FROM: PETER VAN TAMELEN

TOTAL NUMBER OF PAGES *(INCLUDING COVER SHEET)*: 2

MESSAGE:

STAN -

THIS IS THE LATEST VERSION OF THE INTERTIDAL COMMUNITIES SECTION, INCORPORATING PETE PETERSON'S COMMENTS.

ANY MORE CHANGES FROM YOUR END?

PETER

INTERTIDAL COMMUNITIES

Injury and Recovery

Over 600 miles of coastline were oiled in Prince William Sound, on the Kenai and Alaska Peninsulas, and on Kodiak Island. Both the oil and intensive clean-up activities had significant impacts on the flora and fauna of the intertidal zone, the area of shore between low and high tides. Intertidal resources are important to subsistence users, sea and river otters, Black Oystercatchers, Harlequin Ducks, and Pigeon Guillemots. These impacts occurred at all tidal levels in all habitats throughout the spill affected region. Many species of algae and invertebrates were less abundant at oiled sites compared to unoiled reference sites, but other opportunistic species, including a small barnacle, oligochaete worms, and filamentous brown algae, colonized shores where dominant species were removed by the oil spill and clean-up activities. The abundance and reproductive potential of the common seaweed, *Fucus gardneri* (known as rockweed or popweed) was also reduced following the spill. At the wave-sheltered, bedrock shores that are common in Prince William Sound, full recovery of *Fucus* is crucial for the recovery of intertidal communities at these sites, since many invertebrates depend on the cover provided by this seaweed. *Fucus* has not yet fully recovered in the upper intertidal zone on shores subjected to direct sunlight. In other habitat types, such as estuaries and cobble beaches, many species did not show any signs of recovery when they were last surveyed in 1991.

Recovery Objective

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 important species, such as *Fucus* in sheltered rocky sites, and provision of adequate, uncontaminated food supplies for normal community interactions within and between intertidal and nearshore habitats.

Juneau Center
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801
(907) 465-6441 Office
(907) 465-6447 FAX

FACSIMILE TRANSMITTAL SHEET

FAX NUMBER: 907-465-6447

OFFICE NUMBER: 907-465-6441

DATE: 1/23/96

TO: STAN SEANNER

FROM: PETER VAN TAMELEN

TOTAL NUMBER OF PAGES *(INCLUDING COVER SHEET)*: 2

MESSAGE:

STAN -

HERE IS A DRAFT REVISION OF THE INTERTIDAL COMMUNITIES SECTION OF CHAPTER 5. I HAVE ALREADY FAXED A COPY TO PETE PETERSON. I HOPE THIS HELPS! WE WOULD LIKE TO SEE YOUR REVISIONS BEFORE IT GOES TO PRESS SO THAT WE CAN CHECK IT FOR ACCURACY. YOU CAN CONTACT ME ON E-MAIL:

FNPVT@AURORA.ALASKA.EDU

CHEERS,

PETER

21.1.40

I think that our official count is higher. Check.

INTERTIDAL COMMUNITIES

Injury and Recovery

Over 600 miles of coastline were oiled in Prince William Sound, on the Kenai and Alaska Peninsulas, and on Kodiak Island. Both the oil and intensive clean-up activities had significant impacts on the flora and fauna of the intertidal zone, the area of shore between low and high tides. Intertidal resources are important to subsistence users, sea and river otters, Black Oystercatchers, Harlequin Ducks, and Pigeon Guillemots. These impacts occurred at all tidal levels in all habitats throughout the spill affected region. Many species of algae and invertebrates were less abundant at oiled sites compared to uncoiled reference sites, but other opportunistic species, including a small barnacle, oligochaete worms, and filamentous brown algae, colonized shores where dominant species were removed by the oil spill and clean-up activities. The abundance and reproductive potential of the common seaweed, *Fucus gardneri* (known as rockweed or popweed) was also reduced following the spill. At the wave-sheltered, bedrock shores that are common in Prince William Sound, full recovery of *Fucus* is crucial for the recovery of intertidal communities at these sites, since many invertebrates depend on the cover provided by this seaweed. *Fucus* has not yet fully recovered in the upper intertidal zone on shores subjected to direct sunlight. In other habitat types, such as estuaries and cobble beaches, many species did not show any signs of recovery when they were last surveyed in 1991.

Surf Scoters, and other Avian Consumers

In many locations, recovery of intertidal communities has made substantial progress.

Recovery Objective

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 important species, such as *Fucus* in sheltered rocky sites, and provision of adequate, uncontaminated food supplies for ~~normal community interactions within and between~~ intertidal and nearshore habitats.

predators in

the convergence of community composition of oiled and uncoiled shores,

Stephen C. Jewett, 10:44 AM 1/23/96 , Subtidal Communities

Date: Tue, 23 Jan 1996 10:44:54 -0900 (AKST)
From: "Stephen C. Jewett" <jewett@ims.alaska.edu>
To: Pete Peterson <cpeters@email.unc.edu>
cc: Stephen Jewett <jewett@ims.alaska.edu>
Subject: Subtidal Communities

Hi Pete,

Here is my revised recovery objective for "Subtidal Communities". Have a go at it and pass it on to Bob Loeffler. Jeep Rice just informed me that I won't get my HC data until mid-March. What a bummer!

See you next month
Stephen

SUBTIDAL COMMUNITIES

Injury and Recovery

Oil that was transported down to subtidal habitats apparently caused changes in the abundance and species composition of plant and animal populations below ~~lower tides~~ the low tide line. Different habitats, including eelgrass beds, kelp beds, and adjacent nearshore waters (< 20 m), were compared at oiled and unoiled sites. The concentration of oil in sediments was more than twice as great at oiled sites. The greatest effects were detected at oiled sites with sandy sea bottoms in the vicinity of eelgrass beds, at which there ~~were~~ was reduced ~~diversity and~~ abundance of eelgrass shoots and flowers, worms, clams, snails, oil-sensitive amphipods (sand fleas), and helmet crabs. Organisms living in sediment at depths of 3-20 meters were especially affected. Some opportunistic (stress tolerant) invertebrates within the substrate, mussels and worms on the eelgrass, and juvenile cod, had apparently increased in numbers at oiled sites by 1990.

total petroleum hydrocarbons? when? no year indicated. (1990?)

biological

how can eelgrass shoots and flowers have a "diversity"?

By 1993, oil concentrations in sediments had dropped considerably, so that there was little difference between oiled and unoiled sites. The eelgrass habitat, the only habitat examined, revealed fewer differences in abundances of plant and animals. However, there were still some animals that were more abundant at oiled sites, like those observed in 1990. These included the opportunistic worms and snails, mussels and worms on the eelgrass, and juvenile cod. Reconnaissance surveys indicated more small green sea urchins at oiled sites.

far too much detail. Reduce by 50% to a single paragraph. See my attempt.

Preliminary results from eelgrass habitat in 1995 revealed that natural restoration had occurred. No difference was detected in abundance of eelgrass shoots and flowers, mussels on eelgrass, amphipods, helmet crabs, and dominant sea stars between oiled and unoiled sites. However, the abundance of small green sea urchin was more than ten times greater at oiled sites. The notion of increased urchins due to reduced sea otter predators is being examined in another study. Analyses of the sediment oil concentrations and organisms that live within the substrate is still pending.

no such thing - a contradiction in terms

Also, if urchin abundance differ, convergence of oiled and unoiled communities has not occurred so recovery is incomplete

Recovery Objective

Subtidal communities will have recovered when community composition in oiled areas, especially in association with eelgrass beds, is similar to that ~~in unoiled areas~~. Indications of recovery are the return of oil-sensitive species, like amphipods, and the reduction of opportunistic species at oiled sites, and convergence of community composition at oiled & unoiled sites, which would have prevailed in the absence of the spill.

From 1990 to 1995, substantial recovery occurred of subtidal ~~soft~~ communities. Abundances of most organisms had converged on oiled and unoiled shores and no significant differences in oil concentrations could be detected by 1993. However, abundances of green sea urchins were ten times greater on oiled sites by 1995, perhaps in response to persistence of reduced sea otter abundances, their major predator. The effect of enhanced urchin abundance on plant habitat may cause future divergence of community composition on oiled and unoiled subtidal shores.

INSTITUTE OF MARINE SCIENCES
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
3431 ARENDELL STREET
MOREHEAD CITY, NORTH CAROLINA 28557 USA

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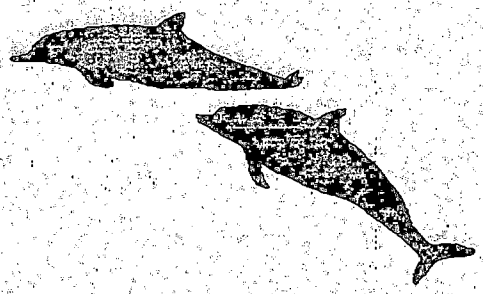
FAX TRANSMISSION
from
INSTITUTE OF MARINE SCIENCES



TO: Stan Senner

LOCATION: EVOS Restoration Office

FAX NUMBER: 907 - 276 - 7178

FROM: Pete Peterson

DATE: Jan 24, 1996 TIME: 1:00 pm EST

TOTAL NUMBER OF PAGES INCLUDING THIS PAGE 4

COMMENTS:

Dear Stan -

I think that these suffice for you to make final decisions on new wording for Intertidal & Subtidal Communities sections. However, I also sent my revisions to Jewett & Van Tamelen so you may get another revision from them.

Pete

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE CONTACT OUR OFFICE AT (919) 726-6841

21.1.4 N

TATITLEK VILLAGE IRA COUNCIL

P.O. Box 171
Tatitlek, AK 99677

Ph. (907) 325-2311
FAX (907) 325-2298

Stm - FYI

January 24, 1996

Ms. Molly McCammon, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, AK 99501-3451

RE: EVOS '96 Restoration Workshop

Dear Ms. McCammon,

I am writing to express my comments regarding the recent Restoration Workshop that was held at the Hotel Captain Cook.

First, I'd like to express my gratitude for the opportunity to participate as a village leader. It means a great deal to be able to hear first hand what progress has been made in addressing the concerns of the people and to better understand the research being conducted on the effects and recovery of the resources damaged by the oil spill. Overall, this workshop was very informative and meaningful and very well organized. The format used to present the information this year allowed for much better participation.

The scientific research projects have much to gain by taking advantage of the vast amounts of traditional knowledge contained in the villages. The sharing of this knowledge will be beneficial to everyone involved in the research projects and also provide for a greater degree of community involvement, thus creating a much better relationship between the villagers and researchers. In order to ensure that maximum use of traditional knowledge is attained, I urge that it be made a requirement in the project proposals-a brief description of how it will be used in each project should be required.

Over the years, in addition to the effects of the oil spill, the sea otter has contributed greatly to the decline in availability of subsistence resources. Village residents are very aware of the growing population of the sea otters and do not agree that it should be listed as "not recovering". We do not agree with the method used to determine the recovery. The overall population of sea otters in Prince William Sound should be considered instead of relying on two specific oiled areas for that determination.

We are very interested in the ongoing research on the recovery of the harbor seals, especially the reasons for the continuous decline of population numbers. Whatever input that we can provide as subsistence users will be available whenever it is needed.

In closing, I'd like to again congratulate you and the EVOS Restoration Office staff on a very well organized and informational workshop. Please do not hesitate to call our office if we can be of any assistance on any of the restoration projects or issues.

Sincerely,

Gary P. Kompkoff, President
Tatitlek Village IRA Council

DATE: 1996-01-19 TIME: 14:32
FROM: MHS:daniel_esler@nbs.gov (Daniel Esler)

X-MHSFile: BBCCCHDH
TO: MHS:stans@evro.usa.com
SUBJECT: Harlequin Restoration Goals
PRIORITY:

Hi Stan:

I wanted to clarify my comments re. harlequin recovery objectives. I agree that using survival as a recovery criteria would be too specific and perhaps limiting. Instead, I'm actually advocating stating recovery objectives even more generally than they are phrased now; i.e., instead of specifying "age- and sex-structure and reproductive success" this could be phrased as "demographic measures", which could serve as an umbrella for a number of possible indices to recovery. In talking with Dan Rosenberg, he seemed to agree with this.

This may all be a moot point, as we'll have a good sense in another year or two about what factors are critical measures of recovery. I just wanted to do a better job of conveying my point than I did in the recovery objectives meeting.

Let me know if you have any comments or questions.

Congratulations for your work in putting together a great meeting. It was informative and invigorating!

Dan Esler

ALASKA NATIVE
HARBOR SEAL COMMISSION
P.O. BOX 2229
CORDOVA, AK 99574
PH 907-424-5882 FAX 424-5883

STAN SENNER
EVOS RESTORATION OFFICE
645 G STREET, SUITE 401
ANCHORAGE, AK 99501-3451
PH 907-278-8012 FAX 276-7178

Jan 24, 1996

Dear Mr. Senner,

I attended the break out sessions on Jan 18 for the marine mammal cluster. I appreciate the opportunity to comment on Harbor Seals and Sea Otters.

On page 11 I commented at the meeting that the last sentence in the second paragraph should read: "Subsistence hunting is affected by the declining seal population and is not a cause of the decline" I would like to strike "may be affecting the recovery of harbor seals". The reason I would like to strike that line is it brings attention to subsistence hunting when there are other factors that may be attributing to the decline as well: killer whale predation, tanker traffic, increased tour boat traffic, timber activities, and other unknown factors.

Page 18, there was a lot of discussion regarding the numbers used in the first paragraph. According to other biologists the population of sea otters in PWS is growing at a rate of 8% /year. If this document is for public review, the whole scope of the ecosystem should be presented. The fact that the PI's only report on the oiled areas such as Knight Is. is not reflective of what the rest of the sound is doing. I would like to see more cross checking and local observations in the data presented regarding the actual numbers and growth rate of the sea otter population. As one villager said " If your house burned down, you wouldn't go and live in it, you would probably move somewhere else" The sea otter may have just moved to more productive feeding grounds.

On the second paragraph, I would like to add that sea otters are an important subsistence resource. On the recovery objective: I would like to see the TC investigate whether or not the sea otter population has returned to its "prespill abundance".

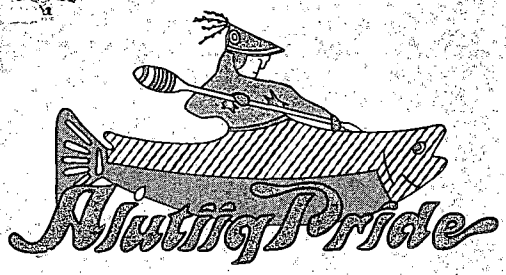
Please call me if you have any questions regarding my comments.

Thank you,

Monica Riedel

Monica Riedel,
Chair, ANHSC

c.c. Patty Brown Schwalenberg Exec. Dir.
Chugach Regional Resources Commission



Chugach Regional Resources Commission

January 25, 1996

Chenega Bay

Eyak

Nanwalek

Port Graham

Qutekcak Native Tribe

Tatitlek

Valdez Native Association

Ms. Molly McCammon, Executive Director
Exxon Valdez Oil Spill Trustee Council
Attention: Stan Senner
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Dear Molly,

After attending the 1996 Restoration Workshop, which was the first one I have attended, I must say that I was impressed with the number of research projects occurring in Prince William Sound under Trustee Council funding. I think its important that the local community members hear what's going on in the scientific community in regards to their resources and the scientific community in turn hear what the community perception is. I was glad to see a large number of Native participants at the workshop. I was especially pleased to see the initiative by the Trustee Council to incorporate traditional knowledge into the scientific research process.

In response to your request for input on the 1996 Work Plan, I have met with my Board of Directors and through discussions with them, am offering the following comments:

As you know, the main concern for CRRC has been the status of the Sea Otter, i.e. its continued listing as an "Injured Resource." In discussions with the community members and Native hunters in the villages affected by the oil spill, I must reiterate that this simply is not the case. I sat in on the presentation by Ms. Ballachey and Mr. Bodkin and listened carefully to their reasons for believing the sea otters are not recovering. From what I understand, the Sea Otter Study Methods they employed included demographic information, trophic level measures, and individual health measures. I can understand the findings of the individual health

4201 Tudor Centre Drive, Suite 211, Anchorage, Alaska 99508, 907 / 562-6647, FAX 907 / 562-4939

measures, but to study the population and food source in one particular area (Knight Island) and expect to come up with a conclusion for the entire Prince William Sound is beyond me.

Gary Kompkoff, who is a member of my board and Village Chief of Tatitlek, I believe, puts the sea otter status in the proper perspective when he said "If you go to a restaurant and there is a case of food poisoning, you wouldn't continue going to the same restaurant." The conclusion made by the traditional knowledge holders is that the sea otters have moved to other areas in Prince William Sound where the food source is more abundant and are proliferating at an alarming rate. Such proliferation has led to reduced shellfish, crab, sea urchins, and clams for subsistence use by the local people.

We must address these inconsistencies to implement a more reasonable management plan of action that will benefit both the sea otter management and local subsistence users. I would be happy to assist in including the traditional expertise in this management effort. Might I suggest the possibility of funding CRRC to conduct a population survey of sea otters in the Tatitlek and Chenega areas to further the research of this issue?

Thank you for the opportunity to comment on the FY96 Work Plan. Please feel free to contact me if you have any questions or wish to discuss this with me in more detail.

Sincerely,

Patty Brown-Schwalenberg

Patty Brown-Schwalenberg
Executive Director

[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,

In addition, local residents would like artifacts returned to the spill area when facilities are adequate to receive them.

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.

DATE: 1996-01-23 TIME: 11:09
FROM: MHS:jewett@ims.alaska.edu (Stephen C. Jewett)

X-MHSFile: APBBBAEC
TO: MHS:stans@evro.usa.com (Stan Senner)
MHS:jewett@ims.alaska.edu (Stephen Jewett)
SUBJECT: Recovery Objectives
PRIORITY:

Hi Stan,
Here is my revised draft that I also sent Pete to edit.
Stephen

SUBTIDAL COMMUNITIES

Injury and Recovery

Oil that was transported down to subtidal habitats apparently caused changes in the abundance and species composition of plant and animal populations below lower tides. Different habitats, including eelgrass beds, kelp beds, and adjacent nearshore waters (< 20 m), were compared at oiled and unoiled sites. The concentration of oil in sediments was more than twice as great at oiled sites. The greatest effects were detected at oiled sites with sandy sea bottoms in the vicinity of eelgrass beds, at which there were reduced diversity and abundance of eelgrass shoots and flowers, worms, clams, snails, oil-sensitive amphipods (sand fleas), and helmet crabs. Organisms living in sediment at depths of 3-20 meters were especially affected. Some opportunistic (stress tolerant) invertebrates within the substrate, mussels and worms on the eelgrass, and juvenile cod, apparently increased in numbers at oiled sites.

By 1993, oil concentrations in sediments had dropped considerably, so that there was little difference between oiled and unoiled sites. The eelgrass habitat, the only habitat examined, revealed fewer differences in abundances of plant and animals. However, there were still some animals that were more abundant at oiled sites, like those observed in 1990. These included the opportunistic worms and snails, mussels and worms on the eelgrass, and juvenile cod. Reconnaissance surveys indicated more small green sea urchins at oiled sites.

Preliminary results from eelgrass habitat in 1995 revealed that natural restoration had occurred. No difference was detected in abundance of eelgrass shoots and flowers, mussels on eelgrass, amphipods, helmet crabs, and dominant sea stars between oiled and unoiled sites. However, the abundance of small green sea urchin was more than ten times greater at oiled sites. The notion of increased urchins due to reduced sea otter predators is being examined in another study. Analyses of the sediment oil concentrations and organisms that live within the substrate is still pending.

Recovery Objective

Subtidal communities will have recovered when community composition in oiled areas, especially in association with eelgrass beds, is similar to that in unoiled areas. Indications of recovery are the return of oil-sensitive species, like amphipods and the reduction of opportunistic species at oiled sites.

Phillip R. Mundy, PhD
Fisheries and Aquatic Sciences
1015 Sher Lane
Lake Oswego, OR 97034-1744
503-636-6335, Voice or facs, auto-switch
Internet: mundy@teleport.com

January 29, 1996

Stan Senner
Exxon Valdez Oil Spill Trustee Council
Restoration Office
645 G Street
Anchorage, AK 99501
907-278-8012
800-283-7745

Via Facsimile: 510-373-7834

RE: **Restoration plan: herring, your draft of today**

Dear Stan:

The revisions in your draft look fine to me. My comments on the ecological context and the herring-pollock nexus are one and the same. Here goes:

Recovery of herring in PWS needs to be judged in an ecological context because of the potential for interaction between juvenile pollock and herring, and because we do not fully understand the origins and role of disease in recovery. SEA has shown that small pollock compete directly with small herring for the same food items, in the same time and place. Older pollock are predators on juvenile herring. If the oil spill reduced the size of herring populations and or contributed to a year class failure in 1989, this could have put the herring population, as a whole, at a competetive disadvantage to the pollock population, as a whole. Such a competitive advantage for pollock could lower the chances for a successful herring year class for years to come.

Since the herring fishery has been built around the phenomenon of a big herring year class every six or seven years, in an ecological context, the effects of the oil spill will have been clearly demonstrated to have ceased when the next highly successful year class recruits to the fishery. At this point concerns about intraspecific competition and the effects of disease will have been laid to rest. (interspecific)

Sincerely,
by fax

Phil Mundy

D:\AMS\1996\SENNER.WPD; January 29, 1996

Fisheries and Aquatic Sciences

FAX COVER SHEET

Monday, January 29, 1996 02:12:33 PM

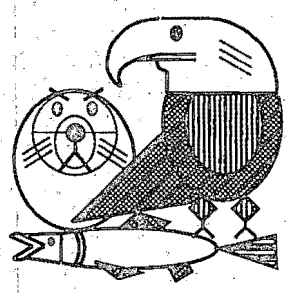
To: EVOSTC Restoration Office
Attention: Stan Senner
Fax #: 1 907 276 7178

From: Phillip R. Mundy, PhD
Fax #: 503-636-6335 autoswitch
Voice: 503-636-6335

Fax: 1 page and a cover page.

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



FAX COVER SHEET

FAX COMPLETE

To: Bob Spies / Phil Munday Number:

From: Stan Senner Date: 29 Jan '96

Comments: Total Pages: 3

Both of you mentioned something about competition and pollock in your comments on the injury description for herring. Would you help me out by suggesting a sentence? Also, Phil, you mentioned something about ecological context in the recovery objective, what did you have in mind? Otherwise, I've got this rewritten.

Document Sent By: K Hile

2/15/95

DRAFT

PACIFIC HERRING

Injury and Recovery

Pacific herring spawned in intertidal and subtidal habitats in Prince William Sound shortly after the oil spill. A significant fraction of these spawning habitats as well as herring staging areas in the sound were contaminated by oil. Field studies conducted in 1989 and 1990 documented increased rates of egg mortality and larval deformities in oiled versus unoiled areas. Subsequent 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.

The 1988 prespill year-class of Pacific herring was very strong in Prince William Sound, and, as a result, the peak estimated biomass of spawning adults in 1992 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.

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.

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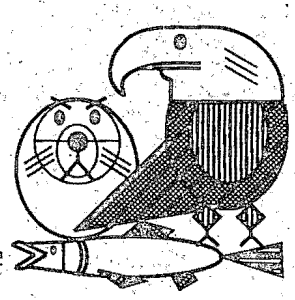

FAX COVER SHEET

To: Kathy Kuletz, USFWS Number:

From: Stan Senner Date: 29 Jan '96

Comments: Total Pages: 5

Here is what Dave Irons sent over and what I have down now as a revised draft. Please feel free to suggest additional improvements.

FAX COMPLETE

Document Sent By:

	Oiled Area	Overall
Kittiwake	100,579	268,512
PC Corm	823	1,558
Pelagic	529	7,161
Red-faced	5,[illegible]	8,967
Murrelet	8,696	3,667
Common	3,030	

2/15/95

revised from original document p. 13.

DRAFT

Recommendations for Revised Recovery Objectives of Restoration Plan
January 1996

Marbled and Kittlitz's Murrelets

These two should be addressed separately. Currently, no other bird species are lumped in the restoration plan. Additionally, there are differences between the species that may require that they be addressed differently. For example, the marbled murrelet is listed as 'Not Recovering' whereas the Kittlitz's murrelet is 'Recovery Unknown', and no recovery objective can be identified for Kittlitz's.

Marbled murrelets have been studied since restoration activities began, whereas our knowledge of Kittlitz's is about where it was for marbled's at the time of the spill. Although data on Kittlitz's was gathered wherever possible during the MAMU studies, Kittlitz's were not targeted and references to them were removed from proposals and reports at the request of reviewers, to maintain focus on the marbled murrelet.

The marbled murrelet is distributed throughout Prince William Sound and the rest of the spill zone, and is relatively abundant. The Kittlitz's is rare, highly localized and appears to have very restricted marine habitat preferences, which will likely require different study designs and methods. I suggest the following:

Marbled Murrelets

Injury and Recovery

The northern Gulf of Alaska, including PWS, is a key area in the distribution of marbled murrelets. The marbled murrelet is federally listed as a Threatened species in WA OR and CA; it is also listed as Threatened in BC.

The marbled murrelet populations in PWS were in decline before the spill. The causes of the pre spill decline are unknown, but may be related to changing food supplies. The oil spill probably increased the rate of decline for this species in the spill area, although the incremental injury is difficult to estimate. Carcasses of nearly 1,100 Brachyramphus murrelets were found after the spill, with 91% of identified murrelets being marbled murrelets. It is estimated that as much as 7% of the mamu population in the spill zone was killed by the spill. Population estimates for murrelets are highly variable, and post spill boat surveys do not yet indicate any statistically significant increase in numbers of mamu in PWS.

Recovery Objective

Marbled murrelets will have recovered when population trends and indicators of productivity are stable or increasing.

Kittlitz's Murrelet

Injury and Recovery

The Kittlitz's murrelet is endemic to Alaska, and a large portion of the world population, believed to number only a few tens of thousands, breeds in PWS.

Because boat surveys usually lump both *Brachyramphus* species (marbled and Kittlitz's), and *Brachyramphus* species were in decline before the spill, it is possible that Kittlitz's murrelets were in decline. The causes of the pre spill decline are unknown, but may be related to changing food supplies or changes in the distribution of tidewater glaciers in recent decades.

The oil spill killed an estimated minimum of 500 Kittlitz's murrelets, which although small in numbers, could represent a large portion of the world population. Because of the highly patchy distribution of Kittlitz's murrelets, and the difficulty identifying them in the field, population data is variable. However, there is no indication of an increase in *Brachyramphus* murrelets in PWS since the spill. Therefore, the recovery status of Kittlitz's murrelet is not known.

Recovery Objective
No recovery objective can be identified for Kittlitz's murrelet at this time.

DRAFT

Kittlitz's Murrelet

Injury and Recovery

The Kittlitz's murrelet is endemic [strictly speaking, is this true?] to Alaska, and a large portion of the world population, which may number only a few tens of thousands, breeds in Prince William Sound. The Kenai Peninsula coast and Kachemak Bay are also important concentration areas for this species. Very little is known about Kittlitz's murrelets. However, they associate closely with tidewater glaciers and nest on scree slopes and similar sites on the ground.

Seventy-two Kittlitz's murrelets were positively identified among the bird carcasses recovered after the oil spill. Nearly 450 more *Brachyramphus* murrelets were not identified to the species level, and it is reasonable to assume that some of these were Kittlitz's. In addition, many more murrelets were killed by the oil than were actually recovered. One published estimate places direct mortality of Kittlitz's murrelets from the oil spill at 1,000-2,000 individuals, which would represent a substantial fraction of the world population.

Because of the highly patchy distribution of Kittlitz's murrelet, the difficulty of identifying them in the field, and the fact that so little is known about this species, the recovery status of the Kittlitz's murrelet is not known. The Trustee Council has funded an exploratory study on the ecology and distribution of this murrelet starting in 1996.

Recovery Objective

No recovery objective can be identified for Kittlitz's murrelet at this time.

Marbled Murrelet

Injury and Recovery

The northern Gulf of Alaska, including Prince William Sound, is a key areas in the distribution of marbled murrelets. 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 population in Prince William Sound had declined before the oil spill. The causes of the prespill decline are unknown, but may be related to changing food supplies. It is not known whether the murrelet population was still declining at the time of the oil spill, but the spill caused additional losses of murrelets. Carcasses of nearly 1,100 *Brachyramphus* murrelets were found after the spill, and about 90 percent of the murrelets that could be identified were marbled murrelets. Many more murrelets were killed by the oil than were actually, and it is estimated that as much as 7 percent of the marbled murrelet population in Prince William Sound was killed by the spill.

Population estimates for murrelets are highly variable. Postspill boat surveys do not yet indicate any statistically significant increase in numbers of marbled murrelets in Prince William Sound. Nor is there evidence of any further decline.

Recovery Objective

Marbled murrelets will have recovered when population trends are stable or increasing. Stable or increasing productivity will be one indication that recovery is underway.

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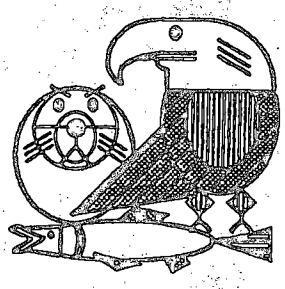

MEMORANDUM

TO: Stan S.

FROM: Bob Loeffler

SUBJECT: Workshop Notes: Intertidal Concurrent Session

DATE: January 19, 1996

Bob Loeffler was the facilitator for the Intertidal Concurrent Session. Pete Peterson was the reviewer. We covered the following resources: mussels, sediments, intertidal organisms, subtidal organisms, and clams. Approximately a dozen people attended.

MUSSELS. *Status.* The group was comfortable with the classification of "Recovering."
Recovery Objective

- The objective is "no oil." The group felt that complete recovery required more than that mussels were not contaminants. We had a long discussion about the fact that the presence of oil an important to insult to people's shorelines, national parks, etc. Pete and others said that when they meet people who are not part of the process, the first question is often, "Is there still oil out there." Those who had attended the Residual Oiling Workshop talked about the strong feeling by native groups that any noticeable oil is an insult. Thus, the group felt that the objective should be when "concentrations of oil reach background levels." The fact that the objective is "no oil" does not mean we should do anything about it (especially once it isn't contaminating predators), but the world isn't recovered until the oil is gone.

- Subsistence (and Other?) Use. The group also felt that the contamination clauses should remain but that "does not affect subsistence use" should be added. They felt that the oil in the mussel beds remains an insult to subsistence (and other?) users.

- Reference to sediment under mussels. Some people requested that their should be some reference to the sediment under the mussel beds, because that is where the oil really is. The group seemed to agree.

- An Attempt. While we did not try to wordsmith the objective, here is this notetaker's try: "Mussels will have recovered when the concentration of oil in the mussels or in the sediments below the mussel beds reach background levels, do not contaminate the mussels' predators, and do not affect subsistence or other shoreline use."

Injury and Recovery.

- Update to include 1995 results. Maline (and Pete) said that the write-up does not reflect Maline's latest findings, and that we should update it. Maline said that we can get the info from the abstract she submitted for the workshop. Specifically, we should reference the results of the '94 clean-up as found out in 1995. We should also describe that the concentrations of oil in mussel beds had decreased between 1992 to 1995.

- Population and productivity. There was also a discussion of whether the write-up or recovery objective should reference the findings about a decrease in population and productivity of the mussels. After some discussion, the group felt that, as yet, we don't have any real findings to report, but that after looking at the data a little more, we may. If and when we do, the info on that subject should be added to the write-up and perhaps to the recovery objective.

SEDIMENT. *Status.* Recovering is fine.

Recovery Objective. Same basic comments as for Mussels.

- Objective is no oil. People thought that aiming only for a decline in subsurface oil is a seriously weird objective. They felt that it should be all EVOS oil — surface and subsurface — and that it should be all gone before we say its completely recovered. They didn't think we should necessarily do anything about it, but the public will not tolerate significant subsurface pools, sheening, asphalt, etc and having us say, "All recovered!"

- Subsistence (and other?) use. As with mussels, the group felt that the contamination clauses should remain but that "does not affect subsistence use" should be added. They felt that the oil remains an insult to subsistence (and other?) users.

- Sheltered sites. They group felt that we could keep sheltered sites as, say, a "such as" location, but it should not be the focus of the objective. That is, it could be a "special focus area" but not the complete focus.

- An attempt. While we did not try to wordsmith the objective, here is this notetaker's try: "Sediments will have recovered when significant concentrations of residual shoreline oil are reduced to background levels, and the oil no longer affects the ecosystem and no longer affects subsistence or other shoreline use."

Injury and Recovery.

- The general public. The reference to "great concern to residents in oil-spill communities" should be widened to the broader public.

- Beach geomorphology. There was a long discussion, prompted in part by Alan Mearns, about the fact that beach geomorphology was changed by cleanup activities (sediment structure and beach profile), and that the beaches have, in many cases, not re-established themselves. The best examples are the storm berms that were relocated into tidal areas (to rid themselves of oil). Point Helen is a good example of a storm berm that was removed, and has not yet re-established itself on the beach. Another example is that many of the fine sediments were washed off some beaches (which is why clams are not re-establishing themselves), and they have not come back yet on some beaches. Some people in the group thought there was good

before and after data through DEC's, Jacqui Michelle's, and Alan Mearns's work. Others weren't so shore. In any case, the group agreed that the info may not need to be in the recovery objective, but could be included in the injury and recovery write-up.

INTERTIDAL ORGANISMS. *Status.* There was a long discussion about the fact that not all intertidal areas are recovering. Peter Van T? said that the CHIA study, last done in 1991 indicated that estuarine areas are *not* recovering. And that we don't have any data since 1991 to dispute that conclusion. After some discussion, Pete Peterson suggested putting (most) after recovering, and putting "a few" or "estuarine sites" into recovery unknown.

Name Change. People suggested changing "Intertidal Organisms" to "Intertidal Communities." They suggested this because it was not the discussion of "hermit crabs, versus marine worms, versus etc. that we were really discussing but the community as a whole.

Recovery Objective. Another indication of recovery is the convergency of oiled and unoiled sites. This could be tacked onto the last part of the existing recovery objective.

Injury and Recovery. There was some discussion that especially the second paragraph of the write-up was significantly out of date. Pete Peterson and Peter Van T? said they'd draft a revision for myself or Stan.

SUBTIDAL ORGANISMS. *Status.* People thought that it was fine as recovering, but perhaps should be "Recovered except for urchins and another organism that the notetaker can't remember."

Name Change. People suggested changing "Subtidal Organisms" to "Subtidal Communities." They suggested this for the same reasons as given for the Intertidal Organisms/Community change.

Recovery Objective. Group thought that it needs a wholesale revision because, for the most part, the communities have recovered, except for urchins and another organism. The recovery objective doesn't indicate that. Steve Jewitt and Pete Peterson will work up some language for Stan & etc. to consider.

Injury and Recovery. Same as objective. The write-up drastically needs updating. It needs to give the overall message that recovery has mostly occurred. Steve Jewitt and Pete Peterson will work up some language for Stan & etc. to consider.

CLAMS. *Status.* Fine as recovery unknown.

Recovery Objective. Bob noted that the objective was significantly wimpy and would be helped by the addition of something less generic, perhaps some indications that recovery was occurring. Group thought that "Indications that recovery is occurring include re-establishment of natural levels of recruitment." could be added to the objective.

Injury and Recovery. In last sentence, add PWS to the list of areas. Add to the description of impacts, something about decreased density and recruitment, and the loss of fine sediments on the beaches.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Rd.
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

MIGRATORY BIRD MANAGEMENT

FAX COVER SHEET

FAX (907) 786-3641

Date: 29 Jan '96

To: Stan Senner, EVOS Restoration office Fax No. 276-7178

From: Kathy Kuletz

Number of Pages: 2

If all pages are not received, please contact: 786-3453
at (907) 786-3443 or 786-3444.

Message: Dave sent everything I'd typed up (it was a rough draft). Your changes look good to me - there are some clarifications I include on the following page. The damage assessment (656) discussion, the oil spill mortality & interpretation of numbers.

Thanks,

Kathy

DRAFT

Kittlitz's Murrelet

only found in Alaska + portions of the Russian Far east.

Injury and Recovery

The Kittlitz's murrelet is ~~endemic (strictly speaking, is this true?) to Alaska~~, and a large portion of the world population, which may number only a few tens of thousands, breeds in Prince William Sound. The Kenai Peninsula coast and Kachemak Bay are also important concentration areas for this species. Very little is known about Kittlitz's murrelets. However, they associate closely with tidewater glaciers and nest on scree slopes and similar sites on the ground.

Seventy-two Kittlitz's murrelets were positively identified among the bird carcasses recovered after the oil spill. Nearly 450 more *Brachyramphus* murrelets were not identified to the species level, and it is reasonable to assume that some of these were Kittlitz's. In addition, many more murrelets were killed by the oil than were actually recovered. One published estimate places direct mortality of Kittlitz's murrelets from the oil spill at 1,000-2,000 individuals, which would represent a substantial fraction of the world population.

Because of the highly patchy distribution of Kittlitz's murrelet, the difficulty of identifying them in the field, and the fact that so little is known about this species, the recovery status of the Kittlitz's murrelet is not known. The Trustee Council has funded an exploratory study on the ecology and distribution of this murrelet starting in 1998.

Recovery Objective

No recovery objective can be identified for Kittlitz's murrelet at this time.

Marbled Murrelet

Injury and Recovery

The northern Gulf of Alaska, including Prince William Sound, is a key area ? in the distribution of marbled murrelets. 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 population in Prince William Sound had declined before the oil spill. The causes of the prespill decline are unknown, but may be related to changing food supplies. It is not known whether the murrelet population was still declining at the time of the oil spill, but the spill caused additional losses of murrelets. Carcasses of nearly 1,100 *Brachyramphus* murrelets were found after the spill, and about 90 percent of the murrelets that could be identified were marbled murrelets. Many more murrelets were killed by the oil than were actually found and it is estimated that as much as 7 percent of the marbled murrelet population in ~~Prince William Sound~~ The spill zone was killed by the spill. *

* At ≃ 900 killed in PWS, + ≃ 100,000 total, only ≃ 1% of PWS Pop. killed. But - likely that many of PWS birds were killed further South as fate of the spill.

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FAX COVER SHEET

To: Monica Riedel Number: 907-424-5883

From: Stan Senner Date: 29 Jan '96

Comments: Total Pages: 2

We are continuing to work on revisions to the harbor seal language in the revised version of Chptr. 5 that was discussed at the workshop. I received your letter dated 24 January and wanted you to see the latest draft. We do not think that we should eliminate reference to subsistence hunting, but do believe that it should more carefully be put into context. I hope this draft is an improvement.

Document Sent By: FAX COMPLETE

2/15/95

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. Estimated mortality as a direct result of the oil spill was about 300 seals in oiled parts of Prince William Sound. Based on comparisons of surveys in 1988 and then in 1989 after the oil spill, seals in oiled areas had declined by 43 percent, compared to 11 percent in unoiled areas.

When a population declines it means that deaths exceed births, and harbor 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. Changes in the amount or quality of food may have been an initial cause of this long-term decline. Although there is no evidence that such factors as predation by killer whales, subsistence hunting, and interactions with commerical fisheries caused the decline in the harbor seal population, these are among the on-going sources of mortality.

Harbor seals have long been and continue to be a key subsistence resource in the oil-spill area. Subsistence hunting is affected by the declining seal population, and lack of opportunities to hunt seals has changed the diets of subsistence users who traditionally had relied heavily on these marine mammals.

Recovery Objective

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

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MEMORANDUM

To: Restoration Liaisons, Work Force, and Legal Counsel

From Molly McCammon, Executive Director

Date: February 2, 1996

Subj: Revised Chapter 5

We have completed a revised version of Chapter 5 of the *Restoration Plan* that incorporates comments received at the 1996 Restoration Workshop. However, final recommendations on the addition of cormorants, scoters, and kittiwakes to the injured resources list have note yet been incorporated into it. Given that you already have several other items (e.g., 1997 Invitation) to review, I have decided to delay giving you the Chapter 5 revisions until Friday, February 9. This will not have any bearing on the scheduled release of the 1997 Invitation, and should only mean a delay of 10 days in circulating Chapter 5 for public comment (most of them were to be mailed separately anyway).

Please remember the Restoration Work Force meeting scheduled for 11 a.m. on Monday morning. This meeting will be followed by Bob Loeffler's farewell luncheon. Thank you.

Contingent valuation studies conducted by the State of Alaska for the *Exxon Valdez* oil spill litigation measured substantial lost passive use values resulting from the oil spill.

Post-it® Fax Note 7671	Date 2/7/96	# of pages ▶ 1
To Stan Senner	From Alex Swiderski	
Co./Dept.	Co. Attorney General's Office	
Phone #	Phone # 269-5275	
Fax # 276-7178	Fax # 278-7022	

Exxon Valdez Oil Spill Trustee Council

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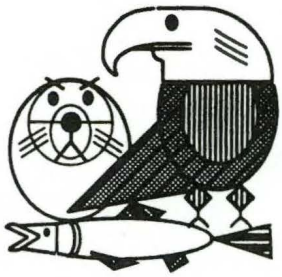

MEMORANDUM

To: Steve Jewett
Peter van Tamelen
Jim Bodkin
Craig Matkin
Kathy Frost

From: Stan Senner
Science Coordinator

Date: January 22, 1996

Subj: Revisions to Recovery Objectives

(copy went to R file)
FAX COMPLETE

I understand that in the break-out sessions on recovery objectives at the Restoration Workshop last week, you volunteered to revise or draft new language regarding the Injury and Recovery Status of various resources injured by the oil spill.

I am working on another round of revisions to Chapter 5 this week. If it is possible to get me your suggestions now, preferably by close of business on Thursday, January 25, that would be most useful. If not, please send your suggestions anyway, because these revisions will almost certainly go through one more iteration after this week before going out for public comment in mid-February.

For Peter and Steve, please send me your drafts concurrently with whatever you send to Pete Peterson, with whom I discussed this before he left for North Carolina.

My e-mail address is: stans@evro.usa.com. My fax number is 907-276-7178.

Any suggestions you can make will be considered seriously and greatly appreciated.

Thank you.

PS: It was good to see you at the Restoration Workshop.

Workshop flipcharts

GENERAL

MAMMALS

-use of data that is not certain... general statement re: "best numbers available" or other appropriate qualification--

-appropriate use of "not recovering" -- *e.g.* seaotters

-"not recovered" vs. "not recovering"

-?combine: "not recovered" and "not recovering"-?

-Concern: "still declining"

FOOTNOTES!!!

FISH

(Need Spies' flip-charts.)

HARBOR SEAL

-"6 - 15% of pre-spill population" isn't supported with hard data--- drop this phrase.

-Skin hunting is a concern.

-Seals have always come back (from hunting experience).

-Hunting effort is less now.

-Killer whales increasing.

-Suggestion: "may be affecting" should be struck in regards to subsistence.

-Reference to 300 killed in PWS should be made more specific as to location.

KILLER WHALE

-About 100, in 6 resident pods...

-Too much emphasis focused on AB pod.

-Question of what's a "population" of killer whales?

-Overall numbers may be the same (pre- and post-) but not the whole story--- resident vs. transient; breakdown of the AB pod.

-Great interest by public.

-In social spp. (wolves/lions/killer whales), "population" dynamics and social structure are inextricably linked.

-Add language regarding AT group (not pod) dynamics; drop parentheses (AB pod)...

-Other resident pods increasing.

RIVER OTTER

-Remove Montague, insert Jackpot Bay.

-Add: actual mortality unknown.

SEA OTTERS

-Recovery Objective should address prey resources (Question: addressed under intertidal resources?)

-10,000 is very general... (range instead?) ...approximately 8,000 - 15,000.

-7,700 number... bias (undetected number).

-"Expanding" population? (Not clear.)

-Should distinguish within the area (population increase/population decrease).

-Sea otters' subsistence importance should be noted.

SUBSISTENCE

1) Objectives "exist at pre-spill levels." Delete

2) More money to subsistence projects and direct restoration. Hire locals.

3) Add crab and shrimp to Injured List.

4) Change procurement so money can go straight to villages.

5) DPD--- require local involvement and local post-project evaluation.

6) Describe injury and status by community/area.

7) Protect subsistence on lands Trustees buy.

8) ~~In any~~ Injury / Recovery Description: Make clear injured resources are not available for use. Harvest levels have not returned to pre-spill levels in all areas.

9) Let locals conduct surveys.

10) Residual oil--- keep as a strategy.

ARCHAEOLOGY

1) Local residents would like return of artifacts to local repositories.

2) Instruct all PIs how to handle artifacts they might come across in their research.

3) Expand site stewardship.

4) Include youth in monitoring project Summer '96.

5) Written interpretation of artifacts found--- share with locals; include local history.

RECREATION/TOURISM

1) Local people as guides, source of knowledge.

2) Impact of tour boats on injured resources--- source of injury/and interference with subsistence users.

DESIGNATED WILDERNESS

1) Want designated subsistence area within; ensure subsistence an allowed use.

PASSIVE USE

1) Spiritual value of resources to traditional users.

BIRDS

*Bald Eagles - Pre-spill increase in Kodiak area.

*Separate Kittitz's/Marbled accounts.

*Murres - not just based on Barren Island.

*Harlequin - taking into account geographic difference and mention "survival"?

*Marbled Murrelet - add more biologic indicators - productivity index?

*Pigeon gullemot - drop PWS, add biologic indicators?

3517
Vivian Mendenhall
786-3691

Russ Oates
786-3443

Shawn Stevenson
colony by colony
or by region

Deb Rudis
586-7240

Bruce Conant 586-7244
USFWS
Waterfowl

Chris Dau 532-2445
USFWS
Izembek