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INTERIM REPORT TO THE TRUSTEE COUNCIL

Review of 1989 Natural Resource Damage Assessment for the Exxon Valdez Oil Spill and Proposals for 1990 Studies

February, 1990

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Introduction

This Interim Report contains the recommendations of the Legal Team and Management Team regarding the Natural Resource Damage Assessment ("NRDA") of the Exxon Valdez Oil Spill ("EVOS"). It reviews (1) studies conducted in the 1989 field season and (2) proposals for 1990 field studies.

We analyzed each study in the 1989 study plan ("yellow book") from three perspectives. For each study, we examined, first, whether it allowed us to estimate population impacts resulting from the EVOS. Second, we evaluated each study to determine whether it showed evidence of "sublethal" impacts from the spill. Third, we examined each study from the perspective of whether it showed injury to non-biological resources (e.g., air, land and water). Our method of analyzing these three impacts is discussed below in Section II. Section III contains our combined recommendations regarding the 1989 studies and the proposals for new studies. Section IV summarizes our recommendations in table form.

This Report was prepared with the full participation and cooperation of legal and management representatives of all Federal and State agencies involved in the NRDA process. Our review was conducted over a 2 1/2 month period. During this time, we met with experts retained by the State and Federal Governments ("Peer Reviewers") and Principal Investigators from the agencies conducting the studies. Except as noted below, all of the recommendations contained in this Report represent the consensus of all participants in the review. The following points must be emphasized:

1. Because the timeline for the review process did not allow the Management or Legal Team or the Peer Reviewers to examine detailed study plans for the 1990 studies, further analysis of the costs of the 1990 studies is appropriate. We anticipate conducting this review following submission of detailed 1990 study plans.

2. Studies on which the Legal and Management Team were unable to reach a consensus are specifically noted in Section III. There are only two: Bird Study No. 5 (peregrine falcons); and Marine Mammal Study No. 1 (humpback whales).

3. Some studies that were judged not to be valuable for the NRDA process may be valuable for other purposes, such as restoration planning. Our recommendations are based

solely on the usefulness of the various studies for natural resource damage assessment.

4. For studies proposed to be discontinued, we recommend a budget of $140,000 be included to summarize the data and write final Study Reports.

5. The budget estimates contained in Section III do not include overhead for administrative expenses. We recommend that 25% overhead be budgeted. This recommendation is included as a separate line item in Section IV of the report, at the end of the Summary of Recommendations.

6. The U.S. Forest Service ("USFS") has made a proposal for an Archaeological study at a funding level of $1 million for 1990. Legal Team members for agencies other than USFS have not had an opportunity to review this study and therefore are unable to make any recommendations with regard to it.

7. In preparing our recommendations, we have reviewed and submitted to the Trustee Council all public comments on the NRDA plan.

8. Our highest priority is to discuss with the Trustee Council recommendations for synthesis of the overall NRDA process. Toward that end, we have made certain organizational recommendations contained in Section 5.

II. Methodology for Assessing Natural Resource Damages

A. Population Impact Assessment

One of the primary impacts of the oil spill was the short and long term injury to populations occupying the affected area. These injuries stem from (1) the immediate death of animals due to oil exposure; and (2) a change in vital rates such as post-spill reproductive or survival rates which cause a population depression. The depression may be temporary, followed by subsequent recovery, or it may be permanent, depending upon ecosystem dynamics.

The next section describes theoretical models of population perturbations which underlie our population dynamics analysis. Section 2 sets forth four methodologies which may be used to estimate total population loss. In Section 3, the applicability of these four methodologies to the EVOS is discussed.

1. Population Response to Perturbation[1]

One of the simplest perturbation models of an oil spill impact is an immediate kill followed by gradual recovery of the population to the level it would have achieved absent the spill. This is shown in Figure 1. The natural resource injury suffered consists of (1) animals initially killed plus (2) the loss of population during the recovery period. The "hatched" area in the figure represents the losses during recovery. The population recovery may be delayed if there is a continued post-spill impact on the population due to reduced reproduction, growth, or survival, or due to additional mortality. In that case the recovery would take longer than recovery from an initial kill, as shown in Figure 2.

If the perturbation resulted in permanent loss of habitat, change in the community composition, or permanent changes in survival rates, a population may never recover to its pre-spill abundance. Under this scenario, depicted in Figure 3, the legal damages for the injury would include the cost of artificial restoration, replacement, or the acquisition of equivalent resources.

It is possible that a population may experience an initial decline from immediate exposure and then recover to a level above the pre-spill population, due to decreased competition after the

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[1] The models presented below are simplified and are offered for conceptual purposes only. Population response in nature is generally much more complicated due to the influence of a variety of factors not discussed here.

FIGURE 1

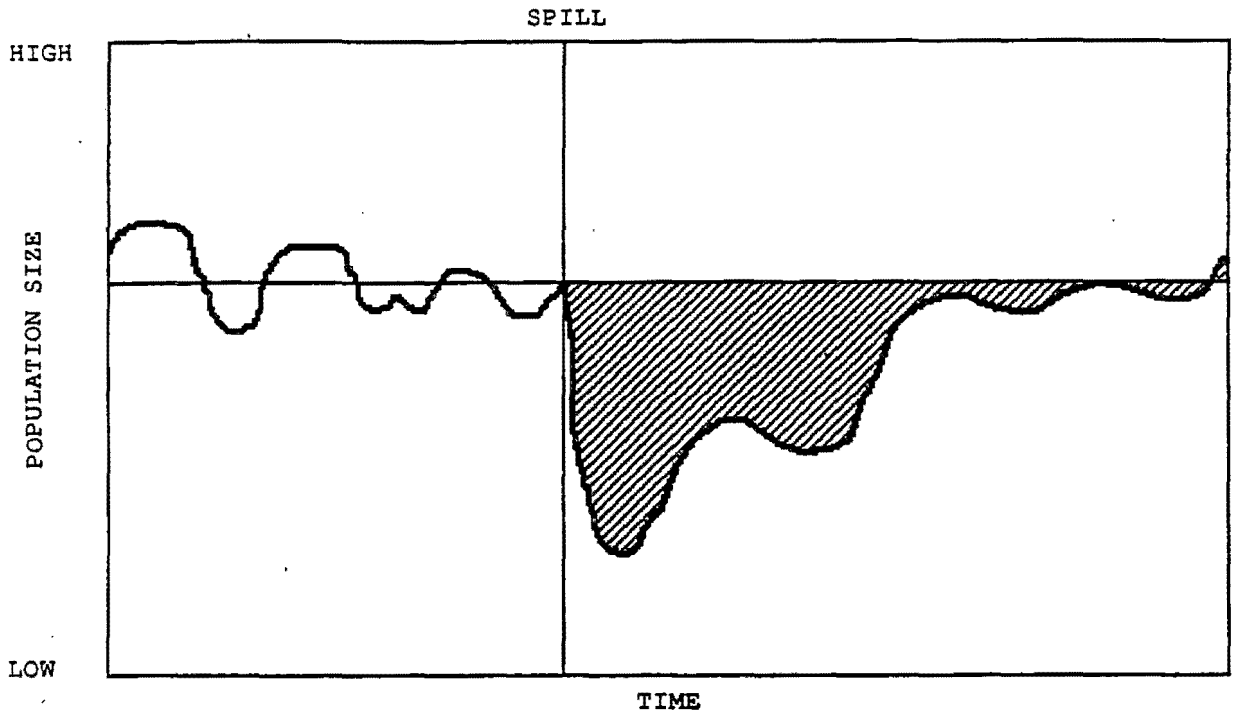


FIGURE 2

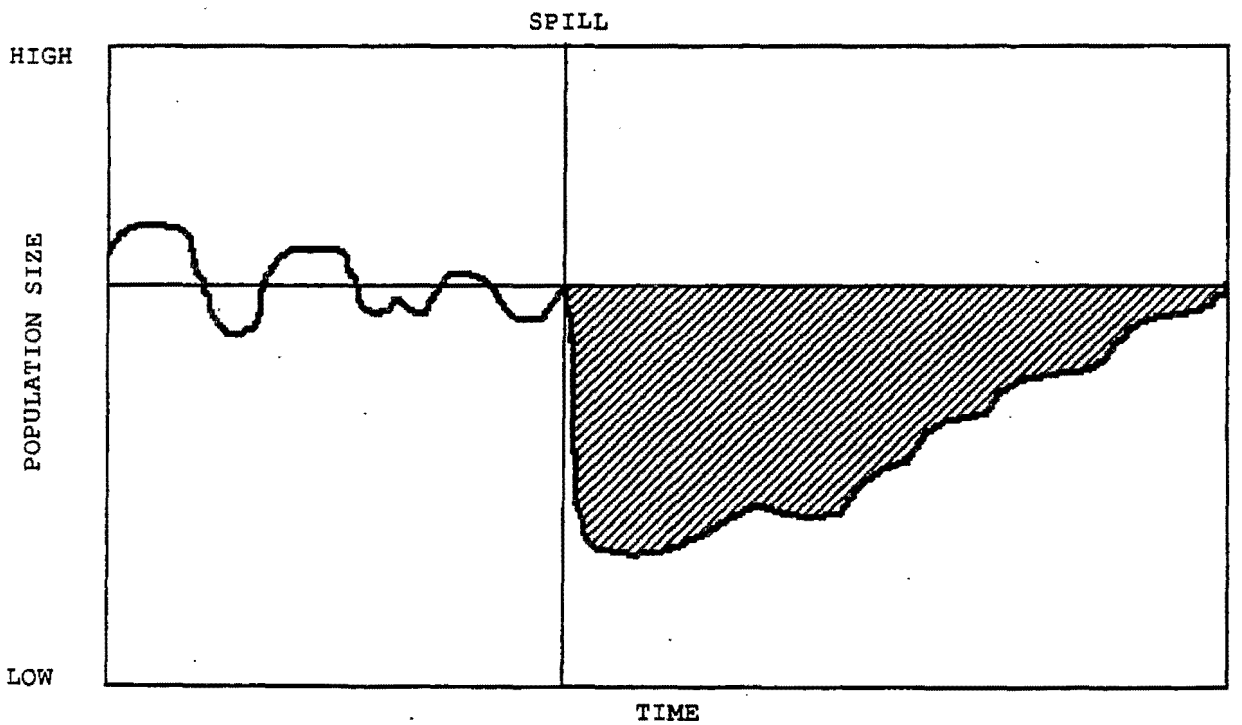


FIGURE 3

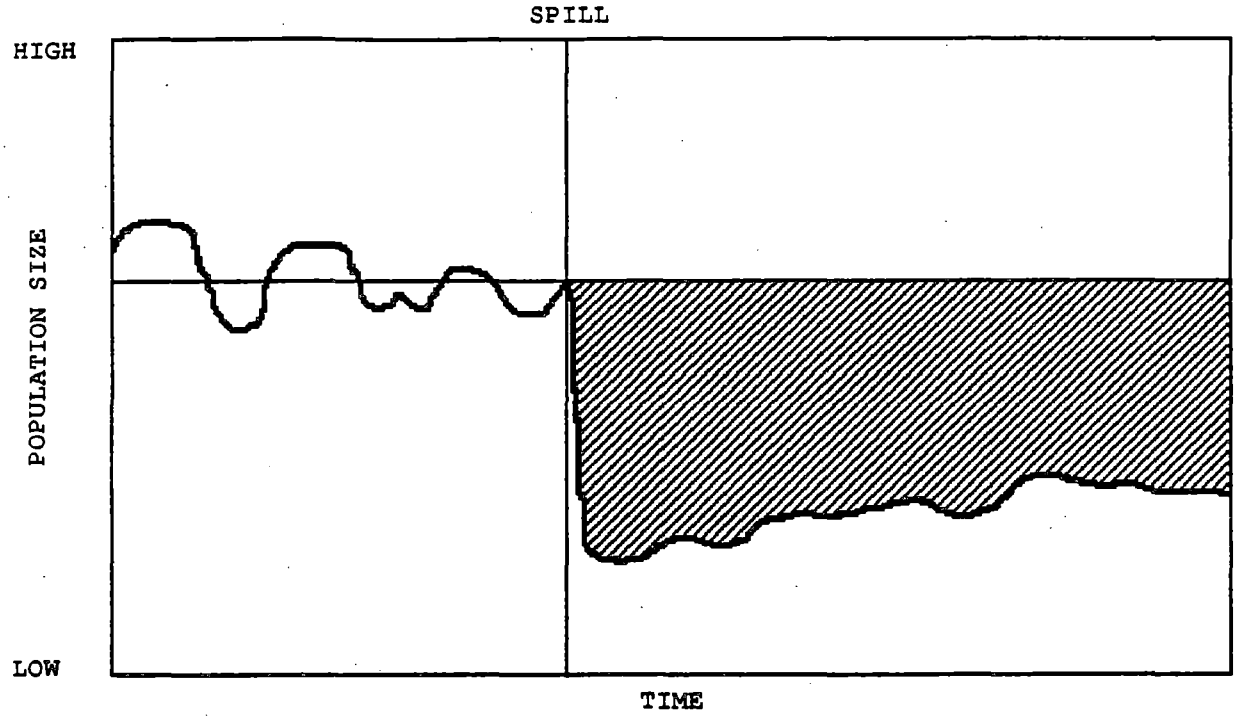
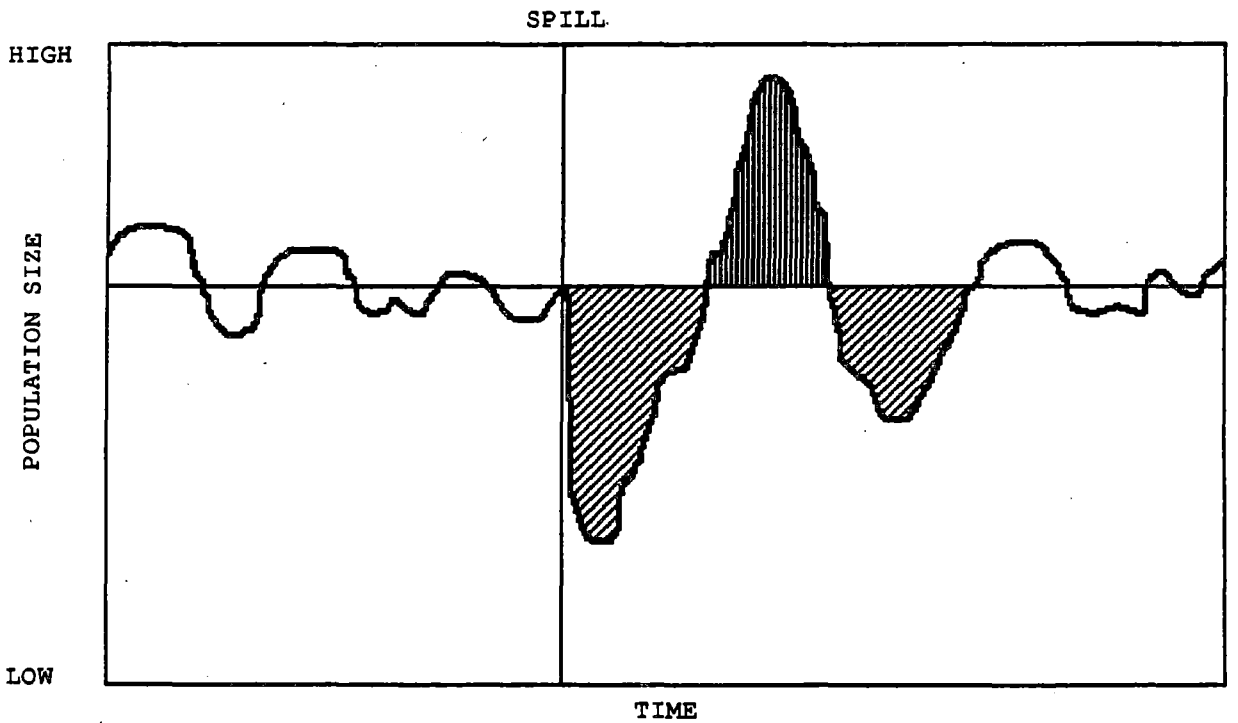


FIGURE 4



spill, a change in other pre-spill mortality factors such as commercial harvest rates, or some other permanent alteration of the ecosystem. Such a population "surge" may be followed by a significant decline prior to recovering to pre-spill levels. See Figure 4. Under this scenario, the injury would be the difference between the total population loss (represented by the diagonal lines) and the population surge (represented by the vertical lines).

2. Methodologies for Assessing Population Impacts

There are four general methodologies for assessing population impacts from an oil spill. The applicability of each methodology to a particular species will depend on whether the information needs of the methodology are available. The methodologies are:

a. Direct Mortality: Body Count and Enhancement

This methodology consists of determining the number of animals initially killed by the spill or the "immediate" impact. This is done by conducting an inventory of recovered carcasses, estimating what percentage of that number was killed by oil exposure, and estimating what percentage of the total population killed by oil was not recovered.

i. Recovered bodies

For some species, particularly birds and mammals, large numbers of dead animals have been recovered. A certain portion of those animals died of natural causes, while others probably died of exposure to oil. For each species, it ~~will be necessary~~ is desirable to determine what percentage of the recovered bodies were killed by oil.

ii. Estimated Total Immediate Deaths

The number of carcasses recovered after a spill usually represents only a fraction of the direct mortality. The proportion of total kill recovered may vary widely depending on the species, search effort, oil on the beach, scavenging, burying of carcasses, wind and current patterns, wave action, and other factors. When possible, an estimate should be made of what proportion of the total number of killed individuals were actually recovered. This may require establishing an experimental program to assess the wash-up rate of marked dead individuals, or simulating drift and recovery rates by some other method.

b. Temporal Comparisons of Population Sizes Before and After the Spill

When historical population data are available, comparison of pre- and post-spill numbers may be made to assess the change in population. Essentially, the pre-spill information can be used to forecast what the population would have been absent the spill. This may then be compared with the actual population as tracked after the spill. The statistical power of such a comparison will depend upon the reliability of the pre- and post-spill census methods, the natural variability of the population, the magnitude of change induced by the spill, and the total amount of data available for comparison.

c. Post-Spill Spatial Comparison of Population Size in Oiled and Unoiled Sites

When populations can be surveyed in otherwise comparable oiled and unoiled sites, it may be possible to assess the impact of the spill even when pre- and post-spill data are not available. Again, the power of this method will depend on the reliability of the census method, the natural variability from site to site, and the magnitude of the change induced by the spill.

Combining the temporal and spatial comparisons can provide the most powerful evidence of an impact, if such data are available. Such a "before and after" contrast of populations at oiled and unoiled sites controls for both spatial and temporal differences which are unrelated to the oiling. For example, it may be that the population of murres at an island which was heavily oiled has historically been approximately 15% lower than the population at one of the unoiled control sites. A post-spill comparison which indicates that the oiled site population is 30% lower than the unoiled, therefore, suggests that the spill caused a 15% population decline.

d. Measurement of Changes in Vital Rates and Prediction of Recovery Trajectory

Where populations have been sufficiently depressed or vital rates sufficiently impacted, it may take an extended period of time for the population to recover to the level it would have reached absent the spill. It may be necessary, therefore, to predict the recovery time using some type of model. In species where it is difficult to measure abundance, but vital rates can be measured, population dynamics models may provide the most useful tool for assessment of impacts. The standard models of population dynamics include:

i. the logistic growth model (Schaefer model) and its variations;

ii. the Leslie model of survival and fecundity; and

iii. the Beverton-Holt age structured models, with assumptions about recruitment and density dependent stages.

Where the relevant vital rates can be measured, they may be used in these population dynamics models to predict the future trajectory of the population.

3. Applicability of Population Dynamics Methodologies to Individual Species or Categories of Species

An analysis of population impacts for each species under consideration may include one or more of the four approaches described above. For some species counting dead bodies may not be possible, but it might be quite feasible to measure a change in survival rates. For other species, the data available may be sufficient to apply all four methodologies. Set forth below is a brief analysis of how relevant each methodology is for assessing population impacts on the species. Additional discussion of the appropriateness of these methodologies is contained in the specific comments for each study (Part III of the Report).

a. Finfish

Very few fish carcasses have been collected in connection with the EVOS. The only form of direct mortality that may be relevant to finfish is a change in egg or fry survival resulting from the spill. In the case of pink salmon, sockeye salmon, and herring, sufficient historical data are available to permit pre- and post-spill comparisons of population size. Post-spill spatial comparisons of oiled and unoiled sites are also possible for pink salmon, sockeye salmon, herring, Dolly Varden char, and cutthroat trout. Spatial comparisons for sockeye salmon and herring, however, would require several years of study given that it takes them 4-5 and 5 years respectively to be reared, migrate to sea, and then return to spawn.

A number of vital rates can be measured for pink salmon, including eggs produced per female, spawning success and egg retention, egg survival, fry to adult survival, fry to adult growth rates, and growth in the first few weeks of marine life. Differential rates between oiled and unoiled streams can be used in a life history model to estimate damage due to oiling. Similar comparisons can be made for sockeye salmon and herring.

1. Shellfish

Few if any shellfish carcasses were collected following the EVOS. Direct mortality estimates, therefore, are not available. In addition, pre-Spill data is not available for most of the shellfish studied.

Spatial comparisons between oiled and unoiled sites is possible and was undertaken for the brown king crab. Many of the shellfish populations, however, demonstrate a high degree of natural spatial variability, making it difficult to demonstrate impacts through oiled/unoiled comparisons.

Population impacts on clams and scallops could theoretically be assessed by analyzing changes in growth rates, as the shells for these species conveniently document seasonal growth patterns. The populations of dungeness crabs and sea urchins in affected areas were too small, however, for any spill impact to be detected by any of the population dynamics methodologies.

C. Marine Mammals

Of the marine mammals studied, only sea otter carcasses were found in any significant numbers. The carcasses collected can be analyzed to determine the general age structure of the population immediately impacted by the spill and the reproductive status of the females killed. It may be possible to use this information in turn to assess population recovery periods through the application of age structure models. The strength of any model prediction will depend, however, on whether we are able to adequately assess post-spill growth rates.

In general, for the other marine mammals studied, pre- and post-spill as well as spatial comparisons between oiled and unoiled sites represent the most feasible techniques for assessing population impacts.

d. Birds

All four methodologies are potentially relevant to a population dynamics damage assessment for birds. Heavily oiled birds came ashore in large numbers during the first months following the spill, and carcasses continued to wash up on beaches for much of the year thereafter. The bodies recovered ~~will have to~~ be sampled and those samples analyzed to determine what percentage actually died from exposure to oil. Typically, the number of bird carcasses recovered after a spill represents only from 5 to 60% of the direct mortality. Field studies and computer modelling designed to determine the rate of carcass loss can be used to arrive at an estimate of total immediate kill.

A comparison of pre- and post-spill population sizes requires a baseline set of data taken before the spill, and a replicate set of data collected after the spill. Colony and at-sea populations for seabirds are highly variable, however, and the historical data are, for the most part, insufficiently precise to be able to demonstrate limited die-offs for most seabird species. Generally, population changes less than 20% will be undetectable, and for some species it will be difficult to detect changes of less than 50% or more. In cases where a difference can be demonstrated, comparisons of populations in oiled and unoiled sites may be highly useful for inferring an oil spill impact.

Demonstrating long-term projections of population changes would require developing population models for the major species affected by the spill, i.e. murres, ~~scaducks, murrelets,~~ etc. Two basic kinds of data are required for such a model: survivorship rates and fecundity measured in terms of nesting, hatching, and fledgling success. Historical data on fecundity are available for some of the species involved, but survivorship data are generally lacking for birds in Prince William Sound and Alaska in general.

e. Terrestrial Mammals

Very few terrestrial mammal carcasses were found last field season which could be linked to the spill. Many of the animals studied spend more time in upland areas than on beaches and, therefore, their carcasses would be hard to locate even if many died of oil exposure. In addition, pre-spill data are lacking for all species studied. The most feasible methodologies for analyzing population impacts on terrestrial mammals, therefore, are spatial comparisons at oiled and unoiled sites and projecting population changes based on a change in vital rates.

Post-spill spatial comparisons between oiled and unoiled sites can be done through direct observation, by studying fecal droppings, and by tracking mammals fitted with radio transmitters. Data on mortality rates and productivity also can be collected through radio tracking and used in projecting population changes. It may not be feasible, however, to instrument enough animals in oiled and unoiled areas to provide statistically valid comparisons. The reasonableness of pursuing either of these methodologies will depend on the size of the populations at issue and the economic value which may be assigned to a population loss.

B. Methodologies for Assessing Sublethal Effects.

The preceding section described methodologies for quantifying the lethal effects of the EVOS. "Sublethal" impacts are effects at the organism community and ecosystem level that do not result in acute mortality of organisms.

1. Assessing Injury At The Organism, Community, And Ecosystem Level

Injury to the natural environment can be identified at organism and community levels and, can be inferred to apply at the ecosystem level under certain assumptions. The potential exists for identifying and quantifying injury through direct observations and measurements or by inference from field and laboratory data or scientific literature. It is possible to translate injury at the organism level to injury at the community level in two ways: (1) when injury at the organism level is determined to be pervasive and the role of the organism is known to be prominent in strong ecological interactions (e.g., plant-herbivore, predator-prey, competitors); and (2) by manipulation of certain components or elements of the community to test the response to disruption of these ecological interactions. Extrapolation to the ecosystem level requires reliable knowledge of the extent, concentration, and form of the insult, the organisms' response, and the distribution of the community in the system.

2. Complementary Assessment Strategies.

The sublethal effect of the EVOS can be analyzed using four complementary strategies:

(1) statistically precise, unambiguous descriptive studies;
(2) field experiments;
(3) dose-response evidence based on field and laboratory measurements that relate injury to doses of petroleum and its derivatives; and,
(4) use of risk assessment methods to project injury based upon empirical relationships developed under the first three strategies, and on the use of scientific literature.

These strategies can be used to develop a cause-and-effect chain of evidence to demonstrate damages from oil contamination. Each of these strategies should, if possible, be focused primarily upon elements of the ecosystem and their interactions with ecological networks[2] of organisms that are both economically important and likely to have come in contact with oil and that are representative of the estuarine and marine communities that predominate in the affected ecosystem. This approach provides a "template" upon which each of the strategies, both singly and in

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[2] Ecological networks are defined as the complex web of linkages among species--typically food web linkages, but they may also involve competitive, inhibitory, or synergistic interactions.

concert, can be implemented in the most productive and legally defensible manner.

In developing and implementing statistically precise descriptive studies, one must take into account natural variability and other characteristics of the areas affected by the spill (e.g., differences in exposure of intertidal communities, mainland, and island sites because of low salinties from freshwater run-off , and exceptionally cold temperatures before the spill). In many instances, effective selection of paired treatment sites (oiled/nonoiled, pre-/post-spill, or both) or field manipulative experiments (using techniques such as transporting oiled rocks between beaches to assess oil effects on recruitment) can be used to eliminate or minimize the influence of confounding factors.

Producing strong empirical or experimental results showing pervasive, long-term changes in communities which can be unambiguously tied to the EVOS is the ultimate goal. In many instances, however, direct evidence of such changes will probably not be available. As a viable alternative, studies that generate data in support of exposure and dose-response relationships with respect to the effects of petroleum (and its conversion products) on growth, reproduction, and behavior can be used to provide strong evidence demonstrating damage from oil contamination.

The first step in this cause-and-effect chain of evidence is to examine dose, i.e. (1) whether there are hydrocarbon derivatives in the immediate environment of the organism and (2) whether the organism accumulates hydrocarbons or their environmentally-formed derivatives. The most basic type of evidence in this regard is whether the oil physically contacted the species of interest. Photographs and records of visual observations can be effectively used in this case as supportive evidence. The other kind of basic evidence is whether hydrocarbon derivatives were <u>measured</u> in the environment of the organism. Measurements of concentrations of oil derivatives in the water, in sediments, in porewater, on rocks, or in the food of the species of interest are used to establish this link. If hydrocarbons or metabolites of oil components are detected in the organism, then the causal link to damage becomes stronger.

Since many species metabolize hydrocarbons, it is likely that analyses of tissues will either not detect the parent compounds or the concentrations will not be representative of the magnitude of exposure. It is therefore necessary to perform other analyses, such as to measure the levels of metabolites in the organism to estimate the degree of exposure or to measure the activity or concentration of enzymes that metabolize hydrocarbons. Since certain enzymes are inducible with exposure, measurement of these enzymes provides a surrogate estimate of dose that is indicative of exposure, usually for days to weeks. Another useful aspect of

enzyme measurement is that the products of metabolism include some toxic compounds. Therefore enzyme assays are a measure of potential for injury as well as an indication of exposure.

Other examples of biochemical changes associated with oil exposure include adducts formed by the reaction of aromatic hydrocarbon metabolites with DNA or proteins, interference with lipid metabolism, and alterations of steroid metabolism. The consequence of exposure responses on higher levels of organization, i.e., at the tissue, organ, or integrative physiological level, can be shown in many ways. For example, disruption of membranes can indicate accumulation of hydrocarbon derivatives (e.g., metabolites) in the lipid layer of the membrane. Lipid accumulation in vacuoles can indicate effects of hydrocarbon derivatives on lipid metabolism. Narcosis may indicate the interference of hydrocarbons derivatives with the transmission of nerve impulses. Alteration of the number of eggs produced by females or in their viability may indicate that some aspect of reproduction, perhaps mediated by hormones, has been impaired. Hydrocarbon derivatives can also impair the efficiency of cellular immune responses so that the organism becomes more susceptible to disease.

The next link in the chain of cause-and-effect is to show population changes. For example, change in embryo viability, abundance of young, or in recruitment may be a direct effect of some impairment of reproduction. These alterations can then be manifested as a change in absolute abundance of the population or as a shift in the age structure of the population due to poor recruitment of larval survival. Controlled laboratory experiments can be conducted under conditions that mimic or partially adopt field conditions, and can assist in identifying damages to organisms that can be translated to population effects (i.e., effects on reproductive success, etc.). For example, pink salmon eggs and fry could be removed from oiled and unoiled redds (spawning grounds) to the laboratory for further monitoring of egg/alevin development and mortality, genetic abnormalities, and the induction of hydrocarbon-metabolizing enzymes, all of which are a measure of exposure to oil. The loop of causation as it affects populations is closed at this stage of ecosystem effect.

A complete ecosystem study and approach to the EVOS has been suggested by some public committees, but we find that it is scientifically impractical and therefore undesirable. The best way to achieve the goal of demonstrating ecosystem effects is to identify "ecological networks" (organisms linked by strong interactions such as plant-herbivore, predator-prey, competitor, parasite, etc.) known to be important in Prince William Sound and other ecosystems affected by the Oil Spill, and to identify key organisms in these networks upon which to focus studies and experiments. If sublethal effects can be clearly identified or

predicted, some level of modeling can also be employed to estimate community-ecosystem effects. Reduced growth or reproduction, or behavioral adjustments that can modify distribution or abundance, even acting in the absence of mortality, can produce important system-wide consequences.

In addition to the above strategies for demonstrating damage, various risk assessment methodologies can be used. The objective of an ecological "risk assessment" is to quantify injury. The magnitude and extent of injury are measured on the basis of a select set of ecological endpoints (i.e., death, growth, etc.) that are considered reasonable indices of the status of biological populations and communities.

Predicting injury through a "risk assessment" strategy broadens the legal and scientific basis for assessing injury and establishing costs associated with lost use and recovery. This is especially true in cases where injury to resources are obfuscated in the field.

The procedures for injury assessment discussed above are not unique. They are, in fact, similar in principal to approaches currently being used in ecological risk assessments for hazardous waste sites. Using the above-described strategies, one can develop an interlocking picture evidencing cause and effect of oil contamination on organisms and their ecosystem.

C. Methodologies for Identifying and Quantifying Impacts to Non-Biologic Resources

A group of studies in the 1989 Plan, particularly Air/Water Studies Nos. 1-5 and the Coastal Habitat study, were used to assess damages to non-biologic resources (surface water, water column, beaches (intertidal sediments), subtidal sediments and air) as well as to demonstrate exposure of biologic resources to hydrocarbons and by-products from the spill.

The strategy of the 1989 Studies was to locate and quantify hydrocarbons from the spill in the various compartments of the environment over space and time.

1. Impacts to water.

a. Surface water. Two methodologies for identifying and quantifying impacts to surface water were used in 1989: mapping of descriptive observations, and sample analysis for hydrocarbon components.

i. Descriptive observations (mapping). As part of its spill response function in 1989, the Alaska Department of Environmental Conservation (ADEC) tracked the spread of the spill

by aerial overflights. Maps of the path of the slick are being prepared based on ADEC's aerial overflight data (Air/Water Study No. 1). These maps show the location of the large mass of oil on the surface relatively early in the spill. They do not show smaller quantities such as tarballs, oily debris, etc. on the surface of the water.

ii. Analysis for hydrocarbon components. The University of Alaska-Fairbanks (UAF) collected offshore surface water samples in Prince William Sound over the first three weeks of the spill for analysis for volatile hydrocarbons. In the nearshore zone, ADEC collected surface water samples at 22 moderately and heavily oiled sites in Prince William Sound in the fall of 1989. These studies were done as parts of Air/Water Study No. 3.

b. Water Column. Impacts to the water column were evaluated in 1989 by analysis of water samples taken at various locations, depths, and times, and using several techniques. Except where indicated below, these were done in Air/Water Study No. 3.

i. Analysis for hydrocarbon components. The National Marine Fisheries Service (NMFS) collected water samples from depths of one and five meters in Prince William Sound during the first five weeks after the spill. Concentrations of petroleum hydrocarbons were found to be generally below the detection limit of the screening technique (1 mg/l.). As part of its response function, outside the NRDA process, ADEC collected numerous water column samples during five cruises inside and outside Prince William Sound during the summer of 1989. The data require extensive review, however, to determine if they may be suitable for use in the NRDA process. ADEC also collected samples of water in the beach matrix for analysis for hydrocarbon components as part of its Air/Water No. 3 study.

ii. Deployment of mussel cages. Mussels bioaccumulate hydrocarbons in the water column and can indicate ongoing low-level contamination below the detection limits of water sample analyses. NMFS deployed mussel cages at 30 locations inside and outside of Prince William Sound to measure the presence of low level hydrocarbons.

iii. Analysis of sediments collected in sediment traps. Sediment traps are designed to collect sediments and associated hydrocarbons that are transported through the water column. ADEC deployed sediment traps subtidally in Prince William Sound as part of its 22-site study referred to above. The UAF also deployed sediment traps early in the spill, outside the NRDA process.

iv. Microbiological studies. The presence and metabolic activity of hydrocarbon-degrading bacteria provide a fairly inexpensive indication that hydrocarbons persist and natural

degradation is not complete. As part of Air Water Study No. 2, ADEC enumerated hydrocarbon-degrading bacteria in the nearshore water column and interstitial water and evaluated their ability to degrade hydrocarbons.

v. Toxicity analysis. Analysis of the toxicity of water that may contain hydrocarbons or oxidation by-products is another method of showing impacts to water. Continuing toxicity may occur in the water flowing through and off of beaches containing residual oil. This type of analysis is not presently being done, but could be useful in demonstrating ongoing injury to the intertidal environment. It would involve laboratory simulations and exposing organisms to the runoff water or laboratory exposure of organisms to water collected in the field.

2. Impacts to sediments.

a. Beaches and intertidal sediments. Impacts to intertidal sediments were evaluated in 1989 by descriptive surveys, sampling for hydrocarbon components, and analysis of microbial activity. Other methodologies that could be used include volumetric analysis to determine the total volume of hydrocarbons in the sediments, analysis of toxicity of sediments, and beach transecting to obtain more detailed observational data on oiling at a particular location.

i. Descriptive surveys (mapping). ADEC conducted aerial overflights to determine the extent of oil on the beaches in 1989 as part of its response function. The data from these surveys are being compiled on maps showing the surface distribution of oil in the areas impacted by the spill (Technical Services Study No. 3). These maps show the degree of oiling based on the surface coverage of the beach by oil. They do not reflect the thickness of oil or the depth of penetration into the sediments. More precise maps will be prepared using data from ADEC's walking survey ("walk-a-thon") of all moderately and heavily oiled areas conducted in September, 1989. This survey provides the most detailed and comprehensive view of oiling, although it was conducted late in the season when some of the oil may have been removed.

ii. Analysis for hydrocarbon components. Impacts to beaches and intertidal sediments are being evaluated by sampling for hydrocarbon components. NMFS took samples of intertidal sediments at 29 locations in Prince William Sound and 25 sites outside the Sound as part of Air/Water Studies Nos. 2 and 4. The Coastal Habitat Study group also took sediment samples at 111 study sites that are to be analyzed for hydrocarbon components. Finally, ADEC collected sediment samples in its 22-site study referred to above.

iii. Toxicity testing. NMFS tested the toxicity of intertidal and subtidal sediments collected in the Air/Water Studies Nos. 2 and 4, using a Microtox bioassay to test the inhibition effect of sediment extracts on the bioluminescence of a species of bacteria. Other standard bioassay methodologies, such as using fish larvae, bivalve larvae, or amphipods as test organisms, are not being done.

iv. Microbiological studies. NMFS evaluated the hydrocarbon degrading potential of bacteria in intertidal and subtidal sediments and enumerated the numbers of hydrocarbon degrading bacteria in Air/Water Study No.4, as discussed above.

v. Analysis to determine the volume of oil in sediments. This is not presently being done. As part of its 1989 response effort, ADEC collected sediment samples from the intertidal zone at approximately 120 locations inside and outside Prince William Sound. The ADEC samples were collected for analysis of the amount of oil in the sediments and are presently archived.

vi. Beach transecting. This was done on a large scale by NOAA and ADEC as part of their 1989 response functions. The methodology involves establishing a beach transect perpendicular to the shoreline, diagramming the beach composition, elevation, and degree of oiling along the transect, and collecting samples for hydrocarbon analysis. It provides more detailed oiling descriptions than could be obtained from the aerial overflights and could be used to calibrate overflight data. ADEC evaluated some 120 such transects in Prince William Sound and NOAA evaluated additional transects in their response capacities. ADEC continued its program in conjunction with its study of 22 sites in Prince William Sound referred to above.

b. Subtidal sediments. Impacts to subtidal sediments have been evaluated by chemical and microtox sampling, as discussed above. Several different agencies have sampled the subtidal zone.

i. Analysis for hydrocarbon components. NMFS and ADEC collected subtidal sediments for analysis for presence of hydrocarbon components.

ii. Analysis for toxicity. NMFS analyzed subtidal sediments for toxicity using the Microtox method as part of Air/Water Studies Nos. 2 and 4.

3. Impacts to Air

a. Modelling of air impacts. Given the short duration of any impacts to air and the lack of direct measurements of such impacts, modelling is the only feasible methodology of evaluating impacts to air. A model is being developed under Air/Water Study No. 5.

4. Synthesis of Impacts to the Non-Biologic Resources.

An additional methodology for evaluating overall impacts to the non-biologic resources that is not presently being utilized is to synthesize the data on particular impacts into a mass-balance "budget" or accounting of the spill over time. Such a budget, which also is referred to as a mass balance or box model, can provide a comprehensive (quantitative and qualitative) description of the location of the oil and its degradation by-products in all major compartments of the environment over time, including, for example, amount evaporated, amount in intertidal sediments and toxicity, amount in water column and toxicity, amount in subtidal sediments and toxicity.

This type of synthesis would be developed using empirical data, and as such is distinguished from purely theoretical predictive models. It can be used to make predictions based on the data to date, however, as well as to present an integrated explanation of the fate of oil up to the present.

EXXON VALDEZ NRDA STUDY RECOMMENDATIONS

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS						
1	Water Birds/Beached Birds	X		USFWS	$258,000	$450,000

COMMENTS

This is one of the most important of the bird studies from a population dynamics perspective, as it provides a minimum estimate of bird mortality caused by the oil spill. Approximately 30,000 dead birds were recovered in the 1989-90 field season. The study should be modified in the 1990-91 field season to include (1) analysis of the recovered carcasses to determine what percentage of that 30,000 died from oiling rather than natural causes; (2) development of a model to estimate the potential total kill -- i.e. to estimate what percentage of birds killed by oil did not wash up on beaches; and (3) field experiments to support the modelling effort which will document oiled bird floatation times, drift, and survival rates once beached. In addition, documentation (photos and/or notes) of birds in oil at sea should be collected -- especially for birds under-represented in the beach counts.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS						
2	Census & Seasonal Distribution	X		USFWS	$565,000	$400,000

COMMENTS

The shoreline boat survey documented a decline in pigeon guillemots, black oyster-catchers, and possibly marbled murrelets. To the extent that these are breeding birds which normally demonstrate site fidelity, population loss would be the most reasonable explanation if birds fail to return to pre-spill abundance in 1990. Boat surveys should be continued in 1990 with increased coverage of oiled areas in PWS and the Kodiak area ~~and should be coordinated with pigeon guillemot and marbled murrelet surveys near Naked, Peak, Storey, Ingot, and Knight Islands.~~ Survey design should be reviewed by statistical consultants. Aerial surveys of waterfowl use should be repeated for all spill affected coastlines in Feb/March and Spring 1990 and again in Jan. 1990 if affect on seaducks is severe. This latter survey should be coordinated with Study #11.

Additions/deletions: This study corroborates several of the individual species studies with regard to changes in behavior. It is essential to conduct winter and spring surveys by aircraft as well as long-term boat surveys. The 1990 survey should be comparable to the 1989 pre-spill survey.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS 3	Seabird Colony Surveys	X		USFWS	$440,000	$150,000

COMMENTS

This study is highly valuable to a population dynamics assessment, as it indicates there was a substantial die-off of murres (up to 60-70% of murres breeding on Barren Island) and suggests a decline in pigeon guillemots, both species one would expect to be vulnerable to oil. Body count evidence corroborates the hypothesis that missing murres were probably killed by oil (74% of beached birds were murres). Few guillemots were found in the beach survey, making it more difficult to establish any population decline was due to mortality versus re-distribution. Another census should be conducted in 1990 for murres and kittiwakes, ~~and, potentially, pigeon guillemots.~~ In addition, an effort should be made to link murre reproductive failure to oil, including conducting hydrocarbon tests on eggs and old and new nest material in oiled and unoiled areas. Also, investigators should attempt to gather evidence showing murre and pigeon guillemot numbers had not declined before the spill.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS						
4	Bald Eagles	X		USFWS	$445,000	$500,000

COMMENTS

This study is highly valuable to a population assessment, due to the potentially high value that may be assigned to individual eagles and the indication that the oil spill resulted in significant mortality and a decline in productivity. Aerial surveys of the eagle population should be completed in spring 1990 to assess whether the population has declined since the April 1989 pre-spill count. If this survey indicates a significant decline, it could be used to imply many more were actually killed than the 151 recovered carcasses. Additionally, comparisons of eagle reproduction rates should be made in oiled and comparable oil-free areas. Prey samples should be collected in the 1990 survey. Results of hydrocarbon analysis of prey, blood samples, and eggs will be important for linking productivity changes to oil contamination. Blood samples should be assayed for hemolytic anemia. Tracking of radio-tagged eagles should continue to determine if the birds were foraging in oil-contaminated areas.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS						
5	Peregrine Falcons		X	USFWS	$43,500	-0- ($200,000) *

COMMENTS

The value of this study from a population dynamics perspective is limited given the small population of falcons inhabiting PWS and the coastal Kenai Peninsula (40-60 pairs). The 1989 survey demonstrated lower numbers of occupied nests and lower numbers of young produced per successful nest than historical rates in Queen Charlotte Islands or the Western Aleutians. The geographical differences between these areas, however, severely limits the usefulness of this comparison. If samples of feathers grown last year were collected and found to contain nickel and vanadium, indicating oil exposure, it would at lease suggest that the change in population and productivity could be due to the oil contamination. The consensus of our Peer Reviewers, however, is that this study should be dropped. ~~They ranked it 12th in importance out of the 15 bird studies.~~

NOTE: ADF&G strongly disagrees with this recommendation and believes the study should go forward. It believes that Bird Project 5 has demonstrated a high probability of oil related mortality to perrigrine falcons, a charismatic animal and high-level predator. In 1989 the study found that: (1) Falcons occupied only 26 percent of the known nesting sites, a number well outside and below the observed range of natural variability for this species; and (2) Abnormally low productivity of young characterized the few nests found occupied.

Apart from the possibility of pesticide contamination, no hypothesis other than oiling has been advanced to explain these findings. Egg shell samples should be collected and analyzed to rule out the pesticide hypothesis. Feather samples should be taken and analyzed as recommended by the State's ornithology Peer Reviewer, in order to further document the source of oil contamination. The recommendation to discontinue this study, if accepted, will abrogate an important element of the Trustees' responsibility to document and recover natural resource.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS 6	Marbled Murrelets		X	USFWS	$115,700	-0-

COMMENTS

This study is of marginal value. Even if there was an actual decline in the murrelet population in certain contaminated areas, it could be due to mortality or redistribution or a natural decline in murrelet numbers since the original baseline transects. Instead of continuing the study, all 1989 hydrocarbon samples should be analyzed, and murrelets should be re-surveyed as part of the 1990 survey for Bird Study #2.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS						
7	Storm Petrels		X	USFWS	$135,000	-0-

COMMENTS

No measurable population impact was demonstrated by the 1989 study. No significant difference was found in reproductive success. Analysis of stomach oils, eggs, and dead chicks for hydrocarbons should be completed, as the results could demonstrate contamination that would be useful in painting a picture of broad ecological damage.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS 8	Black-Legged Kittiwakes		X	USFWS	$190,000	-0-

COMMENTS

Approximately 1220 dead kittiwake carcasses were collected after the spill as part of the beached bird count. An estimated 40,000 of these birds nest in 30 colonies in Prince William Sound. Of the 24 colonies studied, 10 were oiled. Results of the study show that reproductive success of kittiwakes within the oiled colonies were lower than expected when compared to results from uncontaminated areas. Such a decline in reproductive success potentially could be used in combination with the initial death count or an enhanced estimate of total immediate deaths to arrive at a long-term estimate of deaths caused by the oil.

There are five years of pre-spill studies of kittiwakes. There are several nest sites available for study. Lower reproductive success was noted in oiled areas. There is a balanced oiled and unoiled study group. ~~We recommend that the field studies focus on reproductive success. There's~~ a need to check the remaining old nests, get old and new nests to compare oil contamination and to develop lab experiments with eggs, young, and adult to get a dose response and check for sublethal effects. Also, data should be gathered on reproductive success from oiled colonies. There is significant loss at the egg stage via predation. Laboratory analysis and field manipulative studies are recommended. Laboratory analysis should include blood samples for hemolytic anemia, and should include MFO on eggs. Investigators should do liver analysis and look for food contamination and egg contamination. PIs may want to experiment with oiled maxipads in nests and to follow those nests. The PI has some additional material developed for his thesis which is not included in the data available in this study.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS						
9	Pigeon Guillemots		X	USFWS	$109,500	-0-

COMMENTS

This study found evidence of a decrease in pigeon guillemots on Naked Island and that the greatest decline was in the most heavily oiled areas. These findings are confounded to a large extent, however, by a documented overall population decline in Prince William Sound pigeon guillemots between 1972 and 1985. The total PWS pigeon guillemot population was approximately 5000 birds in 1984-85. Data from this study should be combined with studies #1 and #2. In addition, boat surveys conducted under study #2 should give complete coverage to Naked Island and repeat transect done in earlier surveys. ~~This study was ranked 9 out of 15 by the peer reviewers.~~

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS						
10	Glaucous-Winged Gulls		X	USFWS	$73,000	-0-

COMMENTS

This study focused on the reproductive biology of gulls nesting on Egg Island, outside Prince William Sound, and obtained no data from any colony within the oiled portion of the Sound. The study, therefore, is of no value in establishing population impacts attributable to the oil spill. If the study were modified to compare oiled colonies (i.e. on Perry Island) with unoiled colonies within the Sound, an impact might be demonstrated. Gulls, however, are not generally viewed by the public as a unique or valued bird species. Even a demonstrated population impact, therefore, would bring only a small recovery.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS 11	Sea Ducks	X		USFWS	$146,000	$100,000

COMMENTS

Preliminary analysis of results indicates that harlequin ducks which forage in the intertidal area are in poorer condition than those sea duck species which forage farther offshore. This study has potential, therefore, to provide evidence of either a decline in food sources in near-shore oiled areas or direct hydrocarbon contamination of intertidal-feeding ducks. The study does not support a population dynamics analysis, since it focuses on habitat and species contamination and does not provide an estimate of the number of sea ducks killed by the spill. It has value, however, in a sublethal analysis, particularly in demonstrating food chain impacts.

We recommend that the study be limited to harlequin ducks and golden-eyes. Scooters should not be studied.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS 12	Shorebirds		X	USFWS	$166,000	-0-

COMMENTS

Black Turnstones: This study described the use of staging and foraging areas by migrant shorebirds, in particular black turnstones and surfbirds, and provided information on turnstone reporduction on the Yukon-Kuskokwim Delta. It is no value to a population dynamics assessment, as no population impact was documented.

Oystercatchers: Study showed reduced chick survival and reduced food intake rates in oil-contaminated areas. Value to population dynamics assessment is low, however, given the relatively small number of chick mortalities involved. The consensus among the Peer Reviewers was that the oystercatcher study was well designed and well executed, but unlikely to establish a significant recovery.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
BIRDS 13	Passerines	X		USFWS	$59,000	$10,000

COMMENTS

Onshore behavioral surveys of the shoreline should continue to record passerine observations in the intertidal zone, at a reduced level from what was proposed in 1989.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
BIRDS 14	Migratory Birds		X	USFWS	$10,000	-0-

COMMENTS

This study was not done in 1989 and has not been proposed for continuation in 1990.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
MARINE MAMMALS						
1	Humpback Whale		X *	NOAA	$226,000	-0- ($122,000)**

COMMENTS

This study did not detect a decline in the population of humpback whales in Prince William Sound, but it did find the reproductive rate for these whales to be at its lowest in eight years. It would be difficult, however, to link this decline to the oil spill. Absent such a link, this study has little value to a population dynamics analysis. Moreover, it is not possible to conduct chemical analyses for sublethal effects.

*NOAA disagrees with this conclusion.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
MARINE MAMMALS						
2	Killer Whale	X		NOAA	$200,000	$255,000

COMMENTS

Seven individuals from one pod (the A/B pod) as well as members from several other pods were found to be missing this year. If these seven whales did not appear in 1990, the 1988-89 mortality rate would be 19.4%, several times higher than in previous years. Good data from earlier years exists. If the missing whales fail to appear again next year, continued observation and tracking of the whales seems worthwhile. The main reason for continuing this study is the high visibility that killer whales maintain within the public eye and the high value they might correspondingly be assigned should an impact be demonstrated.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
MARINE MAMMALS						
3	Cetacean Necropsy		X	NOAA	$73,000	-0-

COMMENTS

It is unlikely that samples taken from cetaceans will be fresh enough for histological examination. Even if obtained in a timely manner, it is unlikely that any causal relationship could be established. The samples should be held but not analyzed at this time.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
MARINE MAMMALS 4	Sea Lion	X		NOAA	$270,000	$150,000

COMMENTS

Additional population dynamics analysis of sea lions is not recommended as results from 1989 did not demonstrate significant body counts on significant difference between pre- and post-spill populations. This may be due in part to the fact that variances on aerial counts of these marine mammals is quite high, making it difficult to detect changes in distribution and abundance, and the sea lion population in Prince William Sound and the Gulf of Alaska has been in decline over the last 30 years. In addition, sea lion mobility confuses oiled and unoiled comparisons, and modelling population impacts and recovery rates using changes in vital rates would be very difficult to do.

Nevertheless, we believe sea lions are worth studying as part of a sublethal analysis. This study should focus on analyzing whether there has been a change in premature pupping, reproductive rates, and behavior, which could indirectly suggest population changes. Scientists should also collect the placentas for tissue analysis for mixed function oxidaze (MFO) on surviving and nonsurviving pups.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
MARINE MAMMALS						
5	Harbor Seal	X		NOAA	$245,000	$150,000

COMMENTS

Investigators for this study were able to conduct a pre- and post-spill comparison of oiled and unoiled sites. This comparison revealed a greater-than-expected population decline in oiled areas. Aerial surveys of haulouts and rookeries, therefore, should be continued to monitor population numbers and estimate adult to pup ratios. The investigator should also continue taking a full range of samples for toxicology and histopathology analyses from any animals that are collected. However, no additional live seals should be collected under existing federal collection permits unless positive evidence of oil contamination and related physiological changes are found in existing samples and until investigators have received approval from the Trustee Council. Toxicology and histopathology tests should be completed as soon as possible, especially those taken from sacrificed animals. As feasible, the investigator should collect information on reproductive behavior, pup growth rates and food habits.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
MARINE MAMMALS 6	Sea Otter Impacts	X		USFWS	$763,000	$1,056,000

COMMENTS

This study is very important given the number of sea otters in nearshore areas directly impacted by the spill (over 1000), the potential for estimating recovery rates, and the relatively high economic value that is likely to be assigned to sea otters. In addition, it appears that otters in off-shore areas may also have been impacted. If this is substantiated by additional study, it could dramatically increase mortality estimates.

Tests on beached carcasses should be completed to determine what percentage died from oiling and to determine the age of the otters killed. This data may allow projection of population recovery rates. A carcass search should be conducted in early spring to supplement the body count. A drift experiment should be undertaken as well to determine wash-up rates.

Sublethal impacts should also be studied as blood samples show potential liver and kidney damage. We recommend investigators apply DNA and hemoglobin adduct analyses to samples from the tagging study and existing samples, examine tag/recaptured animals for cataracts, ensure histopath analysis is double blind random. We strongly recommend a high priority be placed on body burden sample analysis, especially on tagged individuals (30-40 animals from Fall '89). Investigators should attempt to gather corroborating data on behavior, especially weanlings which can be linked to chemical analyses and fresh carcasses. The PIs should be given guidance on sampling invertebrates for toxic dose information. Further comments: 1984-85 baseline data exists; female-pup ratio data not available over time but comparable over space; use weanling mortality as a prime indicator of habitat change.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
MARINE MAMMALS						
7	Sea Otter Rehabilitation	X		USFWS	$108,000	$130,000

COMMENTS

This study should continue as designed for the same reasons cited in comments to Study #6.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
TERRESTRIAL MAMMALS						
1	Sitka Black-Tail Deer	X		ADF&G	$87,000	$40,000

COMMENTS

Dead animal counts have been one of the major methods for assessing spill effects on sitka black tailed deer. Carcasses found in a pilot study, however, were so decayed that investigators could not determine whether they died of natural causes or oil exposure. The current study plan envisions conducting a beach survey from January 1990 to the end of the winter for dead or visibly stressed animals. We recommend that investigators complete this winter survey at a budget level of $17,300. The viability of further study should be assessed based on those survey results. Additional damage assessment should proceed at that time only upon approval of the Trustee Council.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
TERRESTRIAL MAMMALS						
2	Black Bear	X		ADF&G	$139,700	$10,000

COMMENTS

Principal investigators were not able to use helicopters to capture bears for marking and therefore had to discontinue the project in 1989. Investigators propose to undertake a limited literature search in 1990 to determine whether prior studies have demonstrated that black bears are impacted when denied their preferred food source. We recommend this literature search receive funding.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
TERRESTRIAL MAMMALS						
3	River Otter/Mink		X	ADF&G	$287,700	-0-

COMMENTS

Preliminary analysis indicates that the rate of mink fecal deposition rates between oiled and unoiled areas is approximately the same. Investigators propose to complete the radio-tagging of 40 mink and 40 otter in 1990 to compare population size, food habits, and habitat use in oiled and unoiled areas. Very little data was collected in 1989 because most of the effort was devoted to establishment of study areas and development of techniques. Therefore, no data are available to indicate that an impact might be found if the study were to proceed. Given the high expense of the study and this absence of evidence to support continuation, we recommend the study be discontinued. Existing samples should, however, be analyzed at an estimated cost of $10,000.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
TERRESTRIAL MAMMALS						
4	Brown Bear	X		ADF&G	$162,700	$110,700

COMMENTS

Investigators propose to fit 30 bears with radio-collars and follow them for three years to obtain mortality, population, and hydrocarbon contamination data. The results would be compared with a similar study now being conducted in the unoiled Black Lake area. Since brown bears are a high profile species that are endangered or threatened in all states other than Alaska, we recommend the study be continued.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
Terrestrial Mammals						
5	Carnivores/Small Mammals		X	ADF&G	$302,400	-0-

COMMENTS

This study has not been proposed for continuation.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
Terrestrial Mammals						
6	Mink Reproduction		X	ADF&G	$192,200	-0-

COMMENTS

This study is designed to determine if short and long-term ingestion of weathered Prudhoe Bay crude oil by captive ranch mink affects female reproduction. The reproductive variables to be studied would include breeding behavior, number of kits per litter, kit survival, kit growth and maturation, and histology of adult and kit reproductive traits. Observations would continue until weaning, when animals would be euthanized and necropsied. While the study itself is well designed, there is no demonstrated connection between the lab experiments and the actual exposure animals are receiving in the environment. Given the relatively high cost of this study, the lack of any data to suggest that actual mink mortality caused by the spill was significant, and the relatively low value likely to be assigned mink, we recommend this study be discontinued.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
1	Salmon Spawning Area Injury	X		ADF&G	$144,800	$391,300

COMMENTS

This study is an integral part of any pink salmon population impact assessment in Prince William Sound. It supplements the existing escapement database and will contribute to a pre- and post-spill comparison of population size, a post-spill spatial comparison in oiled and unoiled sites, and in measuring changes in vital rates between oiled and unoiled streams. Differential rates between oiled and unoiled streams can be used in a life history model to estimate population damage due to oiling. Since any claim for damage will depend on the escapement data, there must be systematic and well designed studies to validate the bias and variability of escapement counting methods.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH/ SHELLFISH.						
2	Salmon Eggs & Preemergent Fry	X		ADF&G	$149,100	$302,800

COMMENTS

This study has already demonstrated oil spill population impacts by revealing a 30% increase in egg mortality. It supplements the existing egg deposition and pre-emergence data, particularly by including more oiled sites in the sample. The results could provide direct mortality data by comparing egg survival rates in oiled and unoiled areas. In addition, the study will contribute data relevant to pre- and post-spill population comparisons, post-spill spatial comparisons, and to measuring changes in vital rates.

The study also could provide valuable information for an analysis of sublethal impacts. We recommend expansion of studies with field experiments to assess long-term and sublethal effects of spawning habitat contamination, including transplanting (in baskets) of fertilized (hatchery) eggs into streams with varying degrees of contamination, followed by regular monitoring of egg development and survival. Investigators should do MFO measurements in field-collected eggs, larvae and fry. In laboratory studies, investigators should measure egg membrane disruption, cytogenetics, and growth behavior.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
Fish Shellfish 3	Salmon Coded Wire Tagging	X		ADF&G	$1,943,400	$1,943,400

COMMENTS

This study provides information useful to a population dynamics analysis. The coded wire tagging allows investigators to analyze survival rates for fish released into oiled versus unoiled hatcheries and wild streams. This information primarily contributes to an analysis of vital rate changes, although differences in survival can be thought of as body counts. The coded wire tag (CWT) fish will also be used to analyze early marine distribution and growth in study #4. The spatial and temporal distribution of the CWTs in the commercial catch will be used to help allocate catch to streams of origin for temporal and spatial comparisons of oiled areas with pre-spill conditions or unoiled areas. Data from this study could also be used to allocate catch to streams of origin or "run reconstruction." In the absence of reliable run reconstruction, we will be unable to do a comparison of total adult production at any spatial scale except for PWS as a whole.

The Legal Team has reservations regarding the cost effectiveness of this study, and suggests further review of these cost estimates.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
4	Early Marine Salmon Injury	X		ADF&G	$829,200	$300,000

COMMENTS

This study should be redesigned to focus on elements relevant to a sublethal analysis. The study should consist solely of laboratory and/or field manipulative experiments, with priority on field manipulative experiments measuring growth using otoliths/diet composition/consumption.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
Fish Shellfish						
5	Dolly Varden/Cutthroat Injury	X		ADF&G	$437,400	$269,000

COMMENTS

Of all of the finfish species, Dolly Varden char and cutthroat trout are the most exposed to the oiled marine environment. Oil contamination may affect growth and survival. There is, however, no background data on either species. In 1989, emigrating fish were counted, measured, aged, and tagged in several systems, including oiled and unoiled areas. In 1990, investigators propose to sample the fish tagged in 1989 to determine growth and survival rates. Re-sampling during the 1991 field season may be necessary for reliable survival estimates. Post spill spatial comparisons constitute the only possible population dynamic assessment technique for these species. The experimental design is such that comparisons are almost sure to detect differences if they exist. This study provides the data needed to conduct this assessment.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
6	Sport Fishery Harvest & Effort		X	ADF&G	$175,900	-0-

COMMENTS

This is an economic study, and does not produce information that is useful to the damage assessment.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
7	Salmon Spawning Area, Outside PWS	X		ADF&G	$320,300	$539,400

COMMENTS

Overescapement caused by closure of the fisheries is felt to be the major oil spill impact on pink salmon in the Kodiak area (7b). The first component of this study supplements the existing escapement database and is essential to estimating overescapement impacts on pink salmon. Damage from overescapement may include a decline in average egg survival as a function of spawning density. Published studies on overescapement can be used to estimate the effect of overescapement on vital rates. Escapement counting methods used for the Kodiak area will need to be validated. Special care must be taken to ensure that testing of escapement methods is done in areas representative of most of the Kodiak streams, i.e. this needs to be repeated/extended on six or seven different streams to validate the overescapement. PI's need to work with Salmon Team to assure statistically valid results.

A second component of this study takes place in Lower Cook Inlet (7a), and parallels the project being conducted within Prince William Sound under Study #2.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
8	Egg & Preemergent Fry, Outside PWS	X		ADF&G	$111,400	$293,300

COMMENTS

This study has 2 components, one in Lower Cook Inlet (8a) and the other in the Kodiak area (8b). It supplements the existing egg deposition and pre-emergence data, particularly by including more oiled sites in the sample. The results could provide direct mortality data by comparing egg survival rates in oiled and unoiled areas. In addition, the study will contribute data relevant to pre- and post-spill population comparisons, post-spill spatial comparisons, and to measuring changes in vital rates.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
9	Early Marine Salmon, Outside PWS		X	ADF&G	$348,500	-0-

COMMENTS

This study does not provide any useful information for assessing the impact of overescapement. In addition, in the absence of coded-wire tag fish, it will be of no use in assessing growth or migration patterns in oiled and unoiled sites outside of PWS.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
10	Dolly Varden/Sockeye, Lower Kenai		X	ADF&G	$152,600	-0-

COMMENTS

This study did not get underway in 1989 due to logistical problems, and there is little likelihood of detecting an effect in 1990 given the passage of time.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
11	Herring Injury	X		ADF&G	$374,500	$400,000

COMMENTS

This study includes intensive spawn sampling and special egg mortality studies. Data gathered will be valuable for a population dynamics assessment. With regard to a sublethal analysis, no petroleum hydrocarbon sample results are available but there is seemingly strong evidence of egg/larvae impacts. We recommend (1) MFO on existing archived samples; (2) analyses for body burden; and (3) specific laboratory studies (if not available in literature) of dose-response relationship.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
12	Herring, Outside PWS		X	ADF&G	$60,000	-0-

COMMENTS

It seems unlikely that this study would provide useful information if carried forward into 1990.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
13	Clam Injury	X		ADF&G	$86,200	$175,000

COMMENTS

It would seem, under a cost/benefit analysis that obtaining a reasonable recovery for any documented clam population loss may be unlikely. The value of this study, therefore, appears to be in the contribution it would make to a sublethal/ecosystem damage assessment. We recommend sampling Protothaca saxidomus and Siliqua under a balanced oiled and unoiled, clean and not cleaned design, and expanding growth analyses to include analysis of shell microstructure and an oil "stress check". We suggest conducting reciprocal transplants with indigenous clams and with a common, clean source of clams. This is a substantial redesign of the 1989 studies. Our recommendation is to combine former studies 13 and 21 into a single clam study including selected areas outside PWS. In addition, it may be possible to fold this study into the Coastal Habitat study. Note that if the recommendation for Calibration of Oil Spill Effects is adopted, it may affect study design and funding needs.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
14	Crab Injury		X	ADF&G	$142,000	-0-

COMMENTS

Insufficient numbers of Dungeness crabs exist in western PWS to test for oil effects. Lack of baseline data on brown king crabs precludes population change detection for that species. Not enough samples were taken in unoiled sites to permit a statistically reliable comparison of oiled and unoiled areas. Also, there is no definite evidence of subtidal contamination. We recommend, therefore, that this study be discontinued.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
15	Shrimp Injury	X		ADF&G	$60,500	$65,000

COMMENTS

This study addresses effects of oil on spot shrimp growth and reproduction. Sampling conducted in 1989 suggestd lower catch-per-unit effort in oile areas and higher mortality of eggs (which are held externally) in oiled areas. These shrimp are relatively immobile, near shore, and relatively deep. Oil at depth is probably more likely sometime after the oil has hit the adjacent beach and picked up in sand and debris particles. This study would provide information on dammage at depth as opposed to damage being a near surface phenomenon.

There will be problems applying results to the population at large but the relatively low costs associated with this project make it worthwhile.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH 16	Oyster Injury		X	ADF&G/NOAA	$30,500	-0-

COMMENTS

Analysis of oil spill impact cannot be made based on the results of the 1989 study. A new study could be designed using before and after spill data at the three existing oyster farms to assess whether oil affected oyster mortality or growth. Such a project may cost around $30,000. Since oysters are not a native species, however, the value of such a study to the natural resource damage assessment process is highly limited. In addition, the oyster studies are largely redundant of mussel studies.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
17	Rockfish Injury	X		ADF&G	$45,600	$50,000

COMMENTS

This study determines the presence or absence of hydrocarbons in the ecosystem in a cost effective manner, but, except for the recovery of dead fish--which has been minimal--it does not contribute to a population dynamics assessment. We recommend that it be reoriented to provide evidence of the geographic extent of spill impacts on the reef community. The modified study should include (1) capturing recently recruited rockfish for age, growth, and contamination analyses; (2) sampling adult rockfish for body burden and stomach contents; and (3) sampling unconsolidated sediments and sessile invertebrates (e.g., suspension feeders such as sponges) for indication of residual contamination. Investigators should study at least four reefs between Bligh Reef and Lower Kenai (e.g., Herring Bay). Historical data on communities in both Prince William Sound (Rosenthal) and Lower Kenai (Morison) need compilation and interpretation.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
18	Trawl Assessment	X		NMF&S	$738,800	$86,100

COMMENTS

This trawl assessment surveys for finfish other than salmon, herring, Dolly Varden char, cutthroat trout, or rockfish. These "other" finfish live their entire lives in the marine environment. Little is known about the spatial movements of some of these fish, making it difficult to determine whether any change in abundance is due to redistribution, recruitment, or survival. In addition, it is difficult to measure vital rates of these fish. Realistically, because of the high natural variability of the species, lack of data points, and uncertainty in migration patterns, there is little possibility of detecting population dynamics impacts.

Preliminary sampling, however, indicates that some fish from the first year trawl had abnormally high levels of contaminants in their bile. We recommend, therefore, a continuation of this study, but at a substantially reduced level.

Representative samples of offshore trawl species should be processed for body burden. If evidence of burden exists, investigators should follow up by analyzing corresponding histopath samples, i.e. gonadal material. Investigators need to coordinate fish sample analyses with sediment sample analyses to confirm hydrocarbon source. In addition, investigators need to analyze stomach contents and literature for representative prey and to sample benthic prey for contamination (especially nearshore).

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
19	Larval Fish Injury		X	ADF&G	$413,400	-0-

COMMENTS

This study will not prove useful in any population dynamics assessment. We recommend that the 1989 samples be archived.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH 20	Underwater Observations		X	ADF&G	$550,100	-0-

COMMENTS

It is not recommended that this study continue, as no oil was detected in 1989 at any of the sites surveyed.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
21	Clams, Outside PWS		X	ADF&G	$108,800	-0-

COMMENTS

See comments for Study #13.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
22	Crabs, Outside PWS		X	National Marine Fisheries Services	$111,500	-0-

COMMENTS

The 1989 study lacked adequate control sites to determine whether a statistically significant population difference existed between oiled and unoiled sites. No growth data were taken. Tissue hydrocarbon data were collected but cannot be readily related to growth. Only one Dungeness Crab was captured so a fecundity analysis was impossible. In addition, mobility of crabs makes it difficult to establish that any fecundity differences, if seen, are caused by oil. Finally, as sea otters reinvade the area their influence on crab abundance will confound any future assessments of oil effects on mortality and abundance.

We recommend, therefore, discontinuing this study.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH 23	Rockfish, Halibut, Lingcod - Lower Kenai		X	ADF&G	$108,400	-0-

COMMENTS

This study does not address population dynamics and is not likely to demonstrate impacts.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH 24	Trawl Assessment, Outside PWS	X		NMFS	$2,495,800	$150,000

COMMENTS

Preliminary sampling indicates that some fish in nearshore areas outside Prince William Sound have abnormally high levels of hydrocarbon metabolites in their bile. We recommend continuing this study, but limiting it to nearshore areas outside Prince William Sound and with a reduced effort, not to exceed $150,000.

NMFS has reservations that the study can be done at this cost.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
25	Scallop Resources Injury		X	ADF&G	$53,800	-0-

COMMENTS

The field experiment should be discounted because the treatment mimics neither natural scallops nor aquaculture situations.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
26	Sea Urchin Injury		X	ADF&G	$45,000	-0-

COMMENTS

Any population impact, if detected, would not be large because the geographic overlap of oiled areas and green urchin distribution is so small. Moreover, the sampling protocol prevents a quantitative analysis of oil impacts for those limited areas where urchins were present. Also, human and otter predation will confound interpretation of any density differences. We recommend, therefore, that this study be discontinued.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
COASTAL HABITAT						
1	Comprehensive Assessment	X		USFS	$5,436,000	$6,300,000

COMMENTS

1. Scale back supratidal field study. Focus on particular beaches where damage is likely, such as beaches where winter storms force oil onto supratidal areas. Coordinate supratidal study with terrestrial mammal studies to provide information required. Continue small 1990 sampling effort on how oiling affects digestibility of key forage species (especially Elmius) in one-step and two-step digestion processes in the supratidal. Consider using walkathons to obtain information on scope of oiling. Should develop standardized procedures for photography of oiled areas.

2. First priority in intertidal habitat study should be to utilize existing "before and after" data bases to test whether oil had any biological effects on intertidal communities, and the magnitude of any such effects. An experiment-oriented scientist such as Highsmith should choose those data sets that represent the appropriate and rigorous contrast of control (unoiled) and oiled sites before and after oiling, using sites that were initially biologically similar. The National Park Service's quantitative quadrat data, especially the data collected by Dr. David Duggins, may be the best data for this purpose. The photographic transect data collected by the NOAA Auke Bay coastal habitat study may also be suitable, depending on whether it includes both oiled and unoiled stations, incorporates replication, contains photographs taken at exactly repeated quadrats, utilized a scale of photographs that allows sufficient discrimination of organisms, and includes oiled and unoiled sites that were initially similar biologically. All photographs that can be used in a rigorous before/after contrast should be analyzed to obtain biological data, and those data should be analyzed statistically and interpreted.

3. The major effort in the Coastal Habitat Study should be directed towards rocky intertidal and coarse textured biota on sheltered and exposed shores. This focus is a result of the extensive exposure of these areas to oil, and the importance of these areas to the food chain. Key food chains include (1) mussels to sea otters, ducks, surf birds and subsistence users, (2) limpets to oystercatchers and surf birds and (3) seaweeds (Fucus, etc.) to amphipods and small snails to fishes and others. Mussels are particularly important as organizing species within the rocky intertidal community and as forage species. There is a substantial ecological literature on the impact of mussels on other organisms.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
COASTAL HABITAT						
1	Comprehensive Assessment	X		USFS	$5,436,000	$6,300,000

COMMENTS

Continued:

4. The statistical design, which provides for sampling at random within habitat types in order to permit inductive extension to entire geographic areas, is appropriate. It must be supplemented, however, by selection of some non-random, deliberately selected, control and oiled sites. Sampling of lightly oiled sites should be scaled back. Should consider experimental study to determine effects of light vs. moderate/heavy oiling.

The problem of providing control sites with similar geographical, biological and salinity characteristics must also be addressed. Although the statistical framework is elegant, it should be maintained only for the intertidal study habitats and even for those the overly ambitious work schedule may prevent the use of this statistically elegant approach.

5. The major problem with the study is how to reduce the balance the work load of the biologists with the analytical resources so that results can be obtained in a timely fashion. Either sites must be reduced or more lab sorters hired. Data collection and analysis for the summer 1990 field season should be completed by January 31, 1991.

6. The oiling status used to classify intertidal sites and to extrapolate to basin-wide effects cannot be based solely upon the September walkathon, because there had been significant decreases in oiling at some sites by September. The study should use observational data, plus all available historical data pertaining to the study sites.

7. All possible information on cleanup efforts must be assembled and compared against each study site to insure that cleanup has not caused an improper assignment of oiling status at any study site.

8. For rocky intertidal sites, and perhaps for some other intertidal habitat categories, the seven set-aside areas where no oil cleanup was performed should be utilized to assess the biological

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
COASTAL HABITAT						
1	Comprehensive Assessment	X		USFS	$5,436,000	$6,300,000

COMMENTS

Continued:

impact of oiling as separate from cleanup activities. This is important both to show effects separately and for future management of oil spill response activities. A study to separate effects of oil and cleanup requires careful pairing of some oiled set-aside areas with nearby presumably ecologically analogous unoiled sites and oiled-but-cleaned sites. Since several different cleanup methods were employed, this design could become rather elaborate and extensive but limited information on the exact mode and intensity of cleanup activity probably precludes an elaborate design.

9. The 1990 study of intertidal areas should include explicit attempts to assess recovery rates of oiled systems. These should include some studies of recolonization rates on oiled vs. unoiled plots and should incorporate the necessary statistical designs to permit powerful tests of effects of oiling on recruitment of key rocky intertidal species. If any long-lived species or species with limited dispersal abilities appear affected by oiling, some attention to their site of recruitment and recovery should be made. Such species include certain starfish, soft corals, coralline algae, tunicates, etc.

10. Larval recruitment of barnacles, limpets and possibly benthic algae could be measured by matching rocks of similar composition from heavily oiled and totally unoiled sites, cleaning half of each rock chemically, stabilizing the rocks in intertidal areas both that retain oil and are free of oil. The design has four treatments, control for the chemical treatment and site effects, and will permit a quantitative assessment of recruitment. The same design using fibrous materials such as hemp or polyester rope could be used to study recruitment of mussels.

11. Reestablishment of soft bottom benthos could be studied by constructing bottomless and topless boxes of some inert material such as plexiglass, filling half with oiled sediment and half with clean sediment, after removing most or all of the resident fauna. Replicated pairs are placed in unoiled and oiled environments, preferably in low energy areas.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
COASTAL HABITAT 1	Comprehensive Assessment	X		USFS	$5,436,000	$6,300,000

COMMENTS

Continued:

12. Annual or daily growth rates, corrected for individual size, of bivalves, fish or benthic algae should be compared on a before-and-after or on an oiled vs. unoiled basis to provide information on whether the presence of oil is correlated with impaired biological performance.

13. Shallow subtidal studies should focus on three habitat types: nereocystis, laminarian and eelgrass beds. A limited number of sites (approximately 6) should be selected to represent heavily oiled and control sites with appropriate comparisons for each of the three habitat types and enclosed embayments and more exposed shores.

Sufficient replication to allow statistical application to the entire affected area is not feasible. Comparisons must be made between selected oiled sites and appropriate controls on a pair-wise basis. This means that there are no compelling reasons to continue the spatial coupling of intertidal and shallow subtidal studies. Rather, the following criteria should be used (in order of importance) to guide the selection of sampling sites: (1) Representative of targeted habitat types coupled with appropriate controls; (2) Consideration of sites sampled in 1989; (3) Tie in with subtidal sediment sampling; (4) Tie in with intertidal sampling.

It is critical to limit the extent of these studies such that they may be feasibly completed by January 31, 1991. Accordingly, consideration should be given to limiting quadrat size and the depth ranges sampled. Additionally, experimental studies and observations contributing to the sublethal effects assessment of key species should be integrated with the field studies and performed at the same locations. In this regard, sampling at the subtidal habitat sites may be conducted twice during the field season at selected sites, allowing the deployment and recovery

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
COASTAL HABITAT						
1	Comprehensive Assessment	X		USFS	$5,436,000	$6,300,000

COMMENTS

Continued:

of field experiments. Attention should be directed to the sampling of epiphytic crustaceans which are important prey items for a variety of resource species.

In developing the detailed study plan, investigators should consider taking one sampling in 1990 rather than two out of concern for cost and ability to analyze samples.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
AIR/WATER 1	Geog. Extent/Temporal Persistence		X	ADEC	$343,500	-0-

COMMENTS

This study has been subsumed in large part by proposed Air/Water Study #6. We recommend, therefore, that this study be discontinued but that $25,000 be allocated to complete maps and reports.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
AIR WATER 2	Injury to Subtidal Resources	X		National Marine Fisheries Services	$883,000	$650,000

COMMENTS

Continue as "Injury to Intertidal and Subtidal Sediment Resources" with the following modifications: 1) subsume all elements of Air/Water No. 4; 2) combine NMFS, ADEC, UAF components into one interagency study; 3) reduce overall number of sites, concentrating on heavily oiled areas; 4) establish more controls; 5) each site should have a continuous intertidal and subtidal sediment chemistry transect and a subtidal biology transect; 6) continue sampling at 100 m. depth; sample deeper as necessary to determine extent to which oil is reaching basins and depressions; 7) evaluate weathering of oil in sediments; 8) consider limited testing for polar compounds (potentially harmful degradation by-products); 9) screen all sediment samples by UV/F or other appropriate technique; and 10) conduct the PHC microbial oxidation potential analyses (presently in Air/Water #3) in this study, with emphasis on determination of degradation rates for the higher molecular weight components typical of residual oil.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
AIR WATER						
3	Geog. & Temp. Distrib. in Water Column	X		National Marine Fisheries Services	$595,500	$364,500

COMMENTS

Continue with the following modification: 1) Terminate water quality cruises; 2) expand deployment of mussel cages to test for the presence and bioavailability of petroleum hydrocarbons in the water column; deployment sites should focus on areas of heavy intertidal contamination and sites representative of degrees of intertidal and subtidal oiling, substrate type, and type of exposure; 3) delete interstitial water sampling component, since technique does not accurately gauge injury to interstitial water; 4) ADEC should review its 1989 water quality data in conjunction with Technical Services No. 1 investigators for possible incorporation into study (separate database); this is important as it is key evidence of early acute exposures in the water column; and 5) obtain 1989 sediment trap data from UAF and incorporate as separate data base if QA/QC standards are met.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
AIR WATER						
4	Injury to Deep Water		X	NOAA	$378,900	-0-

COMMENTS

We recommend that this study be combined with Air/Water No. 2 and that air/Water No. 4 be discontinued.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
AIR WATER						
5	Injury to Air		X	ADEC	$106,500	-0-

COMMENTS

Complete work in progress. Do not undertake additional work.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
TECHNICAL SERVICES						
1	Hydrocarbon Analysis	X		NOAA	$2.3 million	$2.0 million

COMMENTS

Continue with the following modifications. 1) establish an ultraviolet fluorescence (UVF) screening procedure for 1990 sediment analyses and provide collection and handling procedures to PIs; this will allow prioritization of samples for GC/MS and provide a quick indicator of sediment contamination; 2) review ADEC and NOAA response data and any other available data and incorporate into data base if QA/QC standards are met, establishing separate data base(s) for unprivileged and less reliable data; 3) institute bar coding of samples for more efficient sample tracking; 4) review and approve all analytical QA/QC plans (e.g. for DNA adduct analyses); 5) prepare brief quarterly report showing type and number of samples that have been analyzed, are being analyzed or awaiting analysis, and showing the number of replicates and samples to be archived; and 6) continue training investigators in proper procedures.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
TECHNICAL SERVICES 2	Histopathology		X	USFWS	$440,200	-0-

COMMENTS

Samples have been archived and are available for analysis, as needed. Histopathology should be done within amounts budgeted for resource-specific studies.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
TECHNICAL SERVICES 3	Mapping	X		ADNR/USFWS	$670,000	$798,200

COMMENTS

Continue to QA/QC all maps. Coordinate with resource specific studies.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
AIR WATER						
6	Oil Toxicity	X		NOAA	-0-	$720,000

COMMENTS

I. Introduction

The rationale for this study is simply that there is no existing program that will supply all the needed data on the geographical spread, chemical characteristics and toxicity of oil remaining in Alaskan waters from the Exxon Valdez spill. The proposal presents a coordinated plan for obtaining such information. It will generate data that will be used to assess the geographical extent and degree of damage to the environment from residual oil. The data from this proposed study can be used to counter the argument that weathering, and degradation have rendered the remaining oil non-toxic.

Study Plan

There are four main components to the program; (1) a mass balance or oil budget, (2) assessment of toxicity of environmental samples of oil in a standard bioassay, (3) assessment of the toxicity and chemical characteristics of oil degradation products, (4) assessment of the toxicity of weathered oil in laboratory studies using sensitive early life history stages of marine animals (e.g. larval fish). Some data from existing studies can be used, for example many of the G.C./M.S. analyses of weathered oil in sediments for various studies can be used to support this present study. Nonetheless, a substantial amount of new effort will be required to provide useful information for the case.

The mass balance study will estimate the amount of oil in the water, on the beaches and in the air at several times after the spill and continuing past 1991. Some new information will be required but much of the currently available data would be used to provide even rough estimates of where the oil has gone. Based upon these preliminary results, it may be desirable to undertake a more comprehensive mass-balance program. That effort needs further refinement and is not budgeted in this proposal.

Continued:

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
AIR WATER						
6	Oil Toxicity	X		NOAA	-0-	$720,000

COMMENTS

The assessment of toxicity of oil remaining in the environment will be based on sampling at 15-20 sites, spread over a large geographical area and assessed using a standard toxicity assay, such as microtox. These sites will be sampled every six months and assayed. As deemed appropriate chemical analyses of environmental samples will be done to correlate with the results of the bioassays. Samples from the supratidal, intertidal and subtidal areas of each site will be screened initially with UV fluorescence to eliminate samples inappropriate for further analysis. Emphasis will be placed on testing sand, gravel and cobble samples. In heavily oiled beaches interstitial water samples will be tested. The 15-20 sites will be selected to cover a wide geographic range and deliberately placed at sites most likely to show continuing effects.

The assessment of the toxicity and chemical characteristics of oil degradation products will also be based on environmentally collected samples from heavily oiled beaches. Large volumes of interstitial water and smaller volumes of variously weathered oil residues will be chemically fractionated using standard techniques of column chromatography. A polar fraction will be eluted from the column for each sample. A small number of selected samples will then be subjected to further analyses by mass spectrometry, gas chromatography, liquid chromatography, infrared spectrophotometry and nuclear magnetic resonance spectrometry to determine its composition. Subsamples of these fractions will be tested in simple assays to determine their toxicity. Microtox and fish cell assays are appropriate for toxicity testing on small volume samples of this sort. Based on the results of detailed characterization of these samples of degradation products and their toxicity, the study will either be expanded or curtailed.

The laboratory studies will test the toxicity of weathered oil to sensitive early life history stages of marine organisms. Columns of beach cobble and gravel coated with oil will be flushed with sea water on a periodic basis and the resultant effluent used to expose larval stages of animals. Various lethal and sublethal endpoints will be measured. In addition this will be closely coordinated with the studies of oil degradation products. It is suggested that pink salmon

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
AIR WATER 6	Oil Toxicity	X		NOAA	-0-	$720,000

COMMENTS Continued:

and herring be used as study species to provide corroborative evidence for initial findings of damage to these species in 1989.

II. Personnel and Organizations

Not all aspects of this study can be carried out by the same organization, but they should be coordinated by one scientist with some experience in hydrocarbon chemistry, toxicology and microbiology. Properly qualified individuals in each case should carry out the research. The mass balance can be carried out in the Air/Water No. 1 study. Most of the chemical analysis can be done under the current technical services components of the NRDA studies. The bioassay of environmental samples would probably be best done by a commercial laboratory experienced in running the microtox assay. The assessment of oil degradation products could be let as a contract to a university research laboratory. The laboratory exposures of eggs and larvae could be done by an existing laboratory, e.g. Auke Bay laboratory. Scientific coordination should be done by a designated scientist in consultation with a small working group of peer review scientists.

III. Budget

Estimated costs.

Mass Balance	100k
Bioassays of environmental samples	250k
Degradation products	120k
Laboratory toxic experiments	250k
TOTAL COST	720K

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH 27	Sockeye Salmon Overescapement	X		ADF&G	-0-	$589,300

COMMENTS

In 1989, excessive over-escapement of sockeye salmon occured in upper Cook Inlet (Kenai River) and in Kodiak associated with extensive fishery closures due to oil on water. High escapements are known to negatively impact sockeye salmon populations. A study of juveniles rearing within lakes and out-migrating smolt is recommended, coupled with lake lymnology investigations, for each area.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET [1]	1990 BUDGET
FISH SHELLFISH						
28	Run Reconstruction	X		ADF&G	-0-	$50,000

COMMENTS

It is expected that a number of the Fish Projects being conducted on salmon in Prince William Sound, Cook Inlet and Kodiak will demonstrate the causes of damage due to the Exxon Valdez oil spill. The ability to quantify the amount of damage may rest heavily upon an assessment of the returning adults. Using the tools developed under Fish 26 Data base Management and Fish 28 Ecological/Life History Modelling and the recaptures from the coded wire tag experiments, various combinations of catch and escapement can be calculated that will be used to estimate the total return (catch plus escapement). The differences in total returns of adult salmon to different areas of Prince William Sound and at different times of the season will be analyzed to measure the amounts of damage to salmon runs that were subject to different amounts of oil on the spawning grounds and while migrating to sea in the spring of 1989. Run reconstruction can also be used to determine if run timing is normal in the returning year.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
29	Ecological and Life History Model	X		ADF&G	-0-	$50,000

COMMENTS

In order to demonstrate the potential for long term harm to the salmon populations from the effects of oiling, it is necessary to sum up the impacts of a number of factors at a number of life history stages such as reduced growth of fry, mortality of eggs and fry, loss of spawning habitat, and overescapement. Such measures are being generated in the NRDA Fish/Shellfish studies 1-10. The magnitude of the overall loss in productivity for a salmon stock can best be understood by looking at survival at each life history stage, (egg, fry, smolt, subadult, adult) over the life span of all fish of the same age, and over all age groups in the population. Such a bookkeeping program is necessary to take advantage of the NRDA data being already collected, and to integrate existing historical data into documenting the actual and potential damages due to oiling. The stocks and areas covered by this computer-based mathematical model are those included in the portions of Fish/Shellfish studies 1-10 as approved by the trustees for funding in 1990, plus any stocks which were observed to have suffered overescapement in 1989 as a result of the presence of oil. The work can start immediately using data from NRDA 1989 and from existing historical sources. The model is termed ecological, because interactions of salmon with other biological and physical components of the environment could be added as they are defined in other studies.

[1] Reflects budgeted figures, not amount actually spent.

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	LEAD AGENCY	1989 BUDGET[1]	1990 BUDGET
FISH SHELLFISH						
30	Salmon Database Management	X		ADF&G	-0-	$120,000

COMMENTS

Large quantities of data are being analyzed in order to demonstrate the fact and extent of injury to natural resources due to oiling. The purpose of this study is to make original data readily available to agency and non-agency personnel so that data analysis can be conducted, and so that all analysis can be accomplished faster and at less cost than is presently possible. The data to be placed under the data base management system (DBMS) will be drawn from two categories; 1) historical data necessary to the interpretation and implementation of the results of NRDA studies, and 2) data resulting from NRDA studies. It is envisioned that the DBMS will be useable by any authorized person with access to a standard personal computer (IBM compatible, MS-DOS, 640K RAM, 20M hard disk) to readily and quickly structure data for CRT viewing, printing, and use by statistical, spreadsheet, and other analytic software. Structuring data requires that original data in electronic form be retrieved and ordered according to user specified criteria of time, space, and selection of variables. Since readily available statistical software packages permit extensive computational manipulation of data, it is not envisioned that the DBMS will possess extensive computational options. Rather it is proposed that the DBMS be constructed to meet the following criteria in order of priority; 1)completeness of contents, 2) speed of retrieval, and 3) ease of use in assembling primary data into data sets for further analysis by other software. Furthermore, the DBMS will take advantage of existing DBMS applications currently available in the Alaska Department of Fish and Game.

In addition to NRDA project data, examples of historic data include commercial catch and effort data for the species and areas targeted in the Fish/Shellfish studies 1-10, all relevant biological data on age, size at age, growth at age, stock identification, spawning escapements, and fry, fingerling and smolt production.

Strategically it is logical that this study be broken into substudies by major species assemblages such as salmon and shellfish. It would also be prudent to extend this activity to other study areas such as habitat, birds and mammals.

[1] Reflects budgeted figures, not amount actually spent.

EXXON VALDEZ NRDA
SUMMARY OF PEER REVIEW RECOMMENDATIONS

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	RECOMMENDATION: DISCONTINUE	SPILL YEAR 1989	SPILL YEAR 1990[Φ]
BIRDS					
1	Water Birds/Beached Birds	X		$258,000	$450,000
2	Census & Seasonal Distribution	X		$565,000	$400,000
3	Seabird Colony Surveys	X		$440,000	$150,000
4	Bald Eagles	X		$445,000	$500,000
5	Peregrine Falcons		X	$43,500	— θ — ($200,000)*
6	Marbled Murrelets		X	$115,700	θ
7	Storm Petrels		X	$135,000	θ
8	Black-Legged Kittiwakes		X	$190,000	θ
9	Pigeon Guillemots		X	$109,500	θ
10	Glaucous-Winged Gulls		X	$73,000	θ
11	Sea Ducks	X		$146,000	$100,000
12	Shorebirds		X	$166,000	θ
13	Passerines	X		$59,000	$10,000
14	Migratory Birds		X	$10,000	θ

* Cost of study, if continued

Φ Spill year is March 1 - February 28

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	SPILL YEAR 1989	SPILL YEAR 1990[Φ]
MARINE MAMMALS					
1	Humpback Whale		X	$226,000	~~0~~ ($122,000)*
2	Killer Whale	X		$200,000	$255,000
3	Cetacean Necropsy		X	$73,000	~~0~~
4	Sea Lion	X		$270,000	$150,000
5	Harbor Seal	X		$245,000	$150,000
6	Sea Otter Impacts	X		$763,000	$1,056,000
7	Sea Otter Rehabilitation	X		$108,000	$130,000
TERRESTRIAL MAMMALS					
1	Sitka Black-Tail Deer	X		$87,000	$40,000
2	Black Bear	X		$139,700	$10,000
3	River Otter/Mink		X	$287,700	~~0~~
4	Brown Bear	X		$162,700	$110,700
5	Carnivores/Small Mammals		X	$302,400	~~0~~
6	Mink Reproduction		X	$192,200	~~0~~
FISH/ SHELLFISH					
1	Salmon Spawning Area Injury	X		$144,800	$391,300

* Cost of study, if continued

Φ Spill year is March 1 - February 28

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	SPILL YEAR 1989	SPILL YEAR 1990[@]
FISH/SHELLFISH					
2	Salmon Eggs & Preemergent Fry	X		$149,100	$302,800
3	Salmon Coded Wire Tagging	X		$1,943,400	$1,943,400
4	Early Marine Salmon Injury	X		$829,200	$300,000
5	Dolly Varden/Cutthroat Injury	X		$437,400	$269,000
6	Sport Fishery Harvest & Effort		X	$175,900	~~0~~
7	Salmon Spawning Area, Outside PWS	X		$320,300	$539,400
8	Egg & Preemergent Fry, Outside PWS	X		$111,400	$293,300
9	Early Marine Salmon, Outside PWS		X	$348,500	~~0~~
10	Dolly Varden/Sockeye, Lower Kenai		X	$152,600	~~0~~
11	Herring Injury	X		$374,500	$400,000
12	Herring, Outside PWS		X	$60,000	~~0~~
13	Clam Injury	X		$86,200	$175,000
14	Crab Injury		X	$142,000	~~0~~
15	Shrimp Injury	X		$60,500	$65,000
16	Oyster Injury		X	$30,500	~~0~~

[@] Spill year is March 1 - February 28

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	SPILL YEAR 1989	SPILL YEAR 1990[1]
FISH/ SHELLFISH					
17	Rockfish Injury	X		$45,600	$50,000
18	Trawl Assessment	X		$738,800	$86,100
19	Larval Fish Injury		X	$413,400	θ
20	Underwater Observations		X	$550,100	θ
21	Clams, Outside PWS		X	$108,800	θ
22	Crabs, Outside PWS		X	$111,500	θ
23	Rockfish, Halibut, Lingcod - Lwr Kenai		X	$108,400	θ
24	Trawl Assessment, Outside PWS	X		$2,495,800	$150,000
25	Scallop Resources Injury		X	$53,800	θ
26	Sea Urchin Injury		X	$45,000	θ
COASTAL HABITAT					
1	Comprehensive Assessment	X		$5,436,000	$6,300,000
AIR/ WATER					
1	Geog. Extent/Temporal Persistence		X	$343,500	θ
2	Injury to Subtidal Resources	X		$883,000	$650,000
3	Geog. & Temp. Distrib. in Water Column	X		$595,500	$364,500
4	Injury to Deep Water		X	$378,900	θ

[1] Spill year is March 1 - February 28

STUDY NO.	STUDY TITLE	RECOMMENDATION: CONTINUE	DISCONTINUE	SPILL YEAR 1989	SPILL YEAR 1990[Φ]
AIR/ WATER 5	Injury to Air		X	$106,500	Θ
TECHNICAL SERVICES 1	Hydrocarbon Analysis	X		$2,300,000	$2,000,000
2	Histopathology		X	$440,200	Θ
3	Mapping	X		$670,000	$798,200

SUBTOTAL FOR CONTINUING STUDIES: $18,589,700

NEW STUDIES

AIR/ WATER 6	Oil Toxicity Study	X		Θ	$720,000
FISH/ SHELLFISH 27	Sockeye Salmon Overescapement	X		Θ	$589,300
FISH/ SHELLFISH 28	Run Reconstruction	X		Θ	$50,000
FISH/ SHELLFISH 29	Ecological and Life History Model	X		Θ	$50,000
FISH/ SHELLFISH 30	Salmon Database Management	X		Θ	$120,000

SUBTOTAL FOR NEW STUDIES: $1,529,300

SUBTOTAL FOR NEW AND CONTINUING STUDIES: $20,119,000

OVERHEAD (25%): $5,029,750

BUDGET FOR SUMMARIZING DATA AND WRITING REPORTS ON STUDIES RECOMMENDED TO BE DISCONTINUED: $140,000

TOTAL COST: $25,288,750

[Φ] Spill year is March 1 - February 28

EXXON VALDEZ NRDA
SUMMARY OF STUDIES TO BE CONTINUED

STUDY NO.	STUDY TITLE	SPILL YEAR 1989	SPILL YEAR 1990[1]
BIRDS			
1	Water Birds/Beached Birds	$258,000	$450,000
2	Census & Seasonal Distribution	$565,000	$400,000
3	Seabird Colony Surveys	$440,000	$150,000
4	Bald Eagles	$445,000	$500,000
11	Sea Ducks	$146,000	$100,000
13	Passerines	$59000	$10,000
MARINE MAMMALS			
2	Killer Whale	$200,000	$255,000
4	Sea Lion	$270,000	$150,000
5	Harbor Seal	$245,000	$150,000
6	Sea Otter Impacts	$763,000	$1,056,000
7	Sea Otter Rehabilitation	$108,000	$130,000
FISH/ SHELLFISH			
1	Salmon Spawning Area Injury	$144,800	$391,300
2	Salmon Eggs & Preemergent Fry	$149,100	$302,800
3	Salmon Coded Wire Tagging	$1,943,400	$1,943,400

[1] Spill year is March 1 - February 28

Rev. 02/08/90

STUDY NO.	STUDY TITLE	SPILL YEAR 1989	SPILL YEAR 1990[*]
Fish/ Shellfish			
4	Early Marine Salmon Injury	$829,200	$300,000
5	Dolly Varden/Cutthroat Injury	$437,400	$269,000
7	Salmon Spawning Area, Outside PWS	$320,300	$539,400
8	Egg & Preemergent Fry, Outside PWS	$111,400	$293,300
11	Herring Injury	$374,500	$400,000
13	Clam Injury	$86,200	$175,000
15	Shrimp Injury	$60,500	$65,000
17	Rockfish Injury	$45,600	$50,000
18	Trawl Assessment	$738,800	$86,100
24	Trawl Assessment, Outside PWS	$2,495,800	$150,000
Coastal Habitat			
1	Comprehensive Assessment	$5,436,000	$6,300,000
Air/ Water			
2	Injury to Subtidal Resources	$883,000	$650,000
3	Geog. & Temp. Distrib. in Water Column	$595,500	$364,500
Technical Services			
1	Hydrocarbon Analysis	$2,300,000	$2,000,000
3	Mapping	$670,000	$798,200

[*] Spill year is March 1 - February 28

STUDY NO.	STUDY TITLE	SPILL YEAR 1989	SPILL YEAR 1990[1]
TERRESTRIAL MAMMALS			
1	Sitka Black-Tail Deer	$87,000	$40,000
2	Black Bear	$139,700	$10,000
4	Brown Bear	$162,700	$110,700

SUBTOTAL FOR CONTINUING STUDIES: $18,589,700

NEW STUDIES

AIR/WATER			
6	Oil Toxicity Study	0	$720,000
FISH/SHELLFISH			
27	Sockeye Salmon Overescapement	0	$589,300
28	Run Reconstruction	0	$50,000
29	Ecological and Life History Model	0	$50,000
30	Salmon Database Management	0	$120,000

SUBTOTAL FOR NEW STUDIES: $1,529,300

SUBTOTAL FOR NEW AND CONTINUING STUDIES: $20,119,000

OVERHEAD (25%): $5,029,750

BUDGET FOR SUMMARIZING DATA AND WRITING REPORTS ON STUDIES RECOMMENDED TO BE DISCONTINUED: $140,000

TOTAL COST $25,288,750

[1] Spill year is March 1 - February 28

Memorandum

TO: Trustee Council

FROM: Legal & Management Team

SUBJECT: Recommended Modification of Council's Organization for Management of Damage Assessment & Restoration

DATE: February 9, 1990

Damage assessment is entering a new phase that reinforces the need for coherent direction of scientific studies of natural resource injury and focuses on the overall legal strategy. Eventually the results of studies must be synthesized into a damage assessment report.

Restoration planning has recently been initiated. Peer reviewers should be utilized to assure proper integration with damage assessment injury studies. The increased number and pace of activities is also placing greater demands on administrative support functions.

The Council should consider modifying its organizational structure in response to these changing demands so that it can continue to carry out its responsibilities in a cost effective manner.

These organizational recommendations have been jointly developed and are strongly supported by the legal and management teams and the peer reviewers. Several alternatives for modifying the organization were considered and are enclosed along with the recommended alternative.

I. THE NEED FOR CENTRALIZING ADMINISTRATIVE FUNCTIONS

Administrative support functions necessary to carry out the business of the Council have not been clearly defined nor has responsibility for implementation been assigned. Agency representatives volunteer to take on the responsibilities as the need is recognized. This manner of operation has worked reasonably well up until now. However, there have been occasions when follow-up was tardy or fell between the chairs. Also, there is no central

contact for individuals wishing to communicate with the Council.

There is a need for a small administrative organization to provide the following support activities:

- Schedule, organize, facilitate and follow-up on Council meetings;
- Provide a central contact point for communication with the public and others; including prompt response to written or oral requests for information;
- Provide for coordination among various teams and the Council;
- Prepare publications;
- Prepare and distribute media releases;
- Provide administrative support for the Science Director.

The administrative staff would consist of an Administrative Officer, 2-writer editors, 2-clerks, a publication assistant and a public relations assistant. Since some of the skill needs may be intermittent, they could be provided on a contract basis.

II. THE NEED FOR COHERENT SCIENCE DIRECTION

The NRDA for the *Exxon Valdez* spill is a large and complex undertaking which must ultimately serve the legal interests of the U.S. and State of Alaska in recovering appropriate damages from the responsible parties. NRDA studies include numerous physical, chemical and geological measurements as well as assessments of a wide range of biota, from microbes to mammals. The successful coalescence of these extensive studies into a powerful injury assessment demands more effective technical coordination. Most important, tighter coordination is needed between the NRDA studies and the legal strategy than has been achieved so far.

Even greater demands will be placed on the scientific management of the NRDA in 1990 and beyond. Many hard decisions will be faced concerning priorities for sample analysis and the completion of 1989 studies. New studies are being proposed for the 1990 study plan which contain elements, such as sublethal effects studies and field experiments, which must be carefully integrated with field observations. In order to be successful this review and integration must be ongoing, not simply considered at the end of the studies. As the 1990 studies proceed, it will be increasingly incumbent that results are rapidly synthesized into the report of assessment and transferred to the legal team for the development of the case.

A full-time Scientific Coordinator should be appointed by the Trustee Council. This individual should have broad general

experience in the scientific disciplines represented in the studies, familiarity with the existing knowledge base on the effects of oil spills, and a proven record of leadership. He/she should be directly responsible for effective technical coordination of the NRDA studies.

A small number of agency science program managers or other senior scientists should work with the Scientific Director to assist him in insuring tight coordination of the NRDA studies. Other scientists may also be appointed as appropriate. These individuals will all work closely with the PI's following the guidance of the Scientific Coordinator. The Coordinator would be responsible for coordinating ongoing peer review participation in the NRDA and litigation process.

This Science Coordinator team should be adequately supported by staff and other resources to insure their effective operation. They should be physically located in Alaska to insure optimal interactions with PI's, Trustee representatives, and members of the legal team.

III. SYNTHESIS AND LIAISON WITH LEGAL TEAM

The Science Coordinator should take the lead in developing syntheses and in coordination of the technical evidence with economic assessments and the legal strategy. Syntheses conducted by the Science Coordinator should be oriented to the needs of the legal team and, conversely, the Science Coordinator should be a focal point for transfer of scientific information to the legal strategy through preparation of the report of assessment.

IV. COORDINATION WITH RESTORATION PLANNING GROUP

The Science Coordinator will also provide for scientific coordination between NRDA injury studies and restoration planning, including peer review.

V. ORGANIZATION ALTERNATIVES

Five organization alternatives are enclosed. They display various structures for accommodation administrative and science coordination needs.

Alternative #5 is the suggested alternative to be implemented. The Management Team will operate as alter egos for their Council members and provide ongoing direction of the program. An Executive Director working for the Management provides day to day direction and coordination of the program. All other positions report to the Executive Director.

Implementation of the organization could be done in phases in order to address high priority needs expeditiously. Providing for science coordination is the highest priority. The Science Coordinator should be in place in time to lead the preparation and

integration of detailed plans for 1990.

Staffing of positions can be accomplished through a combination of hiring and contracting. It may be preferable to contract for services where the position is not full time, is of short duration, or requires specific skills that are difficult to acquire through normal hiring practices. Reassignment of agency personnel is another option.

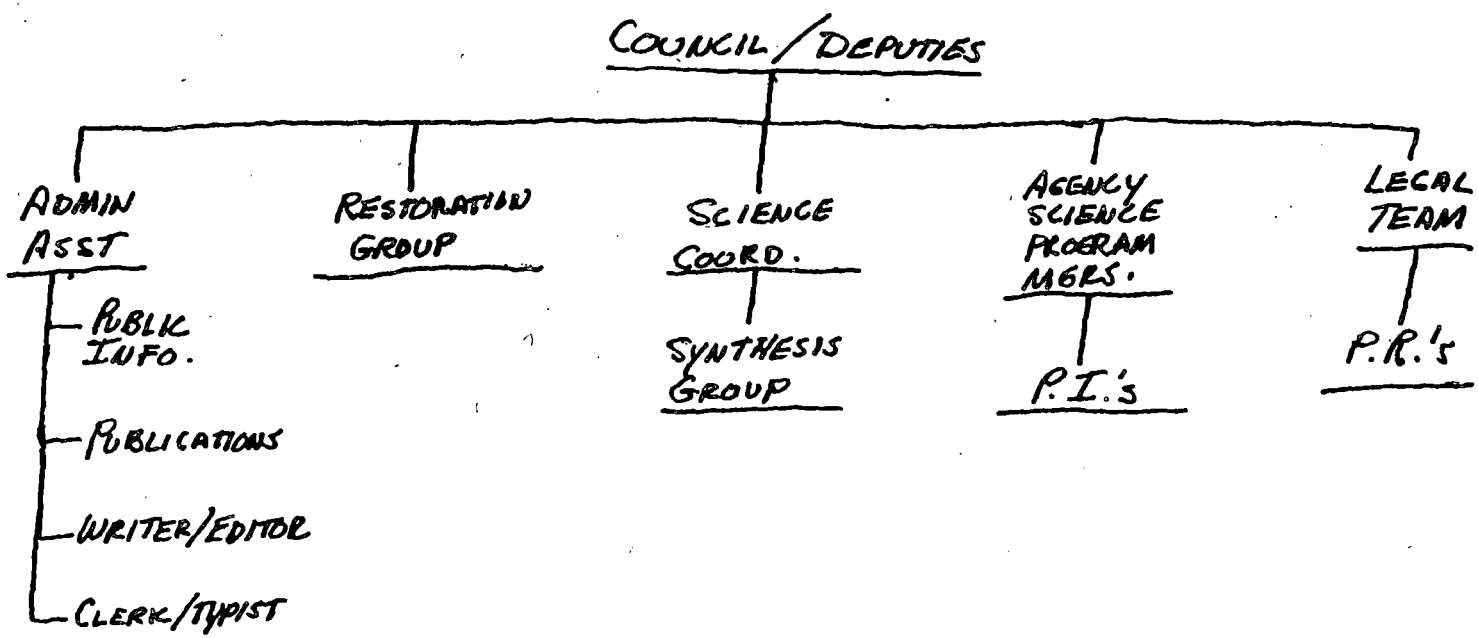
VI. FUNDING

The organization should be supported by Federal and State overhead funding for the NRDA. An estimated 1990 study year cost is approximately $800,000. This would cover salaries and related operational expenses.

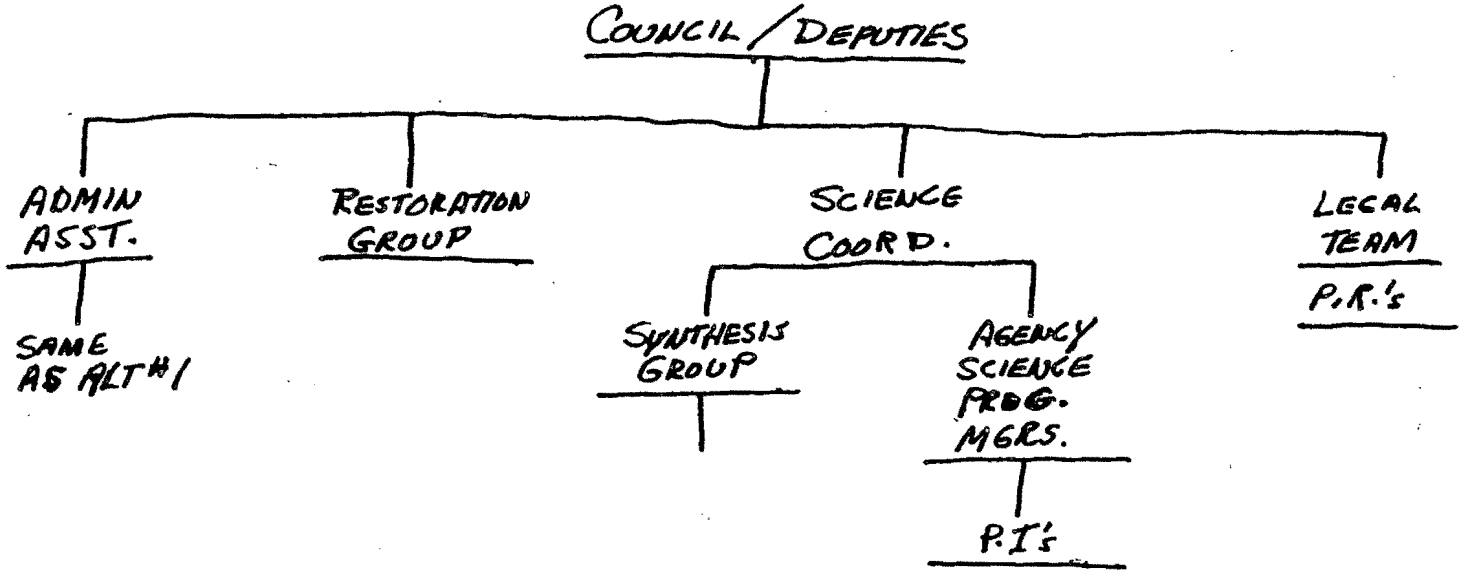
ROLE STATEMENTS

Council:	1. Overall Direction 2. Policy
Legal Team:	1. Legal Interpretation 2. Strategy Development
Management Team:	1. Operational Planning 2. Process Management (but not $)
Scientific Coordinator:	1. Coordination of overall scientific strategy and direction 2. Injury assessment synthesis 3. Legal Strategy compliance 4. Science review 5. Final report of injury
Agency Science Program Manager:	1. Science operations 2. Implementation of overall scientific strategy and direction
Administrative Assistant:	1. Clerical requirements 2. Writer-editor services 3. Public affairs management 4. Publications 5. Correspondence management and control
Restoration Group:	1. Restoration planning 2. Implement the restoration framework
Executive Director:	1. Replaces management team or works for management to provide day to day direction

ALTERNATIVE #1



ALTERNATIVE #2



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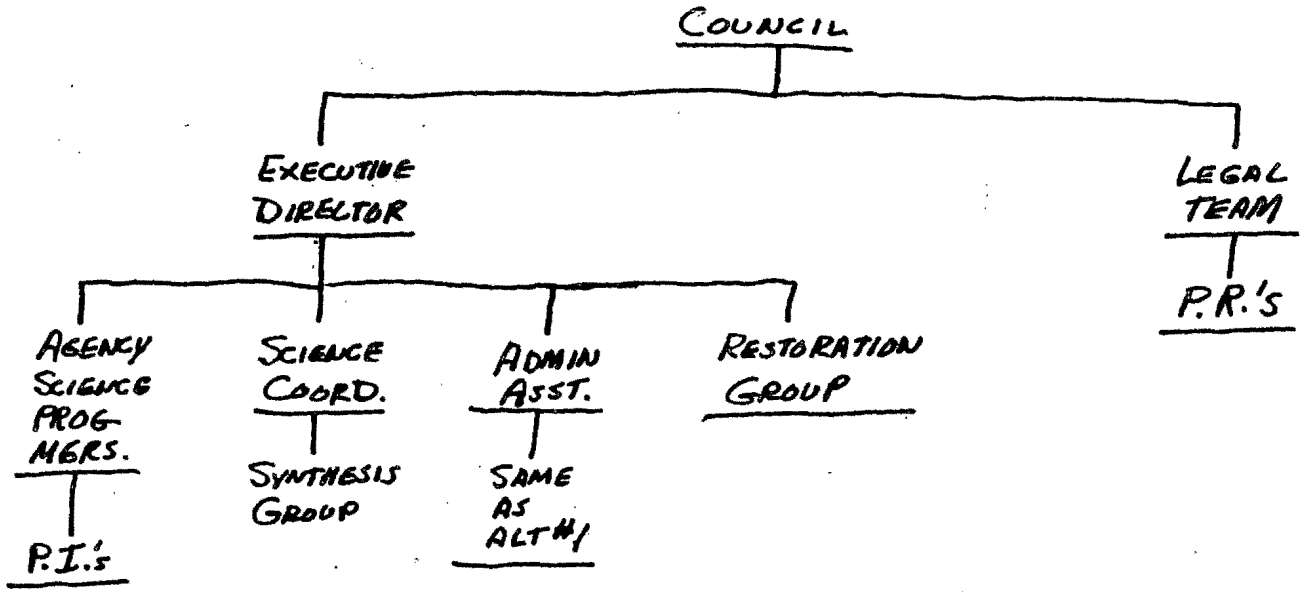
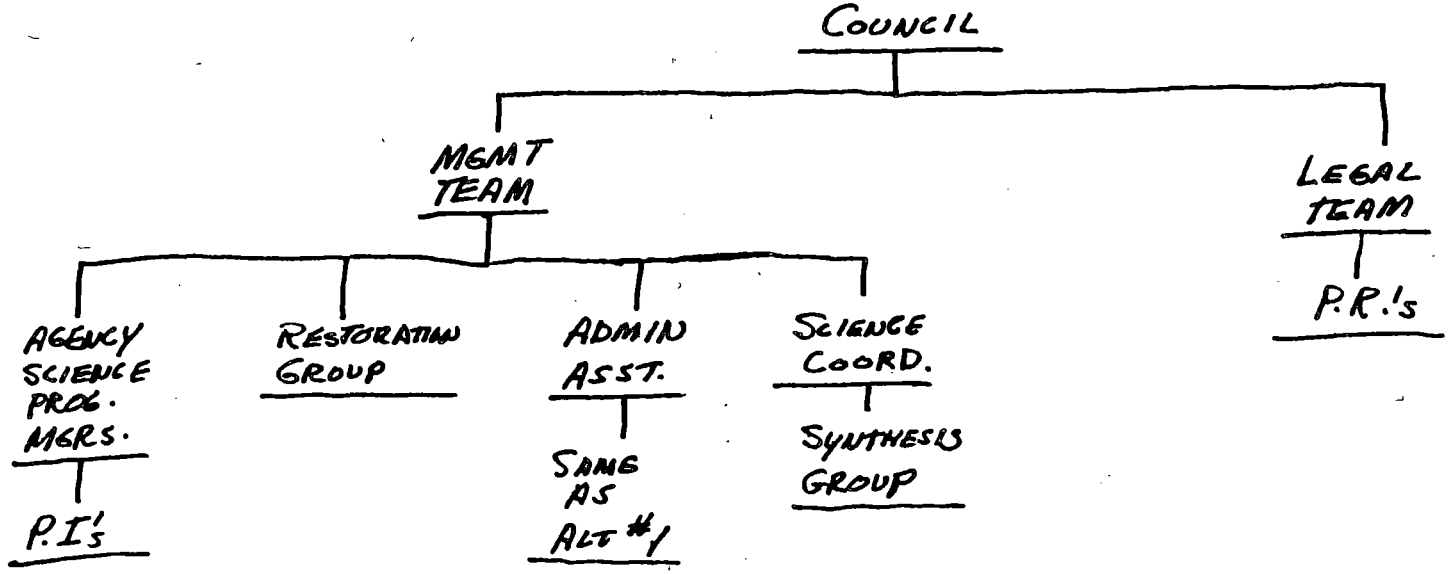
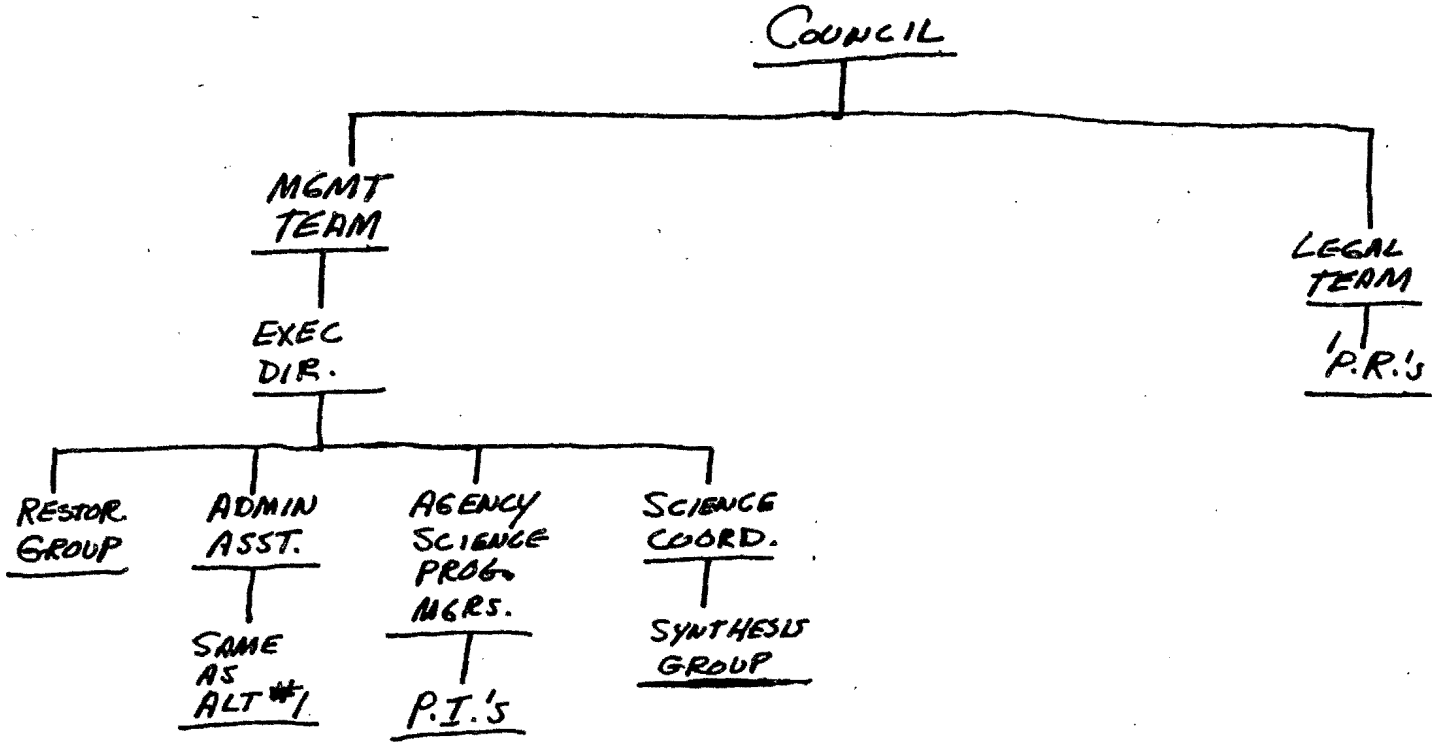


ALTERNATIVE #4



ALTERNATIVE #5



NRDA SCHEDULE OF ACTIVITIES

Activity	Participants	Lead	Dates
Study recommendations to Council	Legal, Mgmt Team, Council	Legal, Mgmt Team	2/13,14/90
Prepare Council Recommendations to Trustees	Mgmt Team	Mgmt Team	2/15,16
Risk Assessment-Define Progress and Timing	Legal Team	DOJ/AC	2/16
Council Present Recommendations to Trustees	Council Trustees	Council	By 2/23
Detailed Plans for 1990 Completed for Review and Response to Public Comment	P.I.'s, P. R.'s, Mgmt Team, Legal Team	Mgmt Team	3/16
Detailed Plans Mailed to Reviewers	P.I.'s	Mgmt Team	3/19
Meet to Review and Complete Detailed Study Plans	P.I.'s, P.R.'s, Mgmt Team, Legal Team	Science Dir.	3/24-4/6
Public Review of 1990 Studies		Admin. Asst.	4/9-5/4
Final Reports for Discontinued Studies (Legal Team Prescribe Format)	P.I.'s, P. R.'s, Legal Team	Science Dir.	6/1
Complete Study Status Report and Mail to Reviewers	P.I.'s	Science Dir.	1/1/91
Meeting to Review Study Status Reports	P.I.'s, P. R.'s, Legal Team	Science Dir.	1/14-18
Initial Report of Assessment	P.I.'s, P.R.'s, Legal Team	Science Dir.	2/28
Implement Restoration Planning Frameworks	Restoration Planning Group		1/1/90-12/31