RPWG
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To: RPWG members and staff
From: John Strand

8/18/92

Potential Themes for Draft Alternatives

The subgroup working on the evaluation criteria has developed an initial list of alternative themes. After some discussion, we believe that it may be useful and quicker to try an internal RPWG exercise to get discussion off to a fast start. We hope you a willing to "play" along?

Below is the list. We ask that you fill in your definition of these themes. We recommend only a few sentences or bullets. Also, add other theme titles and their descriptions at the end. Finally, consider which should be deleted or combined and why?

Please return this to John Strand by **noon August 19th**. I will be scheduling a meeting to discuss draft themes later in the day. Thanks.

Potential Themes:

1. No Manipulation of the Environment
   (write in your description here)

2. Manipulation/Enhancement

3. Immediate Restoration

4. Natural Recovery (No Action)

5. Combination

6. Habitat Acquisition and Protection

7. "Chosen" Resources and Services

8. Others:

RESTORATION PLANNING WORK GROUP
AUGUST 19, 1992
10:00 a.m.

Attendees:

Bob Loeffler
Mark Fraker
Cathy Berg
Karen Klinge
John Strand
Art Weiner

The following items were discussed:

Interim products will be provided to the Restoration Team. RPWG will meet with the Restoration Team on August 26, and if necessary, August 27. Pam Bergmann gave John a heads up that a memo would be forwarded to RPWG from Curt McVee. Art proposed adding the strategic direction for developing a plan to the agenda. RPWG should prepare their rathers for discussion. The EIS contract is now up in the air. Karen stated she would not like to be in the position of having to write the EIS. RPWG should continue doing what we do. Art suggested Cathy get a legal opinion for the ground rules of what can be done barring an EIS.

Curt McVee's letter will be distributed to determine the next stop in the process. John suggested that RPWG could work on the themes and also will proceed with the evaluation process. Ward will give a demonstration of the network at 1:00 when RPWG reconvenes.

Note: Due to a volcano eruption, the afternoon meeting was canceled.

RESTORATION PLANNING WORK GROUP
AUGUST 20, 1992
9:00 a.m.

Attendees:

Bob Loeffler
Mark Fraker
Cathy Berg
Karen Klinge
John Strand
Sandy Rabinowitch

The following items were distributed:

Potential Themes for Draft Alternatives
Memo to Regional Environmental Assistant - August 13, 1992
Options Rating Form
Species Summaries

SCHEDULE

John stated the draft annotated outline needs to be completed today. RPWG requested support from CACI staff to make revisions to the outline. Also, some work will be done on the themes to be presented at the next meeting with the Restoration Team on the 26th. Bob had an idea for most efficiently dealing with the theme issue and suggested everyone complete their exercise, hand it to one person who will collate them into a variety of ideas and come up with a range of things. John stated that this exercise could be done today and brought back to the group tomorrow for discussion. Mark raised the idea of combination themes where emphasis is placed on manipulation enhancement or habitat acquisition. He asked how the EIS would analyze something like this and if you really have something you can distinguish. Bob questioned if there is a need to distinguish.

RPWG began the following evaluation exercise for each resource and service:

RESOURCE OR SERVICE: Sea Otter
Suboption 4C

1. Potential to improve the rate or degree of recovery
Low; haulouts are widely scattered
2. Technical feasibility
Low, difficult to do because of complications of who has legal jurisdiction
3. Degree to which proposed action benefits more than one resource or service
Low; benefits only sea otters but may be incidental for other

species
4. Measurement of results
Low;
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
Medium; there could be an impact on services but it is not major or long-term; there is some impact on the prey items that sea otters eat; depends on the regulations along with the designation that there could be limited tour access or restricted fishing
6. Potential effects of the action on human health and safety
High; self-evident
7. The relationship of the expected costs of the proposed action to the expected benefits
Low; no outstanding benefits; no high costs
8. Degree to which proposed action enhances the resource or service
No, will not enhance
9. Will the restoration opportunity be lost if implementation of the option is delayed
No restoration opportunity will be lost
10. Public comments
No rating

RESOURCE OR SERVICE: Sea Otters
Option 7

1. Potential to improve the rate or degree of recovery
2. Technical feasibility
3. Degree to which proposed action benefits more than one resource or service
4. Measurement of results
5. Potential for NO additional injury to:
-other target or nontarget resources
-other target or nontarget services
6. Potential effects of the action on human health and safety
7. The relationship of the expected costs of the proposed action to the expected benefits
8. Degree to which proposed action enhances the resource or service
9. Will the restoration opportunity be lost if implementation of the option is delayed
10. Public comments

RESOURCE OR SERVICE: Sea Otters
Option 8A

1. Potential to improve the rate or degree of recovery
Medium; could have a large improvement over a very small area;

localized recovery
2. Technical feasibility
Low;
3. Degree to which proposed action benefits more than one resource or service
Low;
4. Measurement of results
Low; don't know what extent they are being harvested
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
Low; if it could be implemented
6. Potential effects of the action on human health and safety
High;
7. The relationship of the expected costs of the proposed action to the expected benefits
Low; there is expense in proving the population is depleted which will give the ability to restrict harvest (high costs)
8. Degree to which proposed action enhances the resource or service
No;
9. Will the restoration opportunity be lost if implementation of the option is delayed
No;
10. Public comments
No rating

RESOURCE OR SERVICE: Sea Otters
Option 8B

1. Potential to improve the rate or degree of recovery
Medium;
2. Technical feasibility
Medium;
3. Degree to which proposed action benefits more than one resource or service
Low; benefits one resource
4. Measurement of results
Low;
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
Medium; additional injury would be minor; short-term
6. Potential effects of the action on human health and safety
High;
7. The relationship of the expected costs of the proposed action to the expected benefits
Medium;
8. Degree to which proposed action enhances the resource or

service
No;
9. Will the restoration opportunity be lost if implementation of the option is delayed
No;
10. Public comments
No rating

RESOURCE OR SERVICE: Sea Otters
Option 13

1. Potential to improve the rate or degree of recovery
Unknown; there is a correlation between oil and the causes to increased mortality; direct causation and linkage is not proven
2. Technical feasibility
High;
3. Degree to which proposed action benefits more than one resource or service
High; because cleaning mussels supports multiple resources
4. Measurement of results
High;
5. Potential for NO additional injury to:
-other target or nontarget resources
Medium;
-other target or nontarget services
High;
6. Potential effects of the action on human health and safety
Medium; occupational hazards
7. The relationship of the expected costs of the proposed action to the expected benefits
Unknown; cost is high but benefit unknown; linkage is not certain; logistics is expensive
8. Degree to which proposed action enhances the resource or service
No;
9. Will the restoration opportunity be lost if implementation of the option is delayed
No;
10. Public comments
No rating

RESOURCE OR SERVICE: Sea Otters
Option 20A

1. Potential to improve the rate or degree of recovery
2. Technical feasibility
3. Degree to which proposed action benefits more than one resource or service
4. Measurement of results
5. Potential for NO additional injury to:

-other target or nontarget resources
-other target or nontarget services

6. Potential effects of the action on human health and safety
7. The relationship of the expected costs of the proposed action to the expected benefits
8. Degree to which proposed action enhances the resource or service
9. Will the restoration opportunity be lost if implementation of the option is delayed
10. Public comments

Meeting adjourned at 12:00 and will reconvene at 1:30.

NOTE: Barbara attended a managers meeting from 1:30 to 3:00. No notes were taken.

RESOURCE OR SERVICE: Marbled Murrelet
Option 9

1. Potential to improve the rate or degree of recovery
Low;
2. Technical feasibility
? Karen will check cites
3. Degree to which proposed action benefits more than one resource or service
Low;
4. Measurement of results
High;
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
Low;
6. Potential effects of the action on human health and safety
High;
7. The relationship of the expected costs of the proposed action to the expected benefits
Low; could cost a lot if night fishing is stopped
8. Degree to which proposed action enhances the resource or service
Yes;
9. Will the restoration opportunity be lost if implementation of the option is delayed
No;
10. Public comments
No rating

RESOURCE OR SERVICE: Marbled Murrelet
Option 17 (programmatic for sea birds)

1. Potential to improve the rate or degree of recovery

High;
2. Technical feasibility
High; has been done
3. Degree to which proposed action benefits more than one resource or service
High; because of the broad scale of destruction
4. Measurement of results
High;
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
High;
6. Potential effects of the action on human health and safety
High; increased risk because of firearms and poison bait
7. The relationship of the expected costs of the proposed action to the expected benefits
High;
8. Degree to which proposed action enhances the resource or service
No; replaces but does not enhance
9. Will the restoration opportunity be lost if implementation of the option is delayed
No;
10. Public comments
No rating

RESOURCE OR SERVICE: Marbled Murrelet
Option 20, 22, 36 (could be a recommendation to existing managers)

1. Potential to improve the rate or degree of recovery
Medium; especially if public land
2. Technical feasibility
High;
3. Degree to which proposed action benefits more than one resource or service
High; benefitting multiple species
4. Measurement of results
Low;
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
Low; (taking the service most severely affected)
6. Potential effects of the action on human health and safety
High;
7. The relationship of the expected costs of the proposed action to the expected benefits
Medium; high benefits and high costs
8. Degree to which proposed action enhances the resource or service

No;
9. Will the restoration opportunity be lost if implementation of the option is delayed
No;
10. Public comments
No rating

RESOURCE OR SERVICE: Marbled Murrelet
Option 37

1. Potential to improve the rate or degree of recovery
Medium;
2. Technical feasibility
High;
3. Degree to which proposed action benefits more than one resource or service
High;
4. Measurement of results
Low;
5. Potential for NO additional injury to:
-other target or nontarget resources
High;
-other target or nontarget services
Low;
6. Potential effects of the action on human health and safety
High;
7. The relationship of the expected costs of the proposed action to the expected benefits
Low;
8. Degree to which proposed action enhances the resource or service
No;
9. Will the restoration opportunity be lost if implementation of the option is delayed
Yes; if imminent threat
10. Public comments
Yes;

RESOURCE OR SERVICE: Marbled Murrelet
Option 31, 32, 33 - programmatic options, do not have to rate

1. Potential to improve the rate or degree of recovery
2. Technical feasibility
3. Degree to which proposed action benefits more than one resource or service
4. Measurement of results
5. Potential for NO additional injury to:
-other target or nontarget resources
-other target or nontarget services
6. Potential effects of the action on human health and safety

7. The relationship of the expected costs of the proposed action to the expected benefits
8. Degree to which proposed action enhances the resource or service
9. Will the restoration opportunity be lost if implementation of the option is delayed
10. Public comments

Meeting adjourned at 5:00. Themes and annotated outline will be discussed in the morning. The remaining species and services will be evaluated also.

AUGUST 21, 1992
9:15 a.m.

Attendees:

Bob Loeffler
John Strand
Art Weiner
Mark Fraker
Sandy Rabinowitch

The following items were distributed:

Memo Re: Potential Themes for Draft Alternatives - 8/18/92
Potential Themes for Draft Alternatives - 8/20/92
Bob's alternative table

ANNOTATED OUTLINE

John and Sandy prepared a response to the DOI comments on the annotated outline. Suggested changes which RPWG agreed with are in all capital letters. The cover letter states that RPWG does not agree with all the changes, and it addresses whether comments were accepted or rejected. Art suggested adding between sections 3 and 4 a theoretical overview diagraming the conceptual overview of how everything works. This would basically be a process section. Bob stated that this is captured in the introduction. Art questioned if the list of PAG members is necessary and felt a list of the interest groups represented will be more important. Sandy and John will finalize the outline and cover letter for distribution.

SCHEDULE

John asked for someone to act as RPWG spokesman in his absence during the September Trustee Council meeting.

THEMES

John asked for suggestions for boiling down themes. Sandy stated he condensed each RPWG member's ideas for potential themes by eliminating duplication but not any conflicts. Art asked what a theme is. Bob stated it is a short title for reference, a paragraph that gives the logical description of the collection of options (flavor) and expresses the logic used to put the options together. Art stated that these are essentially the beginning of the rules. Sandy stated that in meshing the group's ideas for themes, he found that quite a few things were agreed on. However, as individuals we were not thoroughly inclusive. #4 - Natural Recovery needs to be explicit. Bob designed a table which will compliment the evaluation process and help to determine whether each alternative is an implication of all the options. This table also ensures that nothing is missed. Art stated that if an option

keeps showing up, it would appear to be something we should go with. Art also stated we should not get too hung up on the form because the most important thing is the logic behind the sort. Bob stated that monitoring and endowment are separate categories and require a separate decision. Art suggested a theme where we monitor, study and educate. Sandy stated that Mark's perspective on natural recovery was no expenditure of funds. There is a lot of room for a judgement call on this and RPWG must figure out where to draw the line. Sandy argued that according to the NRDA regs., natural recovery is not a specific do nothing alternative but does include monitoring. The ideas for potential themes were discussed as follows:

No Action - Sandy stated monitoring is included. "No expenditure of funds" is illogical because monitoring is included and costs money. RPWG may add a statement on a limitation on monitoring. "Assumes that natural resources and services will recover without human intervention" is a good statement of natural recovery and can be combined with "nothing done beyond pre-spill management activities". The statements, "don't manipulate and don't buy land," are inconsistent and unnecessary. "Includes management of human uses" could be added to "nothing beyond pre-spill management activities".

Protected Natural Recovery (replaces Habitat Acquisition and Protection) - Art stated that Brian Sharp stated the framework doesn't identify what will be done while natural recovery takes place to prevent additional injury. Art suggested adding "natural recovery with actions directed to prevent additional injury" as a bullet under habitat acquisition and protection. Bob suggested condensing this to natural recovery with protection. This alternative would have two thrusts: natural recovery and protection action over and above what is normally done, i.e. habitat protection. A key is protection from further degradation to injured resources and services. Bob added you would do direct manipulation or replacement when the recovery is less than adequate. Bob questioned if land would be purchased for purposes of recreation. Art stated if there was injury to recreation, why can't land be bought to build cabins with the assumption that everything has recovered.

Immediate Restoration - John asked if the idea of trying to fix all resources and services that need fixing immediately was captured. Sandy stated the crux of this alternative is using every penny you can get your hands on and doing everything scientifically feasible. Sandy stated that this bullet could be dropped. Bob stated the title, "Immediate Restoration", does not capture maximum physical restoration that doesn't hurt the humans. Increased management hurts the humans. John stated he takes exception with thinking any type of recovery can be effected in 5 years. He likes the idea of doing things quickly if there is immediacy. Sandy suggested adding to the "combination" doing all that is scientifically possible,

taking all the money and doing things that have potential for success. Bob suggested "Maximum Restoration" as an alternative which captures the above. Art suggested "Maximum Direct Restoration". "Immediate Restoration" is deleted and will be captured under "combination".

The five year idea is deleted. Bob suggested reimbursement should be considered with funding. The definition of "economically" will be discussed later. "Scientifically" may go with technically feasible. Sandy stated the concept is to bring the curve up now. Art stated the first sort should be the most money for the most cost effective option ASAP. The sorts could be started pretty wide until you get to what you want.

Maximum Direct Restoration - Art suggested adding "do all options with the highest (medium and high) potential to approve rate or degree of recovery that are technically feasible (cost effective)". Sandy suggested adding ASAP to stress hurrying up. Bob suggested this title should be "Prioritize Maximum Restoration". Bob stated we should do everything we can to do the most effective. Sandy suggested adding the notion that when you prioritize, you have to go to the list of injured resources and services and have the experts determine what needs to be done first. John stated the focus should be on resources and services needing immediate attention. Sandy suggested some focus on key species and services first. Bob suggested adding "do all technically-feasible options to increase the rate or degree of recovery. In light of limited funds, schedule options according to immediate needs and most-effective techniques. Over the life of the settlement, use all effective techniques to address the range of injured resources and services on an as needed basis".

Bob will prepare his table and provide a copy for the administrative record.

Chosen Resources and Services - John stated this alternative may provide a great opportunity for comparison and contrast in the EIS. Sandy stated this only works if chosen resources and services include all. If less than all, someone will be very unhappy. Art suggested adding "emphasis on restoring those resources that would have the greatest benefit to those people most affected by the spill".

Art suggested asking Ken for input regarding NEPA requirements and the preferred alternative. Sandy stated NEPA does not drive the plan but the EIS. Bob stated there is a question of packaging the plan to minimize the effect of the preferred alternative. If the plan goes out with the EIS, the preferred alternative must be used in both. John stated RPWG will discuss on Wednesday which way we will go.

RPWG meeting concluded at 4:00. Meeting on Monday will continue

discussion of themes.

draft 8/20/92

Potential Themes for Draft Alternatives: RPWG

1. No Manipulation of the Environment

   - No manipulation of environment or species
   - Would only allow direct manipulation projects in critical situation.
   - Management actions allowed
   - Acquisition/protection allowed
   - Monitoring allowed
   - Basically a combination alternative that doesn't allow active, direct manipulation, but allows all other options.

2. Manipulation/Enhancement

   - Focuses on manipulation and enhancement options, but includes all options.
   - Includes purchase of equivalent resources
   - Continue options that enhance after restoration level is reached
   - Includes monitoring
   - Goals would include bring some (need to identify) resources and services to above pre-spill levels.

3. Immediate Restoration

   - Do all that is economically and scientifically feasible on-the-shelf technology to effect recovery in 5 years. Thereafter, assess and decide what to do.
   - Conduct actions within 3 years
   - Use every penny up-front, defer other costs, reimbursements, etc...
   - All actions for immediate results implement ASAP, including those with power expectations.
   - Includes un-proven technologies that may work
   - Includes monitoring

4. Natural Recovery (No Action)

- No expenditure of funds
- Nothing done beyond pre-spill management activities
- ~~A/B~~ with, ~~without~~ recovery monitoring
- Assumes that natural resources and services will recover without human intervention.
- Includes ~~some~~ management of human uses
- ~~Don't manipulate~~
- ~~Don't buy~~ land

5. Combination

- Restoration options from each category
- Includes all restoration options that may favorably effect recovery of resources and services during the settlement period.
- Uses those options that would be the "most effective" for restoration and enhancement - given consideration of time and money.
- Includes monitoring
- Emphasis is on keeping all options available to TC(?)
- Use combination of #1, 2, 4, & 6
- Rename to most effective or full of range of options.

6. Habitat Acquisition and Protection

- ~~Focuses on~~ Includes habitat acquisition and protection measures to help restore injured resources and services
- Includes monitoring
- Excludes all but habitat acquisition, protection and monitoring.
- Includes other options when habitat and protection options are not available.

7. "Chose" Resources and Services

- Emphasis on restoring resources and services of value to humans (commercial and sociably important)

- Emphasis on those that require intervention, not those likely to fully recover on their own.
- Same as combination
- Emphasis on those with (most) perceived injury, then focusing on remaining resources and services.

8. Others: (added)

   A. <u>Restoration of Commercial, Recreation and Subsistence Resources and Services</u>

      - Includes the above and ecologically important species

9. <u>Notes</u>

   - For all of these I would expect most options to remain available. The differences occur in time and money.

10. Monitor, study + Educate

OOS

Memorandum August 13, 1992

To: Regional Environmental Assistant, Office of Environmental Affairs

From: Oil Spill Coordinator, FWS

Subject: Lands/Habitat Working Group Questionaire

Attached is the results of the questionaire requested by the Lands/Habitat Working Group. Questionaires were completed for the following species;

Sea Otters
Marbled Murrelets
Pigeon Guillemots
Black Oystercatchers
Common Murres

A questionaire on bald eagles will be provided to you when it is completed. Should you have any questions, please contact me at 786-3494. These questionaires will also be provided to various members of the Lands/Habitat Working Group, as they requested.

cc:

Lands Habitat Working Group members

Preliminary Information on Habitat Characteristics of Species Injured by the *Exxon Valdez* Oil Spill

1. SPECIES
What injured species do you have expertise in?

Sea otter *(Enhydra lutris)*

Sea otters historically occurred throughout coastal waters of the north Pacific, but were nearly extirpated in the 18th and 19th centuries by fur hunters. The few remanant populations that survived were initially protected in 1911, and have since increased in abundance and distribution, reoccupying most of their original range. In California, sea otters are designated as "threatened" under the Endangered Species Act. Alaskan sea otter populations are relatively abundant, with current population size statewide estimated at 150,000. Prince William Sound (PWS) has been repopulated over the last 30 years by a small remnant group from the southwestern portion of the Sound. In 1973, 1,814 otters were counted during a coastal helicopter survey of PWS; 4,509 otters were counted during a boat survey along the entire coastline of PWS in 1984 and 1985.

This species was the focus of much public attention and concern following the *Exxon Valdez* oil spill (EVOS), and an extensive effort was mounted to capture and rehabilitate oiled otters and return them to the wild. Sea otters are one of the most sensitive marine mammals to the effects of oil contamination. Unlike most other marine mammals, which depend on subcutaneous blubber for insulation, the sea otter has little subcutaneous fat. Therefore it depends on an elevated rate of heat production and an entrapped air layer within its dense, water-resistant undercoat to provide insulation against the cold as well as buoyancy. Direct exposure to oil fouls the otter's fur, causing it to lose its insulative properties and leading to thermoregulatory distress, which can lead to death.

In addition to oiling of fur, ingested oil may have a direct toxic effect (acute, if quantities are sufficient, or chronic, if concentrations are lower and persist in the environment) on sea otters. Indirect effects of crude oil contaminating sea otter habitats may include (1) loss of habitat and (2) food reduction, due to mortality or unpalatability of prey organisms resulting from direct contact of oil with marine invertebrates and overall degradation of the nearshore marine ecosystem.

Study of sea otters in the area of the EVOS is providing a unique opportunity to study the recovery <u>process</u> for

exposure of this species to acute, chronic, and indirect effects of an oil spill.

2. **DEGREE AND RATE OF RECOVERY**
What is your assessment of the degree and rate of recovery of your injured species?

Degree: Recovery is unknown and there are indications of continuing damage

Rate: Unknown

Comment:
Between 3,500 and 5,000 sea otters may have died as a result of acute exposure to oil following the EVOS. Those figures are based on a synthesis of three methods of loss estimates: the 1,000 sea otter carcasses collected during or shortly after the EVOS (available information suggests about 75% of sea otter carcasses are not recoverable, and autopsies indicate less than 5% of mortalities were clearly non spill related); comparison of sea otter abundance estimates from before and after the spill; and a mortality model based on potential exposure to oil and observed mortality rates dependent on degree of oiling.

Continuing damages to sea otters may result from sub-lethal initial exposure and/or continued exposure to environmental hydrocarbons. Additionally, prolonged damages may result from affected sea otter prey populations. Preliminary findings of Coastal Habitat and Shellfish studies have identified elevated levels of hydrocarbons in intertidal and subtidal sediment samples collected within the spill zone. Hydrocarbon analysis of benthic marine invertebrates indicate that high levels of hydrocarbons persist in several species previously identified as sea otter prey in western PWS. A 1991 study evaluating sea otter prey selection and foraging success indicated that sea otters have not altered their diet over the past decade and continue to rely primarily on clams and mussels as forage.

Preliminary results of several Fish and Wildlife Service sea otter damage assessment studies suggest that the affected sea otter population is not recovering and possibly may be suffering continued damages. Those results are summarized below.

Comparisons of pre- and post-spill estimates of sea otter abundance, based on boat surveys of shoreline areas, found nonoiled areas underwent a 13.5% increase in abundance of otters, while oiled areas underwent a 34.6% decrease. In addition, the estimate of post-spill population in the oiled areas is significantly lower than the best pre-spill estimate, indicating a real decline on the order of 1,600

otters initially, and up to 2,200 in subsequent years. No change in abundance was detected between July 1990 and July 1991 surveys.

The age distribution of sea otter carcasses recovered in oiled areas of PWS suggests increased mortality of prime-age sea otters, evidenced by the significant differences between the pre- and post-spill age distribution of otters found dead on beaches in western PWS. There was a shift from a pre-spill composition of primarily young and aged animals to an increased proportion of prime-age animals during and following the spill. This observed change suggests a prolonged, spill-related effect on the western PWS sea otter population.

Significant differences in several blood parameters between wild caught otters from eastern and western PWS in 1990 and 1991 were identified, including suggestion of a mild anemia in pups from western PWS. However, the biological significance of observed differences is unknown.

Forty-five radio-instrumented sea otters were released into the clean waters of eastern PWS during summer, 1989, following efforts to rehabilitate them at otter treatment centers. Based on monitoring over the subsequent two years, it was found that survivorship and pupping rates of these otters were generally lower than that of sea otters in other study populations.

In studies of other sea otters caught in the wild and instrumented following the oil spill, significantly higher post-weaning mortality was found for sea otter pups in oiled areas of western PWS compared to pups in eastern PWS (87% vs. 64%, respectively). However, pupping rates of adult females and pre-weaning survival of pups in 1990 and 1991 were similar and considered normal in eastern and western PWS. In contrast, survival of adult female sea otters was significantly higher in western PWS compared to controls in the east. Causes of the differing survival rates are not understood. Oil contamination, differences in habitat quality and carrying capacity, and length of occupation of sea otter populations in eastern vs. western PWS may be influencing factors.

3. LIMITING FACTORS
What limiting factors, if any, do you think are affecting the degree and rate of recovery of your injured species? Is habitat limiting?

Long-term detrimental effects from initial exposure to the oil spill may be a factor limiting recovery of the sea otter populations. Additionally, chronic effects may result from

continued exposure to residual oil in the environment, either directly or through ingestion of contaminated prey. Given hydrocarbon contamination in bi-valve mollusks, the prey study described a pathway for continued exposure of sea otters to environmental hydrocarbons. Other damage assessment studies have documented decreases in abundance of mussels in oiled areas which may further impede recovery of the sea otter population.

Because reoccupation of oiled habitat appears to be slow if occurring at all (e.g., otter density around northern Knight Island remains low), habitat may be limiting the recovery of the sea otter population.

4. **HABITAT CHARACTERISTICS**
What are the key habitat characteristics (e.g., vegetation, elevation, proximity to water, slope, aspect, etc.) that are necessary to sustain your species and foster its recovery? Be as specific as possible.

The abundance of sea otters may ultimately be determined by the quantity and quality of available habitat. There is, however, a lack of good information on the factors contributing to good sea otter habitat. Sea otter habitat may be defined by two primary components, the sea floor where prey are gathered and the sea surface where resting, feeding, grooming and social interactions occur. Foraging habitat may be further defined as a band of sea floor extending seaward from the high intertidal to a depth beyond which otters are not thought to forage. Maximum dive depths and therefore the width of this habitat band remain undefined. Additionally, the distribution of foraging within this band and how this band may vary as a function of habitat (i.e. soft-bottom vs. rocky) and otter density remain unknown. Most of PWS has only a narrow band of shallow water where otters are able to feed, so feeding generally occurs relatively close to shore.

Factors which need to be considered in evaluating otter habitats in PWS include (1) seasonal differences and patterns of habitat use; (2) substrate differences - how they affect otter densities is not known; and (3) slope of the shoreline relative to the distribution of foraging activity.

In California, sea otter density appears to be related to substrate type with hard, rocky-bottom habitats supporting much higher otter densities than soft, sandy-bottom areas. Areas with extensively fractured or topographically heterogeneous substrates seem capable of supporting higher densities of sea otters than areas with flat and unbroken substrates. However, substrates in PWS tend to be composed

of soft sediments.

Kelp canopies are used for foraging and resting and are a preferred, although not essential, habitat. Kelp forests are limited in PWS but where they do occur, are extensively used by otters during the spring-summer period. Requiring a specific substrate (shallow reef), kelp forests are usually removed in the fall with storms.

Preferred haul-out sites are characterized by low-relief, algal-covered rocks that are exposed at low tide, although sand or cobble beaches are occasionally used.

Pronounced and complex relations between sea otters, a "keystone" or "foundation " species, and the nearshore community have been documented in Alaska. One part of these relations is the direct reduction of benthic invertebrate populations by sea otter predation. Another is the indirect effect of sea otter predation such as where otters limit herbivorous sea urchins in many areas of the North Pacific Ocean, which in turn promotes the growth of kelp and other macroalgae.

Sea otter social organization and behavior are also important factors in considering habitat characteristics. Sea otters exhibit a high degree of sexual segregation with some seasonal variations. Females and males generally rest in separate areas with the exception of solitary, adult males that maintain territories within female areas. In Alaska, male groups are usually situated in areas with more abundant food resources but that are less protected from stormy weather than female areas. Male otters are the first animals to colonize unoccupied habitat. Females generally rest in small groups or "rafts," and males frequently rest in very large groups. At times, females with pups form "nursery groups." Although otters commonly rest in tightly to loosely structured groups, foraging activity generally takes place individually, often away from resting areas. Parturition and mating also tend to occur away from others. Mothers with newborn pups are frequently solitary. Many otters prefer particular rafting sites.

With the exception of one otter during the July 1990 survey, no otters have ever been observed in the offshore areas surveyed, that is areas more than 5 km from foraging habitat.

5. **CONFIDENCE LEVEL**
What is your level of confidence in the answers to questions 2, 3, and 4? (High, Moderate, Low, explain)

Initial killing of at least 1,000 sea otters by the EVOS is

well-documented, and it is probable that as many as 3,500-5,000 otters died shortly following the spill. Results of continuing studies strongly suggest chronic damages to sea otters are occurring which may preclude or delay recovery of affected populations.

In sum, the level of confidence to previous questions is:

2) Moderate - Three independent sea otter studies (i.e., data from surveys of abundance and distribution; post-weaning mortality of pups; age-distributions of beach cast carcasses) have suggested that recovery of the population is not occurring, or is occurring at a slow rate.

3) Low - We are uncertain about the causes of delayed recovery. Residual oil appears to be persisting at relatively high levels in prey species and in the environment, but the implications of this are not known. Initial exposure may have long-term deleterious effects on surviving otters. Baseline (pre-spill) information on sea otters and associated species is minimal. Certainly the EVOS provided a large scale perturbation to sea otters, their habitats, and the associated community.

4) Moderate - General information on sea otter habitat is available, but further information is needed to define habitats in areas affected by the EVOS. In brief, sea otters require shallow water so they can locate prey on the substrate; they need clean water, or access to it; and they must have suitable areas to rest, feed, and propagate. Although these basic habitat requirements are recognized, they have not been quantified individually, nor is the integration/relationship of these characteristics to one another well understood.

Although conclusions to date are preliminary, evidence of persistent damages is compelling and warrants continued investigation, as described below.

6. ADDITIONAL DATA NEEDS
What additional data, expertise, and/or further analysis of existing data is needed to improve your confidence in answering questions 2, 3, and 4?

It would be valuable to continue ongoing sea otter studies in order to fully describe and quantify the effects of oil exposure and the subsequent recovery process over the long-term, and to understand the biological basis of eventual recovery. Information to be gathered, as outlined below, will be of benefit in determining future restoration and management options.

1) Continue otter population surveys established in PWS and extend them to the remainder of the spill zone. This monitoring effort should continue through recovery. These surveys provide a cost-effective, statistically rigorous method for monitoring populations. Even where baseline data does not exist, repeated surveys can show whether populations are stable and compare oiled and unoiled areas. Without long-term monitoring it will not be possible to understand the factors continuing to limit population recovery or consider appropriate restoration goals. Surveys would include aerial population surveys, reproduction surveys, radio-telemetry studies and mortality surveys for through recovery.

In addition, because the potential for recovery of affected sea otter populations is not known, population modeling should be used to predict and evaluate otter recovery to ensure that hypotheses related to recovery are accurate.

2) Protection of habitats important to sea otters will promote population recovery over the long-term. Description of foraging, pup rearing, pup weaning and haulout areas and identification of the distribution, abundance, and seasonal patterns of habitat use over time will be crucial to identifying valuable habitats for sea otters. Future restoration projects should: (a) utilize data from the juvenile survival study (1992-1993) to develop a data base on sea otter movements and patterns of habitat use; (b) integrate this information with other sea otter data on distribution and abundance (pre- and post-spill); (c) evaluate available data on commercial, recreational, and subsistence uses, and identify potential conflicts from various activities and (d) identify and evaluate potential sites for protection of sea otter habitat in PWS.

Areas for which acquisition and protection efforts should be considered include:

(a) Afognak Island, Kodiak Archipelago, supports large numbers of sea otters in protected bays and coves used for feeding and pup rearing nurseries, particularly on the west side.

(b) Additional areas which should be evaluated for potential sea otter habitats deserving protection include areas in PWS, as well as along the Kenai coast, Alaska Peninsula, and Katmai coast.

(c) The creation of marine sanctuaries in key otter habitats, in which conflicting activities would be managed, would help protect sea otters as well as other species impacted by the EVOS.

3) Broad expanses of sea otter habitat were contaminated with hydrocarbons. Ongoing sampling of sediments and sea

otter prey items indicate that sea otters continue to be exposed to hydrocarbons. This sampling effort should continue to assist in understanding the factors aiding or limiting sea otter recovery.

Principal Investigators for the Sea Otter Project are:
Brenda Ballachey (786-3417), Jim L. Bodkin (786-3680), and Doug Burn (271-2346), U.S. Fish and Wildlife Service.

Information from sea otter draft, interim reports by B.E. Ballachey, J.L. Bodkin, D. Burn, A.R. DeGange, C. Monnett, and L.R. Rotterman; and the following reports were the basis for this response as reviewed by Jim Bodkin and Brenda Ballachey and prepared by:
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USFWS/13 August 1992

Preliminary Information on Habitat Characteristics of Species Injured by the *Exxon Valdez* Oil Spill

1. SPECIES

What injured species do you have expertise in?

Marbled murrelet (*Brachyramphus marmoratus*)

A diving seabird, the marbled murrelet breeds along the eastern Pacific from Northern California to Alaska. This species was listed as threatened in British Columbia by the Canadian government in 1990. It is currently being considered for threatened or endangered status along Washington, Oregon and California and is a Category II species in Alaska (i.e., there is concern but insufficient data to determine its status). An estimated 95% of the total population in U.S. waters occurs in Alaska with evidence that the major population centers are in southeast Alaska, Prince William Sound (PWS) and the Kodiak Archipelago. Marbled murrelets nest inland in trees and on the ground. Little was known about their nesting habitat requirements in Alaska until this study was undertaken.

2. DEGREE AND RATE OF RECOVERY

What is your assessment of the degree and rate of recovery of your injured species?

Degree: Stable

Rate: Static (?)-uncertain until further surveys over several years are available

Comment:

Subject to direct mortality from the 1989 *Exxon Valdez* oil spill (EVOS), murrelets comprised 12% of all seabird carcasses retrieved in PWS, while at the time of the spill, murrelets were estimated to be only 6% of the seabirds present in PWS. Thus, proportionally more murrelets were killed than were at risk. Based on the approximately 600 marbled murrelet bodies recovered throughout the spill zone and an 8% chance of carcass recovery, an estimated 8,250 to 9,570, or a high of 14,190 marbled murrelets were killed directly by oil in the EVOS zone. If unidentified murrelets are included, about 1,000 carcasses were recovered which extrapolates to a minimum of 12,500 killed. Because their small size would cause murrelet carcasses to both sink and decompose faster, among other factors, it is believed that the number of marbled murrelet carcasses is probably underrepresented. Both Ford et al. (1991) and Piatt et al. (1990) agree that of the six species of small alcids in the spill zone, marbled murrelets suffered the greatest mortality.

Pre-oil spill data on marbled murrelets was available for the Naked Island group from 1978 to 1981, and for Kachemak Bay in 1988. Based on opportunistic observations in 1978, the population on the Naked Island group was estimated to be at least about 3,000 marbled murrelets. Shoreline boat surveys showed significant declines in marbled murrelets around Naked Island in 1989 (to only 29% of the mean for pre-spill years) and 1991 (57% of the pre-spill mean), but not in 1990 (95% of the pre-spill mean). There was no significant difference between oiled or unoiled sections of Naked Island. There was not a significant decline for murrelets around Storey and Peak Islands, immediately north of Naked Island. The 1991 count for the three islands was the lowest of 6 years with records. Declines in murrelet counts on transects in Cabin Bay, a very lightly oiled area on the western side of Naked Island, were significant early in the summer of 1989, but not in late summer of 1989 or in 1990. At Kachemak Bay, where no significant oiling occurred, murrelet densities on transects along the south side showed no change between 1988 and 1989.

Marbled murrelets showed petroleum hydrocarbon contamination in liver tissue in four (possibly six) of ten apparently healthy birds collected at heavily oiled Eleanor Island. In contrast, one (possibly two) of eight birds taken from a lightly oiled area of Naked Island were exposed, and none of the ten birds from unoiled Eaglek Bay showed contamination.

The PWS July population of murrelets has changed drastically from the 304,432 estimated in 1972. The July estimate was 107,232 in 1989; 81,398 in 1990; and 105,952 in 1991 (Laing 1991). The length of time between pre-oil surveys and post-oil surveys makes it difficult to determine the contribution of the EVOS to this decline. There was no significant difference in declines between oiled and unoiled areas in the summer population. Early April is believed to be the beginning of murrelet migration back into PWS and other inland waters of southcentral Alaska. Thus, because birds were not at their nesting areas yet, it may not be possible to detect oiling effects based on summer breeding distribution relative to shoreline oiling. March counts show a greater decline in oiled than in unoiled areas, with the difference approaching significance. The late winter and migrating population of murrelets along the Kenai Peninsula may have been more directly impacted.

3. LIMITING FACTORS

What limiting factors, if any, do you think are affecting the degree and rate of recovery of your injured species? Is habitat limiting?

Forage fish may be a limiting factor for marbled murrelets but this has not yet been confirmed, see item 4, below.

Whether or not habitat is limiting is currently unknown but would be partially addressed by the further studies and land acquisition recommended under items 5 and 7, below.

In California and Oregon, there is a direct correlation between the occurrence of marbled murrelets offshore and the occurrence of remnant old-growth and coastal forests, indicating their population may be limited by nesting habitat. Additionally, larger stands of trees have higher numbers of murrelets than smaller, or highly fragmented stands.

Human disturbance in the summers following the oil spill, especially in 1989, may have been a factor in seabird distribution. At Naked Island, there were changes in murrelet distribution and abundance with low float plane, helicopter, and boat activities. Human disturbance may be a factor in considering land acquisition (with constraints on development) as a restoration technique (see item 7, below).

Another source of mortality to marbled murrelets is their incidental take in the gillnet fishery (that take was estimated at 1.4% of the PWS population in 1990 and 0.3% in 1991 when there was a lower fishing effort). For the closely related Kittlitz's murrelet, an estimated 1.5% of the PWS population was taken by gillnets in 1991.

Predation on adult murrelets is known to occur by bald eagles, peregrine falcons, and sharp-shinned hawks. Predation on eggs and chicks appears to be frequent. It was likely the cause of at least one and possibly three of the four known nest failures on Naked Island in 1991.

4. HABITAT CHARACTERISTICS
What are the key habitat characteristics (e.g., vegetation, elevation, proximity to water, slope, aspect, etc.) that are necessary to sustain your species and foster its recovery? Be as specific as possible.

Preliminary findings are based on habitat parameters described for the Naked Island study site in PWS in 1990 and 1991. This small sample suggested greater murrelet use of inland areas at the heads of bays as opposed to the outer peninsulas. Slopes facing northwest, west or southwest may have greater use than slopes facing north, northeast or southeast on Naked Island. Open bog meadows, especially at the heads of bays, appeared to be used as flight corridors to upper wooded areas and as "display arenas" by birds using surrounding hillsides. Among five polygons in the main

study area, murrelets flew most frequently into two areas with steep slopes facing west, and 70-80% cover of Hemlock old-growth. All nests (N=7) were in old growth stands of volume class 4 and stand class 4, less than 1/4 mile from the ocean, facing northwest or west, on slopes of 65%, and at elevations of 75-115 m. The stands had 70-85% canopy closure and were part of a contiguous forest area of between 18-176 hectares. Tree species were mountain hemlock, western hemlock and Sitka spruce. The nest trees were 30-80 cm diameter at breast height and 20-30 m tall.

Murrelets are probably shallow divers compared to other alcids. When feeding chicks, they fly from their foraging site to their inland nest with fish and have never been observed perching on shoreline rocks or beaches. Not closely associated with specific shorelines, murrelets have social and nesting behavior which precluded their contact with shore-fast oil. Rather, most injury to murrelets would have occurred from direct oiling on the water during the spill, or in oiled, protected bays where oil is still being released. Murrelets could have consumed contaminated prey, evident by internal contamination from collected specimens. Additionally, the unavailability of prey, due to low prey abundance or the avoidance of shallow waters by forage fish, could disrupt breeding. During the pigeon guillemot study at the Naked Island site, there was a marked decline in sandlance fed to chicks in post-spill years. Sandlance are one of the murrelet's primary prey species.

The migratory movements and winter distribution of marbled murrelets in Alaska are not well known. It is speculated that most Alaska murrelets congregate in ice-free, protected waters from Kodiak to British Columbia. Though little is known about winter murrelet activity in PWS, March counts of murrelets at-sea are approximately 25% of the summer population.

5. **CONFIDENCE LEVEL**
What is your level of confidence in the answers to questions 2, 3, and 4? (High, Moderate, Low, explain)

Data provided are reasonable, but as described in those answers, there are still many uncertainties and incomplete aspects to determining how marbled murrelets were affected by and are recovering from the EVOS. Following is an assessment of the confidence level for each of the numbered responses:

2) <u>Degree and rate of recovery</u>

<u>High</u>- Re: changes in population of PWS since 1972.

Moderate- Re: changes in population at Naked Island study site. Changes in methodology and normal fluctuations at this specific site make statistical tests complicated.

Moderate- Re: direct mortality because the small body size of murrelets leads us to believe that mortality in PWS is grossly underestimated. Because the EVOS coincided with migration, much of mortality could have occurred along the south Kenai Peninsula, where recovery of small carcasses was unlikely.

Moderate- Re: describing the degree and rate of recovery as stable/static. We know from PWS surveys that numbers remain well below 1972 numbers, but there has been little significant difference among the post-spill years of 1989, 1990, and 1991. Further monitoring, via boat surveys, is needed to determine if a change in the rate of recovery ever does occur.

3) Limiting Factor

Low- Re: whether nesting habitat is limiting. There is circumstantial evidence of this for California, Oregon, and Washington, but nothing for Alaska.

Low- Re: prey. Little is known about the primary prey species of marbled murrelet.

Low- Re: human disturbance. While there is strong evidence for disturbance effects in PWS, we do not know how easily murrelets adapt to human activity on the water, or in trees. (Note, in California, nests have been found in trees above picnic/camping areas).

Moderate- Re: gillnetting. There is evidence of some mortality from this factor. Whether this is important at the population level is uncertain, but worthy of further study.

Moderate- Re: predators. Murrelets (adults, eggs, and chicks) may be important food sources for other birds. There is no reason to suspect this is now any different than in pre-oil spill years. In the future, predation could be a problem if increased fragmentation of forests and human activities causes local increases in predators such as jays, ravens, and magpies.

4) Habitat Characteristics

High- Re: current data. Extrapolation from current data is not yet possible, but may be after analysis of 1992 data.

6. ADDITIONAL DATA NEEDS
What additional data, expertise, and/or further analysis of existing data is needed to improve your confidence in answering questions 2, 3, and 4?

The following recommendations are based on preliminary study results. Final data analyses may alter conclusions or result in further suggestions.

1) Continue to monitor marbled murrelets by boat surveys in PWS, the Kenai Peninsula (including Kachemak Bay), and the Kodiak Archipelago. Important data gaps include population estimates along the Kenai Peninsula and Kodiak area. Data on migratory patterns and timing are also lacking. Data from continued boat surveys will allow tracking of the length of recovery, or in the event of continued decline, indicate a need for more intensive restoration efforts. It will also allow identification of marine areas critical to murrelets.

2) At this time there are no demographic records for marbled murrelets which might provide information on their lifespan, age at first breeding, reproductive potential or overwinter survival. These data gaps make it impossible to predict the recovery rate for murrelets. Methodologies do exist to age birds, and should be explored for integration with restoration efforts. Breeding status of birds killed during the oil spill will affect recovery rates. Thus use of bone cross-sections for aging should be explored. Then determining the demographics of the murrelet population will allow a better assessment of recovery rates. Additionally, future monitoring programs should make an effort to estimate annual reproductive success by noting juveniles on the water at the end of the breeding season. To date, the best method of evaluating recovery remains the systematic July boat surveys which provide annual or biannual population estimates for a given region (i.e., PWS). In order to look at juveniles, an early August survey would also need to be made.

3) A method of estimating relative annual murrelet reproductive success should be developed to aid in assessing recovery rates. This could involve surveys to record juveniles at different times than current surveys, censusing specific sites, or analyzing EVOS carcasses to determine bird ages.

4) Murrelets feed primarily on mid-water and surface schooling fish in the summer. In summer, Kachemak Bay murrelets feed almost exclusively on Ammodytees (sandlance), whereas Gadidae (cod species) dominate in PWS, and Mallotus (capelin) predominate in Kodiak. A study is needed to

determine the abundance and distribution of forage fish and evaluate their influence on the recovery of seabirds impacted by the spill. Availability of forage fish, and their potential for unintended manipulation by humans, is an unknown but possibly limiting factor to marbled murrelet recovery from the EVOS. A baseline study to determine the abundance and distribution of age class 0 and 1 forage fish, once methods for assessing them have been refined, would take 3-5 years in order to begin to understand some of the normal variation. This study would also apply to the recovery of pigeon guillemots affected by the EVOS.

5) A major population center of the marbled murrelet exists within the EVOS zone. This population suffered direct mortality form EVOS. To adequately ensure recovery of this population, protection of appropriate foraging areas must be integrated with acquisition of nesting habitat. Specific objectives of the necessary study are to:

(a) Design a comprehensive study to assess critical foraging areas for marbled murrelets breeding in the EVOS zone; and

(b) Investigate murrelet foraging area requirements during the breeding season in conjunction with a proposed nesting study on Naked Island.

Estimated cost of the 1-year study is $250,000.

6) The immediate mortality caused by the EVOS coincided with the approximate time of migration for murrelets. Therefore, further understanding of the wintering grounds and migration routes of murrelets is needed to determine injury, and thus appropriate restoration needs, in areas outside PWS.

7) In order to adequately restore the marbled murrelet population of the spill zone, there must be acquisition or protection of murrelet nesting habitat, throughout PWS, the Kenai coast, and Kodiak, and possibly even along the Alaska Peninsula and Katmai coast. Although this can include ground nesting sites in this region of Alaska, murrelets also nest in old-growth trees which are commercially valuable and subject to harvest. In addition, certain foraging areas may require protection from some kinds of human disturbance during the breeding season. Absent additional data from suggested study 5), above, at least two areas with suitable habitats for which acquisition efforts should be initiated include:

(a) Afognak Island, Kodiak Archipelago

Marbled murrelets are known to nest in spruce trees in Alaska (as well as on the ground) and the 180,000 acres on the north end of Afognak Island proposed for acquisition are vegetated primarily by mature Sitka spruce. Survey data indicate that nesting occurs

throughout the island, and in 1992, one nest was located on Afognak after a logger felled a tree with a chick. Cost would be negotiated over a 6-month to 1-year period ending with title transfer.
(b) Kachemak Bay private inholdings. Logging has been actively proposed in this area with likely detrimental consequences to murrelet nesting habitat.

Principal Investigator for the Marbled Murrelet Project is:
Kathy Kuletz, U.S. Fish and Wildlife Service, 786-3453.

Information from marbled murrelet draft, annual, and final reports by Kathy Kuletz was used for this response as prepared by: Ann Rappoport, U.S. Fish and Wildlife Service, 786-3398, and reviewed by Kathy Kuletz.

USFWS/13 August 1992

Preliminary Information on Habitat Characteristics of Species Injured by the *Exxon Valdez* Oil Spill

1. **SPECIES**
What injured species do you have expertise in?

Pigeon guillemot (*Cepphus columba*)

2. **DEGREE AND RATE OF RECOVERY**
What is your assessment of the degree and rate of recovery of your injured species?

Degree: The Prince William Sound pigeon guillemot population as a whole, and the population in the Naked Island area of Prince William Sound, has continued to decline since the spill suggesting that no recovery has occurred. The population decline was apparent before the spill, however, and the population may continue to decline for reasons not directly related to the spill.

Rate: The rate of recovery is unknown but presumably low, since the population has not increased since the spill.

Comment:

Population estimates for PWS and for the Naked Island area following the spill indicate that the guillemot population is still declining. The PWS guillemot population is currently the lowest it has been since the early 1970s. Guillemots are one of five species which declined more in the oiled area than in non-oiled areas since the early 1970's, suggesting a significant oil spill effect. The Naked Island area guillemot population was 25-36% lower in 1989 than in the early 1980s. The decline has continued with even fewer birds at Naked Island area colonies in 1992 than in any previous year. The post-oil mean number of birds for those colonies is now 56% lower than in pre-oil years.

Throughout the Naked Island group, declines varied among the islands and appeared to correspond to the degree of oiling. The decline was most extreme on Smith and Little Smith Islands which were heavily oiled: the 1990 count was 43% and the 1991 count was 30% of counts from 1977-79. Naked Island had variable oiling. The scattered nature of guillemot colonies and shoreline sections censused there allow assessment of oiling on a fine scale. A significant decline was found for Naked Island, and there was significantly greater decline in oiled shorelines compared to nonoiled shorelines. The 1991 Naked Island count was up slightly

from 1989 and 1990, but still only 70% of the pre-oil count mean of 1,077 guillemots. Storey and Peak Islands were surrounded by oil sheen but received little oiling onshore. They had significant declines in 1989, but not in 1990 or 1991. Together those two islands had a post-oil mean that was 62% of the pre-oil mean of 565 guillemots.

In addition to population declines, guillemot reproduction on Naked Island was generally lower in 1989 and 1990 compared to pre-oil years. Preliminary analyses show significantly lower chick growth rate, chick fledging weight, and nesting success in 1990, but not in 1989. In 1989 and 1990, predation was an important proximate cause of nest failure. There were also changes in the types of prey fed to chicks, with extremely low use of sand lance and herring in 1990. Sand lance and herring were apparently not as available in post-oil years as they had been in previous years. Schooling fish averaged 43% of total prey delivered to chicks in pre-oil years, 36% in 1989, and 13% in 1990.

Two of five adult pigeon guillemots and three unhatched eggs collected in 1989 showed contamination by weathered petroleum hydrocarbons. Four of five unhatched eggs collected in 1990, one year after the spill also showed definite external contamination. These data suggest that guillemots continued to be exposed to oil, even a year after the spill. Guillemots may be exposed to oil due to their daily behavior of perching on intertidal and subtidal rocks at colonies and probing in nearshore rocks and kelp for food.

Local guillemot population declines in Norway, Scotland, Denmark and California have been attributed to oil pollution; in most cases, the oiled populations appear to have recovered fairly quickly.

3. **LIMITING FACTORS**
What limiting factors, if any, do you think are affecting the degree and rate of recovery of your injured species? Is habitat limiting?

The causes of the decline in the Prince William Sound guillemot population are unknown. Thus, it is difficult to point to the most important factors limiting their recovery. Possible limiting factors include food availability, nest site availability, predation rate, petroleum contamination, weather, and winter mortality.

Low sand lance availability, as evidenced by the extremely low use of sand lance as chick food in 1990, has been linked to low reproductive success in many seabirds, including guillemots.

In some areas, guillemot populations appear limited by nest site availability, and guillemots have been found nesting in human-made structures (e.g., docks, bridges). The guillemot population at Naked Island does not appear to be limited by nest sites.

Guillemots may still be exposed to petroleum hydrocarbons on rocks and in their feeding habitat. Only minute quantities of oil are needed to cause egg death. The continued presence of oil in their environment could be a factor limiting their reproductive success and therefore their recovery.

Predation, particularly of eggs and chicks, may be an important factor limiting recovery of the Naked Island pigeon guillemot population. In 1989 and 1990, many nests were depredated by unknown predators, possibly corvids or mustelids. In 1992, there were at least four nests where adult guillemots incubating eggs were killed by a mammalian predator (probably a river otter). This was the first year this type of predation had been recorded in PWS.

Inclement weather has also been an important cause of nesting failure for guillemots at Naked Island. Summer weather following the spill has generally been mild, and nest failure due to nest flooding and other causes related to weather have not been observed since the spill. Weather does not appear to be an immediate factor in the failure of the guillemot population to recover following the spill.

Very little is known about pigeon guillemots during winter. Some change in overwinter mortality could be an important cause of the population decline, but no data are available to assess its importance.

Pigeon guillemots do not appear to be taken incidental to salmon gillnet fisheries in Prince William Sound (based on 1991 data).

4. HABITAT CHARACTERISTICS

What are the key habitat characteristics (e.g., vegetation, elevation, proximity to water, slope, aspect, etc.) that are necessary to sustain your species and foster its recovery? Be as specific as possible.

Pigeon guillemots breed throughout the North Gulf Coast-PWS region in rocky coastal areas. Guillemots are exceptional in their widespread, but low density, distribution during breeding. Guillemots forage in the inshore environment and are rarely observed more than a few kilometers from land.

Nesting habitat.--The pigeon guillemot requires a pre-

existing cavity for a nest site. Guillemots are plastic in choice of nest site and will nest in whatever type of pre-existing cavity is available. For example, in Puget Sound, Washington, where cliffs are composed of sandy materials, guillemots expand on cliff swallow nests to produce a nest site. Guillemots are also somewhat famous for nesting in man-made structures, including docks, pilings, bridge girders, boxes and debris.

In Prince William Sound, guillemot nesting habitat occurs where cliffs are a component of the beach morphology. The cliffs do not need to be particularly tall and may be only a few meters in height, but a cliff is necessary to create the cavities used for nesting. In PWS, guillemot nests may be classified into three types: 1) talus nests which occur in boulders at the base of cliffs, 2) cliff crevices, which occur in cracks in cliffs, and 3) cliff-edge burrows, which always occur at the top of cliffs where trees, usually alder or spruce, overhang the cliff edge.

Important componenst of their breeding habitat are the rocks and water in front of the colony. During the breeding season, guillemots gather daily on the water in front of their colonies, and they also perch on intertidal rocks. The social activities that occur during the breeding season are presumably important to reproductive success.

Foraging Habitat.--Guillemots are inshore feeders. They feed on a variety of fish and invertebrates, and typically take prey associated with the benthic environment.

At Naked Island, nestling guillemots are fed both surface schooling fish such as sand lance, herring, and smelts, and bottom fish including cods, lingcod, sculpins, sticklebacks, gunnels, and flatfish. Adults eat those species, as well as invertebrate food, primarily shrimps and crabs. At Naked Island, the foraging areas used by guillemots from several colonies have been mapped during the breeding season. Most guillemots were observed foraging between 100-600 m from their colonies with some birds traveling up to 2 km.

Wintering Habitat.--The overwintering habits of most seabirds, included guillemots, are little known. Guillemots are still present in Prince William Sound during winter, but they are more dispersed.

5. CONFIDENCE LEVEL
What is your level of confidence in the answers to questions 2, 3, and 4? (High, Moderate, Low, explain)

Degree and Rate of recovery: High

Limiting Factors: Low

Habitat Characteristics: Moderate

The confidence level is **high** regarding a failure of the PWS pigeon guillemot population to recover its former level following the spill. The decline in the PWS guillemot population has been well-documented: it declined by as much as 50% between 1972 and 1985. There was another 50% decline between 1985 and 1989, after the oil spill, when that decline was twice as great in oiled areas as in unoiled areas. Although the extent to which the decline observed in 1989 at Naked Island was due to this overall population decline or to the oil spill is unknown, the most heavily oiled areas on Naked Island were the areas with the largest declines in the number of guillemots in 1989. The continued decline through 1992 in the Naked Island area has been quantified.

The confidence level regarding the factors that may be limiting the recovery of guillemot populations is **low.** Reasons for the continued population decline are simply unknown. Many factors, some related to the spill and some unrelated to the spill, could be involved. Possible factors include the continued presence of oil in the nesting and foraging areas of guillemots, changes in prey availability, predation, and overwintering mortality.

The confidence level regarding habitat characteristics that are necessary for guillemots that are important to fostering recovery is **moderate.** The general characteristics of nesting and foraging habitats used by Prince William Sound guillemots are fairly well known. Specific nesting and foraging areas are also well documented in the Naked Island area. Outside of Naked Island, however, specific information on colony locations and feeding areas is not available. Because guillemots breed at many locations that other seabird species do not, guillemot nesting distribution is not as well known. Confidence regarding habitat necessary to foster recovery is also moderate simply because the reasons that the population is not recovering are unknown.

6. ADDITIONAL DATA NEEDS

What additional data, expertise, and/or further analysis of existing data is needed to improve your confidence in answering questions 2, 3, and 4?

The following recommendations are based on preliminary study results. Final data analyses may alter conclusions or

result in further suggestions.

Although no method of artificially restoring a decimated guillemot population is known, a reintroduction program of the type used for Atlantic Puffins in Main might work for guillemots. Such a reintroduction program could be expedited by the guillemot's ability to nest in man-made structures. However, an understanding of the causes of the long term decline in the PWS guillemot population is required to properly design any guillemot restoration project for PWS.

To improve confidence about guillemot recovery and the factors limiting recovery, we recommend the following:

1) Continue PWS boat surveys to determine the summer and winter population of guillemots. These surveys are necessary to determine if recovery occurs. The surveys probably do not need to occur on an annual basis, but they should be conducted at regular intervals until recovery is observed.

2) Map the locations and sizes of guillemot colonies in other portions of the spill area. By locating major breeding colonies, lands and marine areas suitable for protection can be identified.

3) Monitor guillemot reproduction to determine importance of factors related to breeding that may be limiting recovery. The most likely factors that could be affecting recovery include predation and food availability.

4) Evaluate existing data on forage fish distribution and abundance. Restoration of guillemot populations may depend on the availability of forage fish such as sand lance, capelin, and herring. Forage fish have been relatively little studied, but trawl data have been collected but never analyzed which could reveal trends in forage fish recruitment. Some understanding of what is going on with forage fish populations would be helpful to understanding what is going on with guillemot populations.

5) Determine feasibility of improving restoration by reducing nest predation. This would involve tests to determine if predators key in on nest markers, or if vulnerable nest sites can be altered to reduce predation. Because guillemots exhibit very high nest site fidelity, decreasing predation at specific nests could prove beneficial. Monitoring reproductive success at nest sites will confirm the success of this restoration effort.

6) Develop a population model. Even a simple model would

help determine the relative importance of annual rates of nesting success and overwintering mortality to population change. The model could be used to determine the likely effects of the mortality observed due to the spill and to speculate on likely recovery periods.

Studies on effects of the *Exxon Valdez* oil spill on pigeon guillemots were conducted by:

Karen Oakley, U.S. Fish and Wildlife Service, 786-3579 and

Kathy Kuletz, U.S. Fish and Wildlife Service, 786-3453.

This briefing paper was prepared by Ann Rappoport, U.S. Fish and Wildlife Service, 786-3398, and reviewed by Karen Oakley and Kathy Kuletz, relying on information from draft, annual, and interim reports by Karen Oakley and Kathy Kuletz, the U.S. Fish and Wildlife Service, 1978, Seabird Colony Catalog, and M.E.P. Isleib and B. Kessel, 1973, Birds of North Gulf Coast, Alaska.

USFWS/13 August 1992

Preliminary Information on Habitat Characteristics of Species Injured by the *Exxon Valdez* Oil Spill

1. SPECIES
What injured species do you have expertise in?

Common and thick-billed murres (*Uria aalge* and *lomvia*)

Of the 1,121,500 breeding seabirds in 320 seabird colonies that occur within the area affected by the *Exxon Valdez* oil spill (EVOS), 319,130 were the cliff-nesting common and thick-billed murres. South of Kodiak Island, the Semidi Islands which contain an additional 1,133,000 murres of both species were not affected by the EVOS. Common murres outnumber thick-billed murres at all colonies in the Gulf of Alaska. The former species comprises about 75%-80% of all murres in the region.

Diving seabirds such as murres are known to be adversely impacted by oil spills. Murres come into contact with oil in the water, not at nest sites which are situated on cliff ledges.

2. DEGREE AND RATE OF RECOVERY
What is your assessment of the degree and rate of recovery of your injured species?

Degree:	**Recovered**	**Nearly recovered**	**Stable**	**Declining**
		Just beginning		

Rate:	**Rapid**	**Moderate**	**Slow**	**Static**
		Slow		

Comment:

Degree: An estimated 100,000 - 300,000 birds (mostly murres) were killed directly by oil. Populations at five breeding colonies within the trajectory of the oil decreased following the spill. It is impossible to predict with confidence the magnitude of change due to pre-spill baseline counts of unknown accuracy. Nevertheless, a direct comparison of numbers before and after the spill, suggest 35%-60% fewer birds were present at affected colonies following the spill. Reproductive success for murres usually ranges from 0.4-0.7 chicks/nest site, but in 1989 murres apparantly experienced nearly complete reproductive failures at most colonies within the trajectory of the oil. Below average success has continued at monitored colonies through 1991, however recently there are signs of slow recovery. The onset of egg-laying has also been delayed following the

spill, and like reproductive success there are signs that the nesting phenology is beginning to return normal. Populations and reproductive behavior of murres at two colonies just outside the trajectory of the oil remained normal throughout the period.

Rate: In the 3 years following the oil spill, there have been no significant increases in numbers of birds at monitored breeding colonies. As indicated above, reproductive success and the timing of nesting is slowly returning to normal at several monitored sites. Nevertheless, at the Barren Islands, the colony hit hardest by oil, the beginnings of recovery are barely detectable.

3. LIMITING FACTORS

What limiting factors, if any, do you think are affecting the degree and rate of recovery of your injured species? Is habitat limiting?

It is unlikely that recruitment from colonies outside the trajectory of the oil will play a major role in recovery of populations injured by oil, because murres tend to breed at the same colonies in which they were born. Furthermore, once they have bred, murres often return in subsequent years to the same nesting ledge where they had previously bred. Thus, recruitment from birds produced at a colony is probably the most likely source of birds to effect a population increase. As indicated above, few young have been produced at colonies affected by the oil, therefore we should not expect substantial increases until reproductive success improves.

We do not know what is limiting reproductive success of murres, but several possibilities follow: 1) reduced colony size resulting in insufficient social facilition and increased predation, 2) skewed age classes lacking experienced breeders, 3) decreased food supply, 4) pollution or contaminated food source, and/or 5) disturbance from tours, planes, and boats. Studies are underway to try to evaluate some of these factors.

It is unlikely that breeding habitat has been changed by the oil spill, but feeding habitat may have been modified by the infusion of oil, at least initially. It seems unlikely that hydrocarbon pollution has lingered in the food web, but this possibility has not been totally discounted.

4. HABITAT CHARACTERISTICS

What are the key habitat characteristics (e.g., vegetation, elevation, proximity to water, slope, aspect, etc.) that are

necessary to sustain your species and foster its recovery? Be as specific as possible.

There are two major components of murre nesting habitat; the nesting ledge where a single egg is deposited, and marine areas within 50 km of nest sites in which birds feed. Suitable nest sites are ledges or flat topped islets inaccessible to mammalian predators. Murres feed on fish and bottom invertebrates for which they regularly dive to depths up to 100 m.

Any factor that disturbs nesting murres, especially early in the incubation period, can cause panic flights which may result in loss of eggs. In addition, nesting murres need adequate food near colonies throughout the nesting season. Therefore, ideal circumstances that would foster recovery of colonies include safe, undisturbed nest sites with good supplies of high quality food nearby.

Few proactive proposals have been submitted that have high potential for restoring murre populations rapidly. Nevertheless, reduction of disturbance from air and boat traffic near colonies is one idea that may have merit. Another is to artifically enhance the density of nesting murres with decoys and playbacks of murre calls to try to normalize social facilitation and reduce the tendency of birds to abandon eggs laid relatively early by joining pre- and non-breeders in panic flights. Such events expose eggs to gull predation.

5. **CONFIDENCE LEVEL**
What is your level of confidence in the answers to questions 2, 3, and 4? (High, Moderate, Low, explain)

2) Recovery - moderate to high: Data show that the number of murres present at colonies within the trajectory of the spill were lower after the spill than before. In addition, the onset of egg-laying was delayed and productivity was much lower than normal following the spill. In contrast, populations, reproductive success, and the timing of nesting remained unchanged before and after the spill at colonies just outside the trajectory of the spill.

Replicate counts of murres at colonies following the oil spill provide a basis for testing differences among years, therefore we have a solid basis for tracking recovery of numbers. Information on the timing of nesting and reproductive preformance has been collected in such a way that confidence limits may be placed on estimates at two sites, but at two other sites less appropriate approaches had to be used oweing to the lack of land-based observation

points needed to regularly track the fate of a sample of nests. Therefore, we will be able to detect fairly small changes in reproductive success and the timing of nesting at Puale Bay and Semidis (the two sites with "good" data), but only substantial changes will be detected at the Barren Islands. We probably will only be able to tell "boom" from "bust" productivity at the Chiswell Islands.

3) Limiting factors - low

Many of the potentially limiting factors will be difficult to examine. We will be forced to experimentally manipulate things like levels of disturbance and nesting density, but even if birds respond to these treatments, there may be other factors involved that will slow recovery. Murres generally do not breed until they are 5 years old, so extra young produced in 1993 as a result of enhanced breeding (assuming reduction in disturbance or some other factor will generate this response) will not recruit to breeding cohorts until 1998.

4) Habitat - nest sites (high); feeding areas (low)

We have high confidence that we know what types of nesting areas murres use in the affected areas. Furthermore, there is a great deal known from other areas about site preferences. In contrast, we have little understanding of feeding areas around breeding colonies, and we have no idea where murres from particular breeding colonies winter.

6. ADDITIONAL DATA NEEDS

What additional data, expertise, and/or further analysis of existing data is needed to improve your confidence in answering questions 2, 3, and 4?

The following recommendations are based on preliminary study results. Final data analyses may alter conclusions or result in further suggestions.

1) Monitoring needs to be continued to evaluate patterns of recovery or to document a lack of recovery. By monitoring populations, nesting phenology, and reproductive success at colonies throughout the trajectory of the oil and just outside the affected area, we will measure the duration of effects and also have the highest probability of understanding the process of recovery following such a perturbation. This activity will be a relatively long-term proposition (e.g., 5-10 years).

2) Reduce disturbances near murre colonies damaged by the EVOS. Colonies of murres that are beginning to recover from mortality caused by the EVOS need special protection from human disturbance. Murres at colonies where a high percentage of the individuals are failing to reproduce tend to be flighty at the slightest disturbance. Individuals with eggs or chicks may also fly when the majority of birds flush, thus leaving eggs or chicks unprotected. Reducing instances of disturbance may allow populations to recover at a faster rate than otherwise. The main sources of disturbance are commercial fishing and charter sport fishing operations. This project would involve launching a public education program over a 3-year period in communities which are the major ports for fishing and charters to areas near murre colonies in the Chiswells, the Barrens, and along the south side of the Alaska Peninsula as far west as Puale Bay.

3) Determine the feasibility of using decoys and playbacks of murre calls to simulate more normal social structure in colonies where loss of adults has resulted in abnormally low densities in breeding aggregations. This project has the potential to help return nesting phenology to normal and enhance breeding success.

4) A study is needed to determine the abundance and distribution of forage fish and evaluate their influence on the recovery of seabirds impacted by the spill. Availability of forage fish, and their potential for unintended manipulation by humans, is an unknown but possibly limiting factor to murre recovery from the EVOS. A baseline study to determine the abundance and distribution of age class 0 and 1 forage fish, once methods for assessing them have been refined, would take 3-5 years in order to begin to understand some of the normal variation.

5) In order to adequately restore the murre population of the spill zone, there must be acquisition or protection of murre nesting habitat and/or shorelines adjacent to foraging habitats. In addition, certain foraging areas may require protection from some kinds of human disturbance during the breeding season, as mentioned above. Areas which should be evaluated for potential murre habitats include the Alaska Peninsula coast, Katmai coast, Kenai coast, and Kodiak, as well as PWS. Absent additional data from suggested studies 1 and 4), above, at least three areas with suitable habitats for which acquisition efforts should be initiated are:

(a) Triplets Islands
Purchase of this 60-acre area for inclusion in the Alaska Maritime National Wildlife Refuge would increase protection of breeding habitat for diving seabird populations impacted by the oil spill. Located within the area affected by the

spill, the Triplets host the largest murre colony in the Kodiak archipelago, about 1400 birds. Cost would be negotiated over a 6-month to 1-year period ending with title transfer.

(b) Gull Island
This small island in Kachemak Bay, just off Homer Spit, is less than 3 acres of land, but it contains over 8,000 black-legged kittiwakes, 2,500 murres, and 5 other species of seabirds. It is the most commonly visited seabird colony by tourists in the area, and it has great biological value as a healthy murre colony. Its acquision would help to offset the loss of murres from the oil spill.

(c) Ugaiushak Island
This 500-600 acre island was affected by the oil, and its acquisition would provide an opportunity for the Fish and Wildlife Service to take actions to enhance populations. The island has 13 species of breeding seabirds, including nearly 10,000 murres (pre-spill counts).

Principal Investigator for the Murre Project is currently:
Vern Byrd, U.S. Fish and Wildlife Service, 235-6546.

Information from murre draft interim reports by Dave Nyswander and Cris Dippel was used for this response as reviewed by Vern Byrd and prepared by:
Ann Rappoport, U.S. Fish and Wildlife Service, 786-3398

DRAFT

USFWS/13 August 1992

Preliminary Information on Habitat Characteristics of Species Injured by the *Exxon Valdez* Oil Spill

1. SPECIES
What injured species do you have expertise in?

Black oystercatcher (*Haematopus bachmani*)

Black oystercatchers are completely dependent upon the rocky intertidal shoreline for their life's requirements. The conspicuousness and size of the adults (and their prey) allows observers to quantify the establishment and maintenance of feeding and nesting territories, and the extensive parental care they exhibit.

Direct effects of oil spills include oiling of adults, chicks, and eggs. Indirect effects include increased difficulty in finding food and contamination of food by hydrocarbons. Oystercatchers forage in the intertidal zone and this area was often heavily oiled after the *Exxon Valdez* oil spill (EVOS).

2. DEGREE AND RATE OF RECOVERY
What is your assessment of the degree and rate of recovery of your injured species?

Degree:	**Recovered**	**Nearly recovered**	**Stable**	**Declining**
	Beginning to recover			
Rate:	**Rapid**	**Moderate**	**Slow**	**Static**
	Moderate			

Comment:
Oiling of Green Island in 1989 did not cause the death or relocation of oystercatchers, or prevent the breeding population from initiating nesting. However, adverse effects of the EVOS to the black oystercatcher did include reduced productivity of the Prince William Sound (PWS) population. Oiling affected the reproductive success of oystercatchers in several ways: (1) the relative egg volume of clutches on impacted sites was substantially lower than clutches on non-impacted sites; (2) weight gained by chicks on impacted nest-sites was significantly lower than by chicks on non-impacted sites; yet (3) biomass delivered to chicks at impacted sites was significantly greater than the biomass presented at non-impacted sites. It is believed that variability in food quality was apparently responsible for the difference in growth rates. At the same time, hatching success, fledging success and productivity were essentially invariant among sites.

Intertidal prey organisms of the oystercatcher experienced

diminished productivity and direct mortality. Mortality of mussels, the main oystercatcher food source in the study areas, was significantly higher on Green Island (an oiled site) than on Montague Island (a non-oiled site) in 1989 and persistent contamination of mussel beds may possibly be transferred to oystercatchers. Direct disturbance by beach-cleaning procedures significantly reduced oystercatcher productivity on Green Island in 1990.

Differences in habitat condition were apparently reflected in the decreased feeding rates and longer feeding times of black oystercatchers on Green Island in 1989. It was postulated that if mortality in mussel beds continued to increase over levels measured in June and July, 1989, the decrease in oystercatcher feeding efficiency could reach a level which could significantly affect the birds' ability to find enough food for their young, or even for themselves, if that had not already occurred.

In 1990, beaches on Green Island received several bioremediation and manual pickup treatments. This intense cleaning activity resulted in dramatic differences in productivity between disturbed and undisturbed nest-sites. Many pairs that had disturbance-induced reproductive failures in 1990 did successfully rear young in 1991.

In 1991, sites on Knight Island, both from oiled and unoiled shorelines were studied, in addition to the Green Island and Montague Island sites studied in 1989. Despite high indirect human disturbance, pairs from oiled Herring Bay on Knight Island had unusually high fledging success (100%). Preliminary counts indicated that the number of oystercatcher predators inhabiting Herring Bay was similar to other Knight Island sites where fledging success was greatly reduced.

Some segments of the PWS oystercatcher population appear to be recovering. The number of breeding oystercatcher pairs on impacted Green Island increased by 50% (from 14 to 21 pairs) between 1989 and 1991 while no change occurred on unimpacted Montague Island. Greater numbers of non-breeders were present around Green Island in 1989 than in 1991. Whether the low density and low productivity found on Knight Island (except in the Herring Bay area) in 1991 is characteristic of this population remains to be determined, particularly relative to predation and how it may interact with oiling effects.

Effects of the EVOS could remain as long as any oil toxicity remains in the food chain. Mussel samples have not yet been analyzed to confirm whether persistent mussel contamination is providing a continued threat to the PWS-wide recovery of

oystercatchers.

3. **LIMITING FACTORS**
What limiting factors, if any, do you think are affecting the degree and rate of recovery of your injured species? Is habitat limiting?

Predation was a major known source of egg losses on both oiled and unoiled sites. It is a constant threat to oystercatchers which nest on the ground with little concealment for the nest. Predation is higher for nests left unattended by adults who have to commute to distant feeding grounds, although lack of parental attendance did not appear to be a factor contributing to chick loss on Green Island in 1989.

Habitat may be limiting given the oil which continues to be released from oiled areas, contaminating shorelines.

4. **HABITAT CHARACTERISTICS**
What are the key habitat characteristics (e.g., vegetation, elevation, proximity to water, slope, aspect, etc.) that are necessary to sustain your species and foster its recovery? Be as specific as possible.

A member of the rocky intertidal community, the black oystercatcher apparently prefers gradual (rather than steep), gravelly shorelines. Substrates on Green Island were generally rockier and those on Montague were more gravelly; the Knight Island area was dominated by steep, even more rocky shorelines, in contrast to the gradual, gravelly shores of Green and Montague Islands. Elevation and shoreline type are largely responsible for differences in breeding pair densities on Green/Montague Island and Knight Island: density of breeding oystercatchers on Green/Montague Island was ten times the density on Knight Island. Black oystercatchers most often chose gravel shorelines for initial nest-sites and for renests. There was higher nest mortality on smooth, basaltic nest substrates than on coarse, gravelly substrates. Knight Island oystercatcher pairs that nested in proximity to arctic terns or mew gulls had a much greater chance of fledging young (63%) than pairs that nested alone (4%). It has been suggested that nest substrate is responsible for variability in black oystercatcher nest predation. Nests placed in substrates where gravel size was similar to egg size were most likely to hatch.

Gradual, gravel shorelines most likely expose a greater surface area for foraging during a falling tide than do steep, rocky shorelines. Thus, they would make more prey available to oystercatchers at any given time. Because of

their obligatory strategy of stabbing gaping bivalves that occur in shallow water, mussel-feeding birds may particularly benefit from foraging on gravel shorelines. Blue mussels were somewhat denser on Green Island than on Montague. Preliminary analyses indicated that oystercatchers selected mussel and limpet prey that are larger than the median size available in the environment.

5. **CONFIDENCE LEVEL**
What is your level of confidence in the answers to questions 2, 3, and 4? (High, Moderate, Low, explain)

2) There is some evidence that recovery is beginning; e.g., numbers of breeding pairs on Green Island increased between 1989 and 1991.

3) Preliminary information suggests that predation is a significant factor in suppressing the rate of recovery.

4) Further work is needed to confirm the benefits of certain foraging strategies, and to develop models of optimum nesting and foraging.

6. **ADDITIONAL DATA NEEDS**
What additional data, expertise, and/or further analysis of existing data is needed to improve your confidence in answering questions 2, 3, and 4?

The following recommendations are based on preliminary study results. Final data analyses may alter conclusions or result in further suggestions.

1) Further information is needed to monitor the oystercatcher recovery, particularly on Knight Island, and to examine the predation pressure oystercatchers exert on invertebrate prey populations also affected by the EVOS. This information should be obtained by:

(a) further developing habitat models and testing those produced in 1991;
(b) continuing to monitor the population recovery, reproductive success and chick growth rates of PWS oystercatchers at impacted and unimpacted sites and determining the role predators may play in oystercatcher recovery;
(c) determining if the continued persistence of hydrocarbons in mussel beds is being transferred to chicks and may be responsible for depressed growth rates; and
(d) comparing the foraging ecology of black oystercatchers on impacted and unimpacted shorelines and elucidating the role that oystercatchers play in structuring the intertidal invertebrate community and the effect they

may have on population recovery of their prey species.

This project will provide information needed to protect suitable marine habitat for oystercatchers, and to monitor the natural recovery of the PWS population and explore the role oystercatchers play in the recovery of invertebrate species. This project can be accomplished in 2 years at an approximate cost of $125,000/year.

2) To adequately restore the black oystercatcher population of the spill zone, important oystercatcher nesting and foraging habitats should be acquired or protected. Areas which should be evaluated for potential oystercatcher habitats include coastal areas along the Alaska Peninsula, Katmai National Park, Kenai Peninsula, Kodiak Island, and PWS.

Principal Investigator for the Black Oystercatcher Project is:
Brad Andres, U.S. Fish and Wildlife Service, 786-3443; and

Project Supervisor is:
Kent Wohl, U.S. Fish and Wildlife Service, 786-3503.

Because the principal investigator for this project is currently in the field and was unable to review this response, it should be considered preliminary and draft. Information from black oystercatcher draft interim reports by Brad Andres was used for this response as reviewed by Kent Wohl and prepared by:
Ann Rappoport, U.S. Fish and Wildlife Service, 786-3398.

RESOURCE OR SERVICE: **DATE:**

OPTIONS RATING

CRITERIA											
1. Potential to improve the rate or degree of recovery											
2. Technical feasibility											
3. Degree to which proposed action benefits more than one resource or service											
4. Measurement of results											
5. Potential for NO additional injury to: * other target or nontarget *resources* * other target or nontarget *services*											
6. Potential effects of the action on human health and safety											
7. The relationship of the expected costs of the proposed action to the expected benefits											

COMMENTS:

RESOURCE/SERVICE: **DATE:**

TRACKING CRITERIA											
8. Degree to which proposed action enhances the resource or service											
9. Will the restoration opportunity be lost if implementation of the option is delayed?											
10. Public comments											

COMMENTS:

Common Murre

I. INJURY

There are approximately 320 seabird colonies, not including the Semidi Islands, that occur within the area affected by the Exxon Valdez oil spill (EVOS). They contained about 319,130 breeding murres. Diving seabirds are known to be easily impacted by oil spills. In addition, these species are long-lived with low reproductive rates, thus making any mortality of adults a critical factor in the species' ability to recover from loss. As the oil exited Prince William Sound (PWS), it collided with large rafts of breeding age murres congregating around major nesting colonies. The resulting mortality included an estimated 198,000 adult breeding birds, representing 60 to 70 percent of the total breeding population of certain major colonies. Extrapolating to include mortality of non-breeders, mortality is estimated to be as high as 300,000 birds. This loss resulted in a major disruption of breeding behavior and phenology resulting in reproductive failure for 1989-91. Dramatic decreases in the number of murres at nesting colonies in the EVOS area were noted in 1989-91 surveys. Murres at all sites associated with oil had either low or no success in producing chicks with either very late egg laying or none at all in 1989-91.

II. RECOVERY

Natural recovery of murres, if it occurs, will occur at a very slow rate and can only be detectable over a long term. Although there are some initial indications that some colonies or portions of colonies are returning to more normal phenology, continued monitoring is needed to determine if these changes will continue and result in improved reproductive success. Critical to murre population recovery is minimization of human disturbance around the impacted colonies. Charter boat and commercial fishing activities are known sources of human disturbance to seabird colonies. Disturbances can cause murres to leave the cliffs, knocking eggs off cliffs, and exposing eggs and chicks to predation.

III. RESTORATION

Management: 4, 7*
Manipulation: 16, 17a, 17b
Protection/Acquisition: 20(a-d), 22(a-d), 27
Other: 33a*, 34, 37d, 38d

* programmatic

Harlequin Duck

I. INJURY

Harlequin ducks experienced two consecutive years (1990-91) of reproductive failure following the Exxon Valdez oil spill. This species were subject to considerable direct mortality resulting from the spill. Boat surveys conducted in 1989 in Prince William Sound indicate that populations of Harlequin ducks have declined in oiled areas compared to the non-oiled areas since 1984. NRDA Bird Study 11 documented levels of petroleum hydrocarbon ingestion with resulting physiological effects. This is associated with consumption of oiled intertidal prey items. Affected ducks exhibit minimal adipose tissue and concentrations of petroleum chemicals and metabolites in liver and bile. Evidence from previous studies suggest that Harlequin ducks are sensitive to human disturbance. The western PWS population was subject to very high levels of human distrubance from the time of the initial oil spill clean-up in 1989 through response activities in 1991.

II. RECOVERY

The combination of oil exposure directly and through the food chain to Harlequin ducks, in conjunction with the massive amounts of distrubance associated with the subsequent clean-up and response activities, has led to cessation of reproduction in these ducks in the oil spill area at least in 1990-91. How long this reproductive failure will continue is unknown, especially in consideration of the unweathered aromatic EVOS crude oil remaining in mussel beds in western PWS in 1991.

III. RESTORATION

Management: 7*, 8a, 8b
Manipulation: 13
Protection/Acquisition: 22a-d, 26
Other: 37b-d, 38b-d, 33a*

* programmatic

Pigeon Guillemots

I. INJURY

The pigeon guillemot is a nearshore diving seabird and as such is highly vulnerable to oil spills. There were 516 guillemot carcasses recovered following the Exxon Valdez oil spill. By extrapolation, an estimated 2,000-3,000 guillemots were killed in the spill zone. The oil spill did not decimate the Naked Island guillemot population. Although a population decline of 25 to 36% was noted, the oil spill was probably responsible for only a portion of that decline. However, boat surveys conducted post-oil spill suggest that pigeon guillemot populations showed greater declines in oiled areas than in non-oiled areas. The Oil spill did not significantly disrupt guillemot reproduction in 1989. While the oil spill may have had adverse effects on reproduction which were not detected, many guillemots at Naked Island reproduced normally in 1989.

II. RECOVERY

Guillemot populations that are known to have declined due to oil pollution appear to have recovered relatively quickly. While most alcids lay a single egg clutch, the larger clutch of the guillemot, typically 2 eggs, gives the guillemots the potential to rebuild their populations faster than other alcid species. The PWS guillemot population has been declining for the past 15 years and the causes of this decline are unknown. Because the sources of this decline are unknown it could be difficult to determine or establish recovery from the oil spill.

III. RESTORATION

Management: 4, 7*
Manipulation:
Protection/Acquisition: 20, 22, 27
Other: 33a*, 34, 37d, 38d

* programmatic

Black Oystercatcher

I. INJURY

Boat surveys conducted post-oil spill in Prince William Sound indicate that black oystercatcher populations declined more in oiled areas than in non-oiled areas. The species reproductive success was studied in 1989-91 at oiled sites and non-oiled site. Effects of oiling on the reproductive success of oystercatchers were manifested in several ways. The relative egg volume of clutches on on impacted sites was substantially lower than clutches on non-impacted sites. Although hatching success, fledging success and productivity were essentially invariant among sites, weight gained by chicks on impacted nest-sites was significantly lower than chicks on non-impacted sites. Biomass delivered to chicks at impacted sites, however, was significantly greater than the biomass presented at non-impacted sites. Thus, variability in food quality appears to be driving the difference in growth rates. Direct distrubance by beach-cleaning procedures significantly reduced oystercatcher productivity in the area in 1990.

II. RECOVERY

Although many reproductive variables appear to be rather invariant between sites and years, ther is evedence that black oystercatchers are recovering. However, persistent mussel contamination could provide a continued threat to the PWS-wide recovery of oystercatchers.

III. RESTORATION

Management: 4, 7*
Manipulation:
Protection/Acquisition: 20, 22, 27
Other: 33a*, 34, 37d, 38d

* programmatic

	ALT #1	ALT #2	ALT #3	ALT #4
Alternative: Title	Natural Recovery (No Action)[1]	Natural Recovery with Protection	Active Restoration: Emphasis on Resource Restoration	Active Restoration: Emphasis on Resource Restoration and Human Use
Explanation	o Assumes that natural resources and services will recover without human intervention. o Nothing is done beyond pre-spill management activities. o Monitoring	o Natural recovery o Protection from further degradation to injured resources and services. o Active restoration (including replacement) when an injured resource or service is not recovering. o Monitoring.	o Over the life of the settlement, use all effective techniques to address the range of injured resources. o Addresses services by addressing injuries to resources they are based upon. o In light of limited funds, schedule options according to immediate needs and most effective techniques. o Monitoring.	o Same as Alternative #3; uses effective techniques to accelerate resources' restoration but puts additional emphasis on those options that will ensure the continuity or enhancement of human use -- fishing, hunting, recreation, and subsistence -- that was interrupted by the spill. o Monitoring.
Resources: Manipulation & Replacement	None	When a resource is not recovering.	Use all effective techniques scheduled according to immediate needs and effectiveness across all injured resources.	Same as #3 except, emphasize those techniques which contribute resources that are part of the human use of the spill area.
Management of Human Use	Normal agency management.	Management to protect injured resources. Management could entail some cost to human use.	Protective management applied where it significantly accelerates recovery of a resource.	Avoid protective management that causes significant cost to human use. Do so by substituting, if possible, manipulation or replacement options.
Protection and Acquisition	None	Recommend that state and federal agencies use protective management until resources recover. Emphasis on acquiring private habitat to prevent further stresses and degradation to injured resources.	Targeted habitat acquisition as needed to ensure protection of the injured resources as they recover.	Same as Alternative #3. For differences in acquisitions between Alternatives #3 and #4, see Services.

* Final after many changes.

Alternatives (cont'd)	Alt #1	Alt #2	Alt #3	Alt #4
Services: Manipulation & Human Use	Normal agency management.	None; however, incidental benefit from protection options directed at resources.	Injuries to services are addressed by addressing the injuries to the resources they are based upon.	Those options which accelerate recovery of services.
Protection & Acquisition	None	None	None	Purchases to include public recreation sites and access.
Other Special Designations Etc	None	Use special designation(s) appropriate to increased protection.		

Note: Monitoring is done in all alternatives.

[1] There is some question whether or not Alternative #1, Natural Recovery, would qualify under NEPA as a "no action" alternative. For example, some money would be spent for monitoring. If this alternative is not the "no action" alternative, another "no action" alternative will be needed. RPWG hopes that such an alternative can be avoided, because Natural Recovery/No Monitoring is an unrealistic alternative. It would be a straw-man alternative that the agencies would be unwilling to stand behind.