The 1991 State/Federal Natural Resource Damage Assessment and Restoration Plan for the Exxon Valdez Oil Spill

Volume II: Response to Public Comment
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RESPONSE TO PUBLIC COMMENTS

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GENERAL

COMMENTS AND RESPONSES CONCERNING THE 1990 STATE/FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT AND RESTORATION PLAN FOR THE EVOS

The 1990 plan was made available to the public for review and comment. Five reviewers representing industry and environmental groups submitted comments on the plan. The reviewers included: Alyeska Pipeline Service Company (APSC), American Petroleum Institute (API), Exxon Shipping Company (ESC), National Wildlife Federation (NWF), and Natural Resources Defense Council (NRDC). (Ann McElroy of the University of Massachussets, Boston (UM) submitted technical comments on behalf of the NRDC and is identified separately in the comments.) Reviewers commented on the overall nature and content of the Plan and provided technical remarks concerning many of the individual studies. All comments were considered by the Trustees during their evaluation of the 1990 data and the formulation of the current plan.

This section provides a synthesis of the comments and their respective responses. The comments and responses are organized into two categories -- those dealing with the general nature of the plan and those concerning a specific category of studies or individual studies. For the information of the reader, the reviewers are identified with their comments.

Comments concerning individual studies that have been discontinued or completed are not addressed.

General Comments on the Plan

Comment: The Trustees failed to include the public in their deliberations concerning the studies to be undertaken in 1990. In these deliberations, federal budget priorities overrode the nation's interest in understanding the *Exxon Valdez* oil spill and fully restoring PWS. Consequently, the likelihood that the United States will be able to recover the damage assessment costs from the responsible parties is diminished since "skimping" on the studies may make proof of damages legally insufficient. (NWF)

Response: Owing to the litigation-sensitive nature of the damage assessment process, the Trustees have attempted to solicit public input in a manner that would not compromise their ability to pursue damage claims in a judicial forum. To the extent that public comments on the 1989 NRDA Plan addressed continuing elements of the Plan in 1990, those comments were taken into account in formulating the 1990 Plan. Given that there has been only minimal funding by potentially responsible parties for the conduct of the damage assessment, the Trustees are legally obligated to work within the constraints of the federal budget and monies made available by the State of Alaska. The Trustees are making every effort, in light of these budget constraints, to ensure that the studies that have been undertaken will meet the legal standards for recovery of damage

assessment costs.

Comment: The Trustees have failed to include the potentially responsible parties (PRP) in the assessment process and refused to provide either the PRP's or the public with a meaningful opportunity to comment. This action is contrary to the Clean Water Act, the Ohio v. Department of the Interior decision and the NRDA regulations. Under the regulations, the PRP's are accorded a higher degree of participation than the general public. Their involvement is necessary to ensure the integrity of the process: they can perform replicate studies; oversee study activities; obtain and analyze splits of samples; and perform other validating activities. (APS, ESC)

Response: Under the NRDA regulations, the degree of participation of PRP's in the damage assessment process is within the discretion of the Trustees. See 43 C.F.R. § 11.32. In this damage assessment, PRP's were given a full opportunity to review and comment upon the damage assessment plan. The assertion that the Trustees are legally obligated to allow PRP's greater participation than the public is incorrect.

Comment: The Trustees may not pick and choose from the NRDA regulations on an issue-by-issue basis. (ESC)

Response: The Trustees disagree. The NRDA regulations are optional, and their use is within the discretion of the Trustees. See 43 C.F.R. § 11.10. There is no requirement that the Trustees must choose to employ the regulations on an all-or-nothing basis.

Comment: Because the assessment is not consistent with the NRDA regulations, the Trustees will be deprived of the rebuttable presumption of validity. This will undermine the credibility and enforceability of the final assessment. (APSC)

Response: The Trustees have not made a final decision on the extent to which they will apply the NRDA regulations. Those aspects of the assessment conducted in accordance with the regulations are entitled to a rebuttable presumption of accuracy. At the same time, the regulations recognize that Trustees may need to use innovative assessment methods not specified in the regulations. Where such methods are shown to be accurate and valid, their use enhances the credibility and enforceability of the assessment.

Comment: Failure to follow the NRDA regulations is contrary to statutory mandate. The Trustees do not have the discretion to waver from the dictates of these regulations. Alternative

assessment procedures cannot be used unless compliance with the regulations would produce a clearly erroneous result and the alternative procedures chosen by the Trustees are scientifically and economically valid. Failure to follow the regulations, which under CERCLA are required to be the "best available procedures", will result in a determination that the assessment is scientifically invalid and legally indefensible. (APSC)

Response: This comment is incorrect. The regulations explicitly provide that they are optional. See 43 C.F.R. § 11.10. The regulations recognize that the accuracy and validity of the assessment may be enhanced by use of methods in addition to those specified in the regulations.

Comment: The Plan fails to document the Trustees' decision not to allow the PRPs to implement the damage assessment plan. This is contrary to 43 C.F.R. § 11.32(d). (ESC)

Response: The Trustees believe that their decision to conduct the damage assessment themselves is adequately documented in the Plan.

Comment: Failure of the Trustees to issue the 1990 Plan for public review and comment until after most of its studies had begun violates 43 C.F.R. § 11.32(c), which provides that the assessment plan is to be made available for review for 30 days before the performance of any of the methodologies contained in the NRDA regulations. (APSC)

Response: In order to conduct an adequate assessment, the Trustees determined that it was necessary to begin collection of data before completing the public comment process. This procedure is consistent with 43 C.F.R. § 11.22. To the extent possible, the Trustees have incorporated public comments into implementation of the studies. In addition, the 1990 Plan was based upon the 1989 studies, so comments on the 1989 studies were evaluated by the Trustees before the 1990 field season.

Comment: The 1990 Plan did not allow the PRPs and others to comment on the assessment projects before they were implemented, as the NRDA regulations require. Nor have the Trustees recognized the special role the PRPs are given by the regulations in developing the design and scope of the assessment process, prior to public involvement. This failure to cooperate with PRPs is contrary to the Department of the Interior's position in its promulgation of the regulations, the Department of Justice's position in defending the regulations and the decision in Ohio v. Department of the Interior. (ESC)

Response: In order to conduct an adequate assessment, the Trustees

determined that it was necessary to begin collection of data before completing the public comment process. This procedure is consistent with 43 C.F.R. § 11.22. To the extent possible, the Trustees have incorporated public comments into implementation of the studies. (See previous response.) Under the NRDA regulations, the degree of participation of PRP's in the damage assessment process is within the discretion of the Trustees. See 43 C.F.R. § 11.32. In this damage assessment, PRP's were given a full opportunity to review and comment upon the damage assessment plan.

Comment: The Trustees have violated 43 C.F.R. § 11.32(a)(2)(iii), which requires that the Trustees invite PRP's to participate in the assessment process and to give them thirty days to respond before proceeding with the development of the assessment plan or any other assessment actions, by announcing the availability of the Plan in September of 1990, after most of the 1990 studies had been completed. (APSC, ESC)

Response: See Response above.

Comment: Contrary to the assertions of the Plan, the natural resource damage provisions of CERCLA do not authorize the undertaking of the damage assessment for the *Exxon Valdez* oil spill since CERCLA expressly excludes crude oil from its coverage. (APSC)

Response: While spills of crude oil are not subject to liability under CERCLA, CERCLA provides the legal framework for conducting natural resource damage assessments under both CERCLA and § 311 of the Clean Water Act, which does impose liability for oil spills.

Comment: Contrary to the Plan's assertion that "restoration is a broad term," restoration is defined precisely in decisions interpreting the Clean Water Act and the NRDA regulations as actions undertaken to return an injured resource to its baseline services. (ESC)

Response: The NRDA regulations, which are optional, define restoration as actions undertaken to return injured resources to their baseline physical, chemical, or biological properties or the services they provided. The 1990 Plan's description of restoration is in accordance with this regulatory definition. See 43 C.F.R. § 11.14(ll).

Comment: The Trustees' sole objective should be restoration of the area impacted by the spill. The Plan therefore should identify impacted resources in need of restoration and develop cost-effective methods of carrying out those restoration needs. The

Plan's failure to do this is illegal. (ESC)

Response: The ultimate objective of the Trustees is to restore, replace, or acquire the equivalent of the resources injured by the spill, and the damage assessment is directed toward that objective.

Comment: The Clean Water Act's provision for assessment of damage to natural resources focuses on restoration costs. It does not impose liability for natural resources damages apart from the cost of restoration or replacement, so only costs of those measures are recoverable. Hence lost use and non-use values are not compensable. The only relevance of the loss of use value of resources is in ensuring that in choosing among restoration alternatives, the Trustees can evaluate whether particular alternatives can be performed at a cost that is not grossly disproportionate to the use value of the resource and whether they will be cost-effective. (APSC)

Response: In Ohio v. Department of the Interior, 880 F.2d 432 (D.C. Cir. 1989), the D.C. Circuit held that natural resource trustees are entitled to recover lost use and non-use values as well as the costs of restoration. That case dealt with the natural resource damage provisions of both CERCLA and the Clean Water Act. Furthermore, the Clean Water Act is not the sole legal authority for recovery of natural resource damages arising out of the oil spill; other authorities provide for recovery of lost use and non-use values.

Comment: The Plan includes economic studies designed to assess damages that are not compensable under the Clean Water Act, such as those estimating non-use losses, use value effects, commercial fishery losses, private damages, research losses, archaeological resource damages, hypothetical effects on the value of public lands, recreation values, subsistence values and "natural resource slander." (APSC)

Response: See Response to previous comment.

Comment: The Plan continues to include studies relating to losses to the commercial fishing and tourism industries, which are not recoverable in the NRDA process. Archaeological resources are man-made and therefore not covered by the NRDA process. (ESC)

Response: Commercial fishing and tourism are services provided by natural resources, damage to which is recoverable in the NRDA process. A valuation of the committed use of the cultural attributes of natural resources, as well as, the natural components of cultural sites, is properly within the NRDA process.

Comment: There is no authority in either the Clean Water Act or the NRDA regulations for inclusion of "natural resource slander" in a claim for natural resource damages. Consideration of such a claim in the damage assessment is inappropriate. (ESC)

Response: The services provided by natural resources may be impaired by the perception that the resources have been tainted or contaminated by an oil spill. The determination of whether such impairment is compensable must be made on a case-by-case basis.

Comment: The 1990 Plan contains no economic methodology determination, no resource recoverability analysis, and no restoration methodology plan, as required by 43 C.F.R. §§ 11.35, 11.73 and 11.82, respectively. (APSC)

Response: The regulations provide that the economic methodology determination may be postponed. See 43 C.F.R. § 11.35(d) (2). An evaluation of resource recoverability is one of the elements of the assessment. The Trustees, alone with EOA, are in the process of developing a restoration planning process consistent with the objectives of 43 C.F.R. § 11.82.

Comment: Relevant law requires that the anticipated costs of the assessment be less than the anticipated damage amount in order for the assessment costs to be reasonable. Many of the studies, notably those regarding Terrestrial Mammals, violate this requirement. (ESC)

Response: The NRDA regulations, which are optional, indicate that the anticipated cost of the assessment should be less than the anticipated amount of damages. See 43 C.F.R. § 11.14(ee). There is no requirement that each individual element of the assessment meet this test. Rather, individual elements need only lead to an increase in accuracy and precision in the assessment that outweighs their costs. See Id. The Trustees believe that the assessment meets these standards.

Comment: Many specific comments made on the 1989 Plan concerning alternative methods of analysis to be included were met with blanket responses such as "this was not feasible" or "this is now included in the study." Yet the basis for these decisions is unstated. (UM)

Response: This comment is too general to answer without a comprehensive review of all comments on 1989 studies and the relevant 1990 studies. In some cases, alternative methods of analysis were considered and incorporated into study design. In other cases, even though the alternative method may have been another appropriate method, it was decided that the value of

retaining multi-year consistency outweighed the benefit in changing to an alternative method.

Comment: The studies do not appear to be integrated with respect to consistency of methods used, habitats or species sampled, or in the timely generation of data and summary reports. (UM)

Response: Studies were designed and executed by scientists with expertise in those fields. Efforts were made to ensure first that the methods used were appropriate to meet the objectives of the study for the resource in question. There is an ongoing process to integrate results of different studies. Data are being generated on an ongoing basis.

Comment: Several studies include sediment sampling from the same areas. One set of samples should be sufficient. The uncoordinated collection of samples from the same sites may lead to inconsistent and conflicting data. (API)

Response: We agree with this concern and are coordinating submission of samples for analysis. Sometimes sediment samples are analyzed for different factors and multiple samples are necessary.

Comment: A small number of samples (10 per study) were submitted for the preliminary evaluation of the first year's work in preparation for the 1990 plan. The Plan indicates that many hundreds of additional samples were submitted later, but it is not known what, if any, bearing these additional samples had on the 1990 work plan. There is a need for better project coordination, timely data analysis, report generation, and distribution. (UM)

Response: Any problems created by the limited amount of hydrocarbon analysis data available during preparation of the 1990 plan have been resolved. Principal investigators are receiving results in a timely and consistent fashion.

Comment: Although the Plan states that results from 1989 dictated study efforts in 1990, those results are not presented. The 1990 studies were more microscopic than those of 1989 without identifying the need to intensify study. Instead, the Plan should have been broadened to consider the viability of the ecosystem as a whole. (ESC)

Response: Because of potential litigation, 1989 results were not presented. The 1990 Plan focused efforts on a number of areas where more data were needed, both from a "microscopic" and ecosystem perspective.

Comment: The 1990 damage assessment plan demonstrates that the Trustees have not been following the Department of the Interior's Natural Resource Damage Assessment regulations. The purpose of damage assessment cases, as shown in Ohio v. Department of the Interior, is to restore the environment. Some 1990 studies aim to assess low levels of damage, which is the only impact discernible, and which will not be useful in the processes of restoration and rehabilitation. (API)

Response: Use of the natural resource damage assessment regulations is optional. While the Trustees agree that the goal of the natural resource damage assessment process is to restore the environment, every effort should be made to identify and quantify all injuries to natural resources as a result of EVOS. Quantified "low levels" of injury will result in recoverable damages based upon use and non-use values. As indicated in Ohio v. Department of the Interior, recoverable damages include restoration costs plus use and non-use values of the affected resource. Meaningful and responsible restoration cannot be effected without fully understanding the scope and degree of resource injury.

Comment: The studies will not determine whether biological changes were the result of oiling or human intervention. This evaluation is not possible due to a lack of reliable baseline data, and vagueness in definitions of oiling. (API)

Response: Recoverable damages for injuries to natural resources include both the effects of EVOS and the detrimental "human" cleanup activities. While multi-year baseline information on specific natural resources is desirable, it is not necessary in this damage assessment process, where adequate control areas can be identified.

Comment: Studies should not have been dropped due to lack of evidence of impacts early on in the NRDA process. Lack of discernible impacts at early stages would not necessarily indicate that there will be no effects in later years. Discontinuation of studies fails to take into account such factors as bioaccumulation and biomagnification, or genetic and reproductive impacts. (NRDC)

Response: Where possible, the delay in detectability of injuries was taken into account in determining which studies should continue. Certain studies will continue to assess such factors as bioaccumulation and biomagnification and genetic and reproductive impacts.

Comment: Although some studies were discontinued, forty additional sites will be investigated, many of which were not affected by the spill. The plan does not explain the reasons for this increase.

(API)

Response: The forty sites that are referenced are not additional sample sites, but represent improved sampling sites from the 1989 season for the Coastal Habitat Study. The total number of coastal habitat sites selected for 1990 did not increase. The new sites were intended to provide for the full array of spatial and habitat sites to meet the study design. The sites selected that were "unaffected" by oil represent control sites to match the physical and biological characteristics of the existing inductively selected oiled sites. This paired design will be used to determine the effects of oil or the subsequent beach cleaning activities on the intertidal ecosystem.

Comment: The 1990 Plan fails to provide the potentially responsible parties and the public with sufficient information to evaluate the scientific validity or the cost-effectiveness of the damage assessment. (APSC 1, 2, NWF 9) Although the 1990 Plan contains greater detail than the 1989 Plan, it does not contain sufficient information to allow meaningful comment. (APSC, NWF) It lacks information concerning: number and representative nature of sampling sites; number and quality of samples to be collected and analyzed; description of methods for collecting, preserving, shipping, identifying, preparing, analyzing, and reporting of samples; and details of the statistical design for interpretation of results. This violates the NRDA regulations. (ESC)

Response: The objective of the 1990 Plan was to provide adequate information for reviewers to understand the scope and methods of the assessment. The Trustees believe the information provided is sufficient for this purpose.

Comment: The lack of detail in the Plan permits the Trustees to avoid publication of the budget cuts affecting the assessment and risking potential recoveries of damages from the potentially responsible parties. (NWF)

Response: See response to the first comment in this section. Further, there is no obligation on the part of the Trustees to include within the Plan any statements regarding increases or decreases in budgets affecting the damage assessment.

Comment: In the 1990 Plan, the interrelationships among studies still is not adequately addressed. (UM)

Response: Although not directly addressed in the 1990 Plan, the Trustees have implemented a synthesis and integration process that is providing a clear understanding of the interrelationships among studies and providing specific recommendations on how this

integration can be improved. This should be more evident in the 1991 Plan.

Comment: 43 C.F.R. § 11.22 does not authorize the implementation of the studies described in the 1989 and 1990 Plans prior to review and comment. It does not contemplate that vast sums of monies might be spent to survey injury to all resources possibly affected by the spill or the analysis of data from such surveys or that injury determination might be based upon this work. It permits only the preliminary collection of field samples and site visits in order to preserve data and material that might otherwise be lost. (ESC)

Response: The purpose of 43 C.F.R § 11.22 is to allow the Trustees to obtain data on an expedited basis that might be lost if all of the procedural requirements of the regulations were followed. The provision authorizes collection of perishable data and materials. The extent of collection is within the discretion of the Trustees.

Comment: The 1990 Plan describes 51 studies, most of which are being conducted without first identifying that they are related to an injury that has been determined pursuant to the regulations (43 C.F.R. §§ 11.61 -.64). Some of the studies are designed to determine that no damage has been done to a particular resource. Other studies use non-specific methods or methodologies for determining injury, testing, and sampling that do not comply with the guidance of 43 C.F.R. §§ 11.62 -.64. (APSC)

Response: All studies are directly related to documenting injury to natural resources as a result of the EVOS. It is a standard scientific procedure to use the null hypothesis as a statement of the study objective. The most appropriate methodologies were used for each study.

Comment: The Plan improperly combines the injury determination and injury quantification phases of the assessment process so that there are studies attempting to quantify resource levels for which no injury has been documented. This is contrary to the regulatory mandates to conduct the assessment at a reasonable cost (43 C.F.R. § 11.13(c)) and to quantify only for injuries found in the damage determination phase (43 C.F.R. § 11.71(a)). The Plan also is going forward with damages determination before the injury and quantification phases have been completed, in violation of 43 C.F.R. §§ 11.81-.84. (APSC, ESC)

Response: The Trustees are unaware of any studies that involve quantification of injury where no injury has been demonstrated. Damage determination for a particular resource is appropriate where the underlying injury information is available. There is no

requirement that damage determination with respect to a resource await completion of injury determination and quantification with respect to all other resources. Furthermore, the Trustees are not required to avoid collecting data relevant to injury quantification and damage determination at the same time that injury determination data is being collected where this is the most cost-effective procedure, and relevant data otherwise would be lost.

Comment: The Trustees should have performed a pre-assessment injury screening to determine which resources potentially had been injured by the oil spill. This would have eliminated many of the 1989 studies. The Trustees then should have evaluated 1989 data before authorizing studies for 1990 and allowed only those studies to go forward where it had been determined, in accordance with the regulations, that injury had in fact occurred and that the studies would be necessary to achieving cost-effective restoration. (APSC)

Response: The Trustees did conduct a pre-assessment screen before beginning the assessment process. A copy of this preassessment screen was included as Appendix C in the August 1989 State/Federal Natural Resource Damage Assessment Plan for the *Exxon Valdez* Oil Spill. Data collected from the 1989 studies were evaluated when determining the studies to go forward in 1990. Studies that were not deemed necessary to continue in 1990 were discontinued.

Comment: The 1990 Plan does not use a proper baseline for assessing the difference between the pre- and post-spill level of services rendered by the injured resources: many studies fail to take into account natural causes for differences in resource levels between and oiled and non-oiled areas; fail to consider contamination of resources by sources other than *Exxon Valdez* oil spill; ignore historic data showing natural variations in resource levels; or compare resources at oiled and non-oiled areas without using the regulatory criteria (43 C.F.R. § 11.72) for selecting "control" areas. (APSC)

Response: Proper baselines, when available, are used for assessing differences between pre- and post-spill resource values. In many cases baseline data did not exist, in which case treatment (oiled) and control (unoiled) data sets were gathered to make comparisons. Every effort is being made to account for other sources of variation or contamination. Control areas were established in accordance with regulatory criteria.

Comment: The 1990 studies do not distinguish between reductions in baseline services provided by the natural resources and changes in the resources themselves. According to the regulations, restoration or replacement measures are limited to those necessary to restore or replace the resources services to their baseline

level. But the Trustees have not attempted to determine reductions in baseline services. This will invalidate the results of the assessment. (APSC)

Response: By determining injury to resources it will be possible to distinguish between the reductions in baseline services and changes in the resource. In addition, the regulations indicate that restoration may be achieved by restoring a resource to its baseline condition, either in terms of services or its physical, chemical, or biological properties.

Comment: The Plan does not provide the level of detail specified by the regulations regarding the scientific and economic methodologies used in the studies, especially as concerns sampling and data sharing. (APSC)

Response: The Plan provides that level of detail necessary to apprise the public of the damage assessment studies being undertaken and the applicable methodologies. As time allows, further detail is incorporated into the study plans for public review. The Trustees disagree with the assertion that there has been a regulatory violation; sufficient information has been provided to allow adequate public review. In addition, use of the damage assessment regulations is optional, although the Trustees have acted in a manner consistent with the regulations.

Comment: No justification is given for the discontinuance of studies, including the larval fish injury, crab injury, and whale necropsy studies. Public comment was not allowed prior to the Trustees' decision to drop these studies. This constitutes a significant modification of the assessment plan. (NRDC)

Response: Numerous studies have been discontinued or modified; others remain as originally implemented. The damage assessment process is dynamic with results being continually evaluated. If it is appropriate to modify or discontinue studies, given the purpose for which the studies were undertaken, their modification or termination is effected. Studies were evaluated on their likelihood to provide additional data from five perspectives: (1) immediate injury, (2) long-term alteration of populations, (3) sublethal or latent effects, (4) ecosystem-wide effects, and (5) habitat degradation. The fact of modification or termination is communicated through the next iteration of the Plan. Regardless of whether the termination of a study or group of studies may be a significant modification of the Plan, the public has been informed of those terminated studies and has been given the opportunity to comment on that action.

Comment: The Plan appears to shift resources to restoration

activities before an adequate analysis of the impacts from the spill is completed. (NWF)

Response: The Trustees believe that it is important to begin restoration of certain resources where there is adequate information to do so and where early restoration may prevent further injury. This policy will not interfere with an adequate analysis of the impacts of the spill.

Comment: The Trustees do not state any support for their supposition that the data obtained from studying particular species can be extrapolated to other species. (NWF)

Response: Leading scientists are working with the Trustees to determine when results from studies of particular resources can be extrapolated to other species or groups of species.

Comment: The Plan does not address the adverse effects of the spill on the interactions among different species and different elements of the ecosystem. It lacks a fully integrated ecosystem study. Although the coastal habitat study professes to undertake this type of study, it is unclear how this will be accomplished. (NWF, NRDC)

Response: An active and ongoing study synthesis process has been instituted to integrate the results of different studies. This will provide a broader, ecosystem wide understanding of injuries.

Comment: The Plan fails to acknowledge that recovery is taking place and focuses instead on microscopic examination of selected aspects of the affected area. As a result, many of the studies are not legally justified and are of little relevance to the Trustees' restoration goals. There is convincing evidence that fishery resources are vital and productive, that mature otters and pups are repopulating areas that were affected by the spill, and that density and diversity of bird species are returning to pre-spill norms. These observations should have been used to formulate a restoration-based Plan rather than embarking on a microscopically-focused set of studies. The Trustees should have followed the guidance of the NRDA regulations and commenced intensive scientific studies only if observations from cleanup and natural recovery warranted them. (ESC)

Response: The assessment is designed to provide a comprehensive analysis of the effects of the oil spill on the environment. The analysis of natural recovery is an important component of this assessment. On the other hand, the Trustees cannot ignore injury to certain populations or resources simply because other populations or resources appear to be recovering from the effects

of the spill. Nor can the Trustees ignore continued toxic contamination of marine food chains simply because some aspects of the ecosystem are gradually recovering from the grosser impacts of the spill. If the commenter wishes to provide scientific data supporting its statements regarding recovery of natural resources, the Trustees will consider this data in conducting the assessment.

Comment: The Plan contains studies that focus on basic scientific research, traditional agency studies or management activities, and on preparation for litigation. These are unnecessary in a process that is intended to identify and measure cost-effective restoration requirements (e.g., salmon run surveys, humpback and killer whale censuses, bird and sea lion surveys, and gathering of recreational use data). (ESC)

Response: The assessment is designed to determine the nature and extent of injury to natural resources resulting from the spill, and to provide sufficient information to develop methods for restoring injured resources. The assessment does not include basic scientific research or traditional management activities. In some cases, of course, assessment of the effects of the spill requires studies similar to those commonly conducted by resource managers, but beyond the scope of normal agency management activities in an area unaffected by an oil spill. One of the purposes of the assessment is to determine the amount of natural resource damages in order to present a claim to the parties responsible for the spill. Until the parties responsible for the spill voluntarily assume responsibility for the effects of the spill on the environment, the Trustees cannot ignore the need for information sufficient to support a claim in litigation.

Comment: The Plan's studies that involve "takes" of birds, otters, seals, sea lions, mink, and deer are unjustified given the apparent health and vitality of these species. The following studies have no bearing on restoration requirements: laboratory research on mink reproduction and toxicity of polar compounds; radio-tracking of eagles, bears, and sea otters; premature pupping of sea lions in areas outside the impacted area; and measurement of insecticides in peregrine falcon eggs. (ESC)

Response: The actual health and vitality of birds, otters, seals, sea lion, mink, and deer cannot be determined without study. Some injuries may be sublethal and can only be documented by "take" of specimens. All of the listed studies have a direct bearing on restoration planning by providing a more complete picture of the total injury, both lethal and sublethal, to the resource.

Comment: Studies use unnecessarily invasive techniques, including the killing of animals from PWS. (API)

Response: Animals were collected only after careful review by leading scientists and agency experts and the take was in each case kept to a minimum.

Comment: The technical programs are aimed at finding evidence that some biological parameter is statistically different between oiled and non-oiled areas, but there is no indication how such findings will relate to restoration or how the differences can be linked to the presence of oil. (API, ESC)

Response: Each study includes provisions to link documented injury to oil. All information on injury is important to enable resource managers to understand the impact on a resource so that appropriate restoration planning can occur.

Comment: The Plan does not explain how the information gained from the various studies will be used to answer questions about the relative benefits of various restoration alternatives. (ESC)

Response: The NRDA studies provide essential information concerning the nature and extent of oil-spill injuries in relation to the biology and ecology of the injured resources. Before restoration alternatives can be adequately evaluated, it is necessary to have an understanding of the degree and nature of the injury of the resource. Once potential restoration implementation activities are identified, they will be evaluated in terms of technical feasibility, environmental benefit, cost, and other factors.

Comment: There is no connection between the restoration alternatives set forth in the Plan and the economic work evaluating the need for restoration and determining whether any of these projects are supportable in light of natural recovery. (ESC)

Response: An integral component of the restoration planning process is to determine the nature and pace of natural recovery of injured resources, and identify where direct restoration measures may be appropriate. All proposed restoration alternatives will undergo economic and environmental analyses to determine whether these projects are justified in light of natural recovery.

Comment: Restoration studies are only necessary if technical studies show that a resource will be adversely affected for a long period of time. Restoration studies that are being conducted before the results of the assessment studies are available assumes that all resources are injured and will require restoration measures. While this approach may shorten implementation time of restoration once the damage assessment process is over, it unwisely

expends resources for feasibility studies and literature searches concerning resources that are later determined not to require active restoration measures. (ESC)

Response: The Trustees disagree that restoration studies are only necessary if a resource will be adversely affected for a long period of time. Restoration studies may concern any degree of injury to a natural resource in order to determine whether to enhance natural recovery. During the course of the NRDA studies, where the nature of the resource injury is reasonably clear, and where no alternatives would be foreclosed, it may be desirable to begin implementation of certain restoration activities prior to the conclusion of the NRDA studies and a final restoration plan.

Comment: The Trustees are responsible for selecting a cost-effective restoration program; the public's participation in this process is unproductive since the public does not have any independent knowledge about injuries or restoration needs. Public meetings held to develop lists of restoration ideas create expectations in the public that are not justifiable given the actual state of the environment. The restoration project's emphasis on public involvement is contrary to the regulatory requirements since it is not cost-effective and distracts the Trustees from focusing on the technical information needed to identify whether specific restoration measures are needed. (ESC)

Response: The Trustees believe that public involvement is an important part of the restoration process. The commenter's desire to increase the influence of responsible parties while excluding the public is inconsistent with the goals of the restoration process.

Comment: The Plan fails to take into account that oil exposure may have affected various species from sources other than the *Exxon Valdez* oil spill, such as those of biogenic (plant waxes) and petrogenic (shoreline oil seeps) as well as human (vessel traffic) origins. (ESC)

Response: If there is any indication that the hydrocarbon contamination in the spill area was caused by sources other than the oil spill, the assessment will address this issue. Hydrocarbon analysis is designed to differentiate between different sources of hydrocarbon exposure.

Comment: Many of the studies in the Plan violate the requirement that the anticipated costs of the assessment be less than the anticipated damage amount in order for the assessment costs to be reasonable. (ESC)

Response: As noted above, the Trustees believe that the studies in the assessment plan are consistent with the reasonable cost requirement in the NRDA regulations.

Comment: The Plan does not make clear that sampling programs, especially those in the Fish/Shellfish and Terrestrial Mammals studies, will produce information necessary to prove that a statistically significant portion of the expected biological variability is a function of hydrocarbon contamination as opposed to other natural factors. (ESC)

Response: These studies are designed to compare different parameters in oiled and unoiled areas and to measure exposure and injury from hydrocarbons.

Comment: In general the 1990 Plan still does not provide sufficient detail on statistical design to ensure that the studies will produce unbiased data for use in modelling efforts. (ESC)

Response: Sufficient information is provided in the 1990 Plan to facilitate an understanding of methodology and statistical testing. Modelling is not being considered for all studies.

Comment: The normal histology of most of the species being studied is not known. Sufficient information will not be gained by examining a few control specimens. Thus, a determination that a particular condition is abnormal and linking this abnormality to the spill will be difficult, if possible at all. (ESC)

Response: Histology samples are being interpreted by leading experts and are based, where possible, on known normal histology, for example, for sea otters. Proper precautions are being taken to ensure accurate interpretation of histology samples.

Comment: Many of the 1990 studies rely on non-specific or non-standard indicators to correlate evidence of hydrocarbon exposure to presume population impacts, which will not bear technically conclusive results. (ESC)

Response: This comment is difficult to respond to because it does not specify what indicators are considered non-standard. Generally, the techniques, analyses, and selected indicators in the studies are well documented in the literature and scientifically sound. In one study (brown bears), a well accepted hydrocarbon analysis is used, but applied to a sample (fecal) not previously tested. In no event do studies attempt to jump directly from hydrocarbon exposure to population impacts.

Comment: The criteria for determining oil-induced lesions in invertebrates and fish were developed for the *Amoco Cadiz* spill and may not be applicable to PWS species. (ESC)

Response: It is appropriate to use information in the literature to assist in measuring injury, including oil-induced lesions in invertebrates and fish. Any differences in these lesions between those impacted by the *Amoco Cadiz* oil spill and the EVOS will be evaluated as a part of the injury assessment efforts.

Comment: The Plan inadequately documents the ecological similarity of control sites and test sites. (ESC)

Response: Every effort was made to select control sites that are ecologically similar to test sites; the Plan generally describes this process.

Comment: Many studies are designed to show that there is no damage to the subject resource(s). Such studies should not have been included in the Plan given the probability that no damages will be uncovered. Their inclusion violates 43 C.F.R. §§ 11.23(b) and 11.61(e)(3). (ESC)

Response: The null hypothesis identified in many of the studies is a well established, objective starting point for scientific evaluation. Other hypotheses could have served equally well. The Trustees disagree there has been a violation of the natural resource damage assessment regulations.

Comment: The Trustee Council did not issue study plans for the 1989 and 1990 assessments far enough in advance of the public comment deadlines making the comment process meaningless. (NRDC, NWF, API)

Response: The Trustees have extended the deadlines for response to public comment in both years and received extensive and detailed comments on both plans. Comments on the 1989 and 1990 Plans have been taken into consideration in subsequent development of the study plans. The Trustees have made extraordinary efforts to ensure publication of the 1991 Plan earlier in the year and will consider public comments received thereon prior to commencement of the 1991 studies. Comments concerning ongoing studies will be considered as well.

Comment: As public comment has not been allowed prior to commencement of the studies, it has been difficult for responsible parties to call duplicative studies to the attention of the State or the Trustees. (API)

Response: The Trustees are endeavoring to avoid any unnecessary duplication of efforts in the joint State/Federal science study plans and have taken into account comments on the 1989 and 1990 plans.

Comment: Release of the Plan constituted a "major federal action" for which an environmental impact statement was required to be done. Even assuming, however, that the Trustees are taking steps that are the "functional equivalent" of an EIS, their "after-the-fact" publication of the studies does not meet the NEPA requirement that there be procedural standards for thorough consideration of the issues and judicial review. (NWF)

Response: The Trustees do not believe that NEPA is applicable to the damage assessment and restoration planning processes, but they will consider its applicability to future restoration projects on a project-by-project basis.

Comment: Repeated comments citing the need for an on-going review process were met with blanket statements indicating review was being done. However, this review process was never adequately described. If the Trustees had the Plan adequately reviewed by outside experts, these experts should be named and their comments made public. There is no guarantee that these comments were adequately addressed in the new Plan unless full disclosure is made. In response to comments on the 1989 Plan suggesting that the names of investigators involved in the damage assessment would aid in determining the adequacy of the plan, the Trustees stated that names are not necessary for evaluation of the study. Yet in most grant and contract evaluation processes, the "track record" of the investigator is taken into account. Particularly here, where few details of the actual investigations are given, naming the scientists involved would provide information valuable to assessment of the adequacy of the study. (UM)

Response: Given the litigation-sensitive nature of the damage assessment, the Trustees are not making public the internal workings of the process they have chosen for independent review. For the same reason it is not appropriate to make known the names or comments of those undertaking such review. The Trustees have taken into account "the track record", i.e., the professional qualifications, of these persons in selecting them for this process.

Comment: Without access to the results from the first year's studies and an independent review of the Plan, it is impossible to assess the propriety of the Trustees' decisions respecting (dis)continuation of each study. (API, UM, NRDC)

Response: To date the Trustees have opted not to release results of the studies undertaken in the damage assessment process owing to the litigation-sensitive nature of those results. As indicated in the 1990 Plan, the Trustees have attempted to formulate a method for mutual release of their data with those of the potentially responsible parties into a public repository. The Trustees are also preparing a protocol for review of scientific information before release to the public.

Comment: On page 336 of the Plan the Trustees state that a summary document on results of the first year's study was to be ready for public distribution in July, 1990. Yet the status of efforts to make this information available to the concerned public is not known. (UM)

Response: The document referred to concerned Phase I of the literature review undertaken by the Restoration Planning Work Group to identify references relevant to restoration. The Progress Report "scheduled for public distribution in July 1990" was issued by that group in August of 1990.

Comment: Since the discussions with Exxon regarding the deposition of data into a public repository have yielded no visible results, the Trustees should make their data available to the public immediately. (NWF, UM, NRDC) The regulations do not permit the Trustees to condition their release of data into a public repository on similar commitments by the potentially responsible parties. (APSC)

Response: Because the data acquired by both the Trustees and Exxon are litigation-sensitive, these parties have endeavored to arrive at a mutual agreement for release of data to the public. In the event that this effort is not successful, the federal and state governments will consider making public the results of damage assessment studies once the quality of the data has been assured, the results have been scientifically reviewed, and legal considerations are taken into account. The regulations leave to the discretion of the Trustees the manner in which data are shared/released and the timetable for the same.

Comment: The NRDA regulations require that the Trustees release to the potentially responsible parties all data results and documentation from the 1989 and 1990 studies. Without these data, the public cannot assess the propriety of modifying a particular study or initiating a new one. Nor can the scientific community peer review the Plan. (APSC)

Response: The Trustees are not required to follow the NRDA regulations in performing this damage assessment, but are acting in

consonance with the regulations. The regulations permit the Trustees to exercise their discretion insofar as the manner by which data and results are released and the schedule for their release are concerned. 43 C.F.R. § 11.31(a)(4).

Comment: The Trustees' failure to make public the results of the scientific studies is a breach of the public trust. It prevents the scientific community from understanding the implications of the spill for future cleanup efforts and from having the most current information about the interaction of oil with arctic waters and ecosystems. This impedes scientists' ability to advise the state of Alaska as it is considering oil and gas exploration issues. (NWF)

Response: The Trustees disagree. The timeline for release of results from the damage assessment studies is dictated in large measure by professional scientific practices and litigation concerns. There is no obligation to have these data available for public review by any particular date or for consideration in resolving any particular political issues.

Comment: Studies being conducted by the State of Alaska and the federal Trustees are similar and in some cases the same. The lack of coordination between the State of Alaska and the federal Trustees may result in a doubling of assessment costs and damages. Double recovery of such costs is statutorily prohibited. Differences between the Trustees should be resolved before the commencement of unnecessary studies. (API)

Response: The state and federal governments are conducting the damage assessment jointly. There is full coordination between the two, and the Trustees have made efforts to avoid duplication of studies in approving the damage assessment studies.

Comment: The Trustees provided insufficient explanation in the Plan for their budgetary cutbacks and curtailment of certain studies as well as their decision not to implement certain studies proposed by the public. The deleted studies were necessary to performing a complete evaluation of damage assessment, and studies not initiated were necessary to form a comprehensive restoration plan. (NWF) Without explanations for discontinuation of studies undertaken in 1989, the public is constrained in its ability to comment on these decisions. (NWF)

Response: The Trustees have made every effort to ensure that the requisite budgets are available for studies necessary to assess damage from the EVOS. They are obligated, however, to conduct the assessment within budgetary constraints and have acted in a manner consistent with the NRDA regulations so as to achieve a cost-

effective assessment. To the extent that these standards have required discontinuation of certain studies or non-implementation of others, the Trustees believe they have acted reasonably.

Comment: There is no commitment beyond the 1990 field season to carry out studies to assess long-term damage. The Trustees are obligated to conduct such studies. All scientists consulted believe several years of studies are needed to understand the impacts of the spill on the marine ecosystem. As the plan states, the effects may not become evident for three to four or more years. The Trustees should make clear their commitment to long-term studies. (NRDC, UM)

Response: Many factors affect the determination whether, and which, studies will be continued beyond the publication of the damage assessment plan each year. The absence of any commitment within the 1990 Plan to extend the damage assessment beyond that year's field season does not connote the end of scientific study. In fact, the Trustees, concurrent with this Response to Comments, are publishing the 1991 Plan. The Trustees will continue to consider the recommendations from the scientists working on their behalf regarding continuation of the assessment process. They are mindful that some damage may not be known for many years; to the extent that resources are available to them for that purpose, the Trustees will continue scientific study of the oil spill's impacts on the ecosystem.

Comment: Many of the resources that are the subject of the 1990 Plan either are recovering rapidly through natural recovery or exhibit no injury, and additional study of these resources is neither cost-effective nor necessary and violates the regulations. (APSC)

Response: The Trustees do not agree. There may be some resources for which natural recovery is the best restoration option, but this conclusion is not necessarily applicable to all the affected resources. In some instances, appearances of recovery may belie long-term and sublethal impacts to the ecosystem's resources.

Comment: The Trustees have no authority to conduct a damage assessment under any statutes other than the Clean Water Act. (ESC)

Response: The Clean Water Act (CWA) and other state and federal authorities provide the basis for a natural resource damages claim. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) establishes the procedural framework for conducting the damage assessment under section 311 of the CWA.

MARINE MAMMALS

Comments on Marine Mammals Studies - General

Comment: Data collected for whale, seal, and sea lion studies is not from impacted areas. (API)

Response: In some cases the location of study sites is outside the spill zone. Those sites were chosen because the species of concern tends to concentrate at that site and has a broad geographic range that includes the spill zone. Also, historical data is often available from these locations, which allows pre- versus post-spill comparisons.

Comment: Several of the marine mammals studies rely on new and unproven methods for injury detection, including capture of animals, surgical procedures, and implantation of radio devices. These methods may cause additional stress or mortality. Justification for such activities is lacking. Reliance on these techniques will produce poorly formed conclusions that associate low-level hydrocarbon exposures to observed biological effects. This is true of the cetacean distribution data being gathered in Marine Mammals 1, the reproductive data gathered in Marine Mammals 4 and 5, and the sublethal data concerning sea otters being obtained in Marine Mammals 6. (API, ESC)

Response: Methods being used are all well established techniques. In some cases, however, they are being applied in new and innovative ways. These applications are carefully considered by contracted experts and are expected to yield reliable conclusions.

Comment: Significant impacts on marine mammals such as drift net mortality are ignored in these studies. (ESC)

Response: All significant sources of mortality are considered in design of the studies.

Comment: The sublethal or chronic endpoints proposed for use as indicators of hydrocarbon exposure are non-specific at best. Any observed changes could be correlated with a number of sources such as diesel fuel or hydraulic oil spills, and not necessarily EVOS. In addition, the endpoints are subject to a high degree of natural variability such as nutrition, sex, and non-specific stress. (ESC)

Response: In most cases sublethal and chronic endpoints are quite specific. They are significant changes in populations as a result of impacts on survival or reproduction. All studies are designed to deal with natural variation and oil contamination from other sources.

Comment: The intensity of the Trustees' efforts to meet the objectives of Marine Mammals 1, 2, 4, 5, and 6 is neither warranted nor cost-effective since it is unlikely that population impacts, other than those on sea otters, will be found because of deficiencies in baseline data and natural variations in population parameters being evaluated. Even with respect to Marine Mammals 7, literature suggests that sea otters have a remarkably rapid rate of natural recovery. (API, ESC)

Response: Efforts on marine mammals are both warranted and cost effective because impacts are likely and studies are well designed. Marine mammals are a highly valued resource. All these species were potentially exposed to hydrocarbon contamination. Significant historical data is available for comparison, and studies are designed to deal with natural variation. Sea otters have never been studied following an oil spill the size of the EVOS, therefore the rate of natural recovery is still unknown.

Comment: The design and application of statistical models for testing effects are vague. It is not clear how EVOS effects are to be estimated in many of the marine mammal studies. For marine mammals that are especially mobile, the field sample observations cannot distinguish effects of oiling, location, and timing. Therefore it will not be possible to tell whether any statistically significant effect was EVOS-induced. (ESC)

Response: Study plans provide sufficient detail to evaluate design and application of statistical models. For additional detail on methods, references are listed.

Comment: Historical population trends and estimates of variability are largely unavailable for the parameters being measured in the Marine Mammals studies: humpback whale distribution (Marine Mammals 1), killer whale natality and mortality (Marine Mammals 2), pathological examination of pinnipeds and otters (Marine Mammals 4, 5, and 6) and population sex/age structure of sea otters (Marine Mammals 6). The lack of adequate pre-spill baseline data will severely limit the Trustees' ability to detect post-spill differences, and attributing measurable differences to the spill will not be technically possible. (ESC)

Response: All desirable historical data is not available for all studies. However, this will not preclude detection of injury. Comparative data is being developed in control areas over a period of several years.

Comment: Whale, seal, and sea lion studies are not based on sufficient evidence of the presence of injury. Expenditures are

not justifiable. (API, ESC)

Response: Indications of potential injury among these species are sufficient to justify these studies.

Comment: The location, timing, and level of oiling are important variables in all of the studies, yet the criteria for selecting study sites are not given in the Plan. (ESC)

Response: Selection of study sites was based upon one or more sources of oiling information which included observations of: oil at NRDA study sites, oil on water, and shoreline oiling.

Comments on Marine Mammals Studies - Specific

Marine Mammal Study No. 2 - Killer Whales

Comment: Marine Mammals 2 will provide data that may be useful for long-term goals of managing PWS, but are not directly related to oil spill impacts, e.g., distribution data for killer whales. (ESC)

Response: The focus of the study is to determine injuries to whales in PWS. We agree that some useful collateral data may result from this study that is not directly related to oil spill impacts. However, these data are expected to address injuries and may be useful in determining restoration activities.

Comment: Marine Mammals 2 lacks evidence of exposure of killer whales to oil, and it is unlikely that an exposure pathway can be established given the rapid return of Prince William Sound waters to background levels of oil and the lack of substantive contamination of fish or other prey species. (ESC)

Response: Cetaceans were observed in PWS on the day of the oil spill. Killer whales were observed swimming in oil slicks. Investigations are taking place regarding the effect of direct contact of oil to cetacean skin/eyes, inhalation, and ingestion.

Comment: Marine Mammals 2 is designed to show that killer whale mortality rates have not changed since the spill, i.e., that there has been no damage to this species. This type of study should not be included in a damage assessment. (ESC)

Response: The null hypothesis is a well established scientific procedure for conducting studies. This comment restates an objective. Changes in mortality rates may be a finding of the

study.

Comment: The quantification of field search efforts for killer whales is not clear. (ESC)

Response: Within the limits of weather, the field crews search for whales daily during the field season. The amount of data collected will determine the adequacy of statistical comparisons/analyses.

Comment: This study will not achieve its objectives because historical killer whale movements and population dynamics are too poorly understood for meaningful comparisons with post-spill data. Also, the normal distribution pattern for killer whales in PWS has not been established. (ESC)

Response: The study does consider and has access to all existing historical information for PWS killer whales. Population dynamics, including distributional patterns, are well known for several pods of killer whales in PWS.

Comment: Collection of data only from PWS makes this study technically deficient. (ESC)

Response: Studies were also conducted in S.E. Alaska. Also, over 20 years of killer whale research on the west coast are available to establish pod behavior and population dynamics.

Comment: The assumption that the absence of a killer whale for one year indicates its mortality has not been established as a valid one. (ESC)

Response: Based on over 20 years of research, scientists who work with killer whales agree that if an animal is missing from a resident pod for over a year, it is dead.

Comment: Sampling locations are inadequately described only as areas "known for whale concentrations." (ESC)

Response: Known whale concentration areas are surveyed first. However, researchers routinely search all areas within PWS. Reports are also available from the sighting network throughout PWS.

Comment: The Plan does not indicate whether data concerning age, sex, or activity will be gathered other than through photographs.

Disturbance and harassment created in the efforts to take photographs may bias results. (ESC)

Response: The age of whales (other than calves) cannot be determined from field observations and subadult males and females appear the same. Females can be identified if they are with a calf and adult males can be identified by the large size of their dorsal fin.

Comment: The change in methodology resulting from the addition of the non-professional sighting network will make comparison of the 1990 data to that of previous surveys of questionable value. (ESC)

Response: There is no change in methodology between 1989 and 1990. A sighting network was in place during the 1989 season. Dedicated effort is similar between both years.

Comment: Analytical methods are not well-described: there is no definition of "pod integrity" or any description of how distribution data will be analyzed; the numbers and types of analyses are not given and QA/QC issues are not addressed; and the methods for determining mortality and natality rates are not included. (ESC)

Response: Analytical methods are described in the text. We state specifically that distributional data will be evaluated subjectively. Mortality is based on the number of missing animals from resident pods over a two year period and the number of stranded animals found on the beach. Natality rates are based on the number of new calves observed with their mothers for each season.

Comment: Objectives A, B, and D appear to depend on probabilities of whales sightings being constant over the whole survey route when, in reality, such probabilities are highly variable because they depend on environmental factors such as bathymetry and local prey densities. (ESC)

Response: The survey design does not rely on sightings being consistent over any particular area. When whale sightings occur, all environmental factors are recorded and these observations are considered during analysis.

Comment: It is unlikely that the results of this study can be used to link any measurable impact on killer whales with the spill because: 1) the study implies that any change from the pre-spill conditions represents spill damage whereas other environmental

factors such as fishery conflicts are not being examined; 2) killer whales are highly mobile, so the assumption that the absence of particular whales from Prince William Sound is due to mortality is invalid; and 3) baseline natality and mortality data, which are neither sufficient nor well understood, are essential to the success of this study. (ESC)

Response: A large effort is being made to examine the impacts of all factors on killer whales, including non-oil environmental factors and fishery conflicts. Although killer whales are highly mobile, much research has been conducted on the stability of killer whale pods/membership over time.

Marine Mammal Study No. 5 - Harbor Seals

Comment: Marine Mammals 5 does not distinguish between oil spill effects and natural factors, such as ecological succession, natural cyclical changes and human activities, that may account for the difference in resource levels between oiled and non-oiled areas. (APSC)

Response: This study does distinguish between natural changes and those caused by oil. Historical abundance data from before the spill clearly indicate that oiled and unoiled population trends and rate of decline were the same. Ecological succession is not relevant to harbor seals in this context.

Comment: Marine Mammals 5 inadequately deals with the declining populations trends of harbor seals. (ESC)

Response: The study design adequately deals with declining population trends. We recognize this trend and have historical data indicating that it is the same in oiled and unoiled parts of PWS. We reference a source of detailed information in the study plan. This study is not designed to investigate this ongoing decline, but is intended to look at differences between oiled and unoiled areas.

Comment: It will be difficult to establish causal relationships for chemical residue data and pathologic observations in the investigation of tissue hydrocarbon levels or histologic changes in Marine Mammals 5. (ESC)

Response: Histopathology experts indicate that they can establish causal relationships for certain pathological observations.

Comment: Objectives A and B of this study will be impossible to

achieve through the methods described in the Plan. Because the link between petroleum residues in tissues and pathological conditions often is not clear, the cause of death will be difficult to establish. Oil spills can cause pathologic changes that are not associated with increased residue levels. On the other hand, residue levels can be elevated in the absence of any pathologic conditions. (ESC)

Response: Objectives A and B are difficult to achieve but certainly not impossible. Determining that harmful pathological conditions resulted does not require that residue levels be elevated. Pathological changes may or may not be associated with elevated residues depending on what residues are tested, time and duration of exposure to oil, length of time after exposure that samples were taken, etc.

Comment: The collections of additional seals in 1990 was unwarranted in light of the fact that the impact on seal populations demonstrated in 1989 was minimal and that there are difficulties with the program design. (ESC)

Response: The collection of additional seals was warranted and was supported by marine mammal experts throughout the scientific community. The data obtained were valuable in determining persistence of hydrocarbons and whether or not pathological changes persisted.

Comment: Differences between oiled and unoiled areas cannot be attributed to oil as opposed to natural variability. The study is part of ongoing research into the cause of the declining harbor seal populations in the Gulf of Alaska and is not appropriately part of the NRDA program. (ESC)

Response: Design of the study will allow for detection of differences between oiled and unoiled areas that can be attributed to EVOS. This study is certainly not part of ongoing research.

Comment: The field methods for this study will not detect distribution changes. Any changes in distribution will appear to be changes in abundance. (ESC)

Response: The study will detect changes in abundance between oiled and unoiled areas. Changes in distribution are not expected to be a problem because harbor seals demonstrate a strong site fidelity and haulout sites are highly traditional.

Comment: QA/QC issues are not addressed in the description of this

study. (ESC)

Response: Standard, scientifically accepted, QA/QC procedures are followed in all studies.

Comment: The analytical descriptions are not sufficiently detailed. Sample sizes for the exposure/pathology work are inadequate and the use of reference seals from southeast Alaska is inappropriate. (ESC)

Response: Methods are described in sufficient detail. Additional information can be found in referenced publications. Use of reference seals from southeast Alaska is considered appropriate because they were clearly unoiled, but taken from comparable habitat.

Comment: The analysis strategy appears to assume that sample locations are analogous to home ranges and that pathologic findings will correlate to tissue residue, but these assumptions are not valid. (ESC)

Response: The physical presence of oil marked seals collected in 1989 clearly indicated their exposure to oil. It is not necessary to assume that they were from the oiled areas, it was physically apparent. Seals in unoiled areas were clean and seals from oiled areas were discolored. Also, it is well known that harbor seals are relatively sedentary and show marked site fidelity.

Comment: Statistical procedures are defined in vague terms. It is not clear how the oil spill effects will be estimated and statistically tested. The level of the effect being tested and the effort needed to detect that effect are not provided. (ESC)

Response: Statistical methodology is clearly stated. It is also clear that the level of statistical significance is 0.05.

Comment: The sampling effort is not appropriate to meet the study's objectives. The probability of declaring an effect when there really is not one is not given. Nor is the probability of failing to find an effect when there really is one given. Thus, it may be impossible to ascertain whether a statistically significant effect was linked to the oil spill. Criteria for choosing impact and control sites were not given. (ESC)

Response: Sampling effort is appropriate to meet the objectives. Probability levels for the relevant tests are given. Choice of oiled and unoiled sites was based upon presence of oil on the

shoreline.

Comment: The forty percent decline in abundance observed in the trend counts was based strictly on two years' data. This is not sufficient to establish any meaningful baseline, trends, or natural variation. Since the cause of these declines has not been pinpointed, it is not likely that any impact of the spill can be detected by this study. (ESC)

Response: Historical data in combination with data collected at the control site will provide a basis for evaluating the ongoing population decline and any natural variation in the population. It is not necessary to pinpoint the cause of the ongoing decline in numbers in order to determine injury from EVOS.

Marine Mammal Study No. 6 - Sea Otter Impacts

Comment: Mature otter and pups are again repopulating areas that were affected by the spill. This evidence should be taken into account in the Plan. (ESC)

Response: We recognize there is some reoccupation of oiled habitat, and will be able to evaluate population distributions through surveys and by monitoring radio-instrumented adults and pups. Occupation of an area does not, however, necessarily imply that those otters or the habitat into which they move are in pre-spill condition.

Comment: None of the sea otter studies is likely to produce useful information since this species is recovering rapidly and uncovering minor differences between area populations will not contribute to defining a restoration need or a restoration strategy. (ESC)

Response: We know of no basis for the statement that there is an "obviously rapid recovery process" ongoing in oiled areas. The extent of certain differences between areas will be determined by the study, and it is not reasonable to determine that they will be minor prior to execution of the studies.

Comment: The description of the DNA content, sperm morphology, and haptoglobin binding analyses in Marine Mammals 6 is inadequate for technical review. Further, the endpoints for detecting hydrocarbon exposure are non-specific and are subject to a high degree of natural variability. (ESC)

Response: Detailed descriptions could not be included in the Marine Mammals 6 study plan due to space constraints; however,

references providing thorough descriptions of these analyses were provided in the bibliography. The natural variability in these measures has been examined in other mammals, including some wildlife species, and has been accounted for in the statistical design of the study.

Comment: Any post-spill differences detected in distinct sea otter populations will not be attributable to the oil spill since sea otters typically have site-specific age, sex, and growth characteristics. (ESC)

Response: There are pre-spill population data on sea otters in eastern and western PWS, including information on sex, age, and growth characteristics. This information will be used in interpretation of findings from the present study.

Comment: It will be difficult to establish causal relationships for chemical residue data and pathologic observations in the investigation of tissue hydrocarbon levels and/or histologic changes in Marine Mammals 6. (ESC)

Response: Studies on otters that were known to be oiled and died in the spring and summer of 1989 will provide evidence on associations between exposure, pathologic changes, and hydrocarbon burdens. Similar studies on unoiled controls will provide baseline information. Results from this work will provide a basis for interpretation of data from additional carcasses found in areas affected by the oil spill.

Comment: The objectives for assessing spill impacts on otters are largely unattainable given the design and analyses of this study. There is no reference to the magnitude of the physical and ecological differences between the impacted and non-impacted study areas. Sea otter densities will be different generally between any two sites owing to natural factors, independent of oiling. This will affect the aspects of the study concerning population, sex, and age structure and reproductive history from carcass evaluations. (ESC)

Response: The sea otter damage assessment studies were reviewed by a qualified biostatistician and guidance will be provided during the data analysis phase. Distributions and abundance of sea otters in PWS are available from historical data. We agree there can be natural factors influencing study areas; however, existing data on basic demographic parameters of both eastern and western PWS are available and will be utilized in analysis and interpretation of results.

Comment: Study 6A lacks adequate description of the sampling locations and site selection criteria. Oiled sites are not well identified. Time of day of surveys is not indicated. Feeding behavior can vary significantly between subpopulations. There is no indication how sexes of the adult animals will be determined. (ESC)

Response: Sampling locations were selected based on sites examined in historical surveys, and were supplemented with additional, randomly selected sites. Surveys are done during daylight hours. Sexes of adults are not determined in the surveys. NRDA review of oiling data has ensured consistency and most accurate identification of oiled areas.

Comment: The methods proposed fail to distinguish between distribution effects and populations declines. Movement patterns of otters in the spill area are too poorly understood to be of value in making comparisons between oiled and reference sites. (ESC)

Response: Distributions of sea otters can be estimated from historical data and repeated post-spill surveys. Previous and ongoing telemetry studies address detailed movement patterns on a seasonal and annual basis.

Comment: Boat survey sampling frequencies are too low to detect differences in density over time. Since there is only one pre-spill estimate of population size, trends or variance cannot be determined. (ESC)

Response: Boat surveys will estimate distribution and abundance over time. Although there is only a single pre-spill boat survey, an estimate of variance of survey data can be obtained from post-spill results.

Comment: There is no pre-spill hematology for otters in the study area for use in comparing hematology data between areas. And historical differences in hematology have been attributed to variations in habitat quality. (ESC)

Response: Sea otters from unoiled areas will provide control values for blood samples collected from otters in areas affected by the oil spill. Hematology of California sea otters is also available and can be used to supplement the Alaskan control values. Interpretation of the hematology values will be done by a highly qualified clinical pathologist who is familiar with differences that may be associated with variations in habitat quality.

Comment: Many of the sublethal parameters being evaluated are not standard methodologies for wildlife, for assessing oil impacts, or assessing population impacts, so they are simply research. (ESC)

Response: The fact that these techniques may not be standard for wildlife in no way negates their value for the present studies, which are unprecedented in scope. The methods have been evaluated in other mammalian species, including several wildlife studies. It is fully appropriate to apply the most advanced scientific techniques to assess damages from the oil spill.

Comment: The population modelling technique of Study 6A is inappropriate because it requires a far better knowledge and understanding of population status and trends than are currently available for sea otters in PWS. (ESC)

Response: Sea otters in PWS and other parts of Alaska have been the subject of numerous studies including population modelling efforts. Given pre-spill studies and the large numbers of carcasses collected after the spill, there are ample data on which to base a population modelling effort.

Comment: The baseline data for Study 6A are too limited; the sample sizes are too small; the assumptions regarding population status are insupportable; and the clinical laboratory and residue analysis data will be inconclusive and have little bearing on effects of the spill. (ESC)

Response: A considerable amount of data exist from pre-spill studies on sea otters in PWS and will be utilized in the present study as baseline information and to support assumptions made regarding population status. Sample sizes were estimated to be adequate for statistical testing. Clinical laboratory data and hydrocarbon residue analyses will be related to reproduction and survival of the otters from which samples were collected. It is inappropriate to state, prior to the study, that results will be inconclusive and have little bearing on the effects of the spill.

Comment: The control areas for Study 6B are not described well in the Plan or in the baseline reference. Assessing oil impacts from change in age structure of beached carcasses necessitates a full understanding of trends and variation in the population and subpopulation age structure dynamics. (ESC)

Response: Ten years of pre-spill carcass collection efforts provide the control for this study. Beaches which were walked pre-spill for carcass recovery will be the focus of post-spill collection efforts. With data available from multiple years, we

have a very good understanding of pre-spill sea otter age distributions at death in PWS, and of the variance among years.

Comment: The spring 1990 carcass count and age structure data in Study 6B will not have valid predictive value for estimating long-term impact. (ESC)

Response: The main purpose of collecting carcasses in the spring of 1990 is to evaluate age-class distribution of the dead otters and to compare this to pre-spill data. This study in itself was not intended to predict the long-term impact of oil exposure. Continued studies of recovered carcasses will provide insight on the long-term impacts to the population.

Comment: The carcass drift experiments will greatly overstate the direct spill-related mortality because distressed otters are very likely to haul out on land, thereby increasing the likelihood of their being found. No such behavior will occur with the drift buoys. The drift study is inadequately described and gives insufficient information regarding the locations, deployments, and extent of any follow-up efforts. (ESC)

Response: The drift study was not intended to estimate direct spill related mortality but rather to simulate drift characteristics of floating carcasses. We recognize that many factors would affect carcass recovery and estimates of direct mortality. The floats were deployed based on information provided in the boat surveys.

Comment: Statistical procedures are poorly described. It is not clear how the oil spill effects will be estimated and statistically tested. The level of the effect being tested and the effort needed to detect that effect are not provided. (ESC)

Response: See response for the following comment.

Comment: The sampling effort is not appropriate to meet the study's objectives. The probability of declaring an effect when there really is not one is not given. Nor is the probability of failing to find an effect when there really is one given. Thus, it may be impossible to ascertain whether a statistically significant effect was linked to the oil spill. Criteria for choosing impact and control sites were not given. (ESC)

Response: Marine Mammal Study 6 (A, B, & C) is a large study involving several approaches to the estimation of damage to the sea otter populations in PWS, with a total of 32 objectives listed.

The above comments are very general, and thus necessitate a general response. A biostatistician assisted the principal investigators in design of the studies, including determination of sampling design and sample sizes. A biostatistician will provide guidance in data analyses. Although any single approach to damage assessment may not in itself provide a conclusive result regarding links to oil-related damages, information gained by different approaches will be supportive in synthesizing the overall assessment of damages to the sea otter populations following the oil spill.

Comment: The sublethal effect investigation is research-oriented and not useful for assessing injury. The methods employed are not routine for wildlife or oil spill impact assessment. The mechanism by which the oil spill could cause chromosomal damage to otters is remote, given the toxicity of crude oil, its environmental fate, and the levels of polycyclic aromatics in otter prey stemming from the spill. (ESC)

Response: Methods in this study for evaluating chromosomal damage have been utilized in previous wildlife studies; references were included in the bibliography. Crude oil contains many toxic components which could provide mechanisms for chromosomal damage. It is erroneous to conclude that research-oriented studies do not have a role in the damage assessment process, particularly because no routine methods have been established for assessing effects of oil on mammalian populations.

Marine Mammal Study No. 7 - Otter Rehabilitation

Comment: It will be difficult to establish causal relationships for chemical residue data and pathologic observations in the investigation of tissue hydrocarbon levels or histologic changes in Marine Mammals 7. (ESC)

Response: Studies on sea otters from the rehabilitation centers that were known to be oiled and died in the spring and summer of 1989 will provide evidence on associations between exposure, pathologic changes, and hydrocarbon burdens. Histopathological examination of several different tissues from a large number of otters, and determination of hydrocarbon levels in these tissues, will provide insight on relationships involved.

Comment: Objectives A and B of this study are inadequately described and cannot be achieved. They ignore the fact that translocation of otters will likely play a larger role in otter survival than will oil exposure. (ESC)

Response: Objective A can be tested using control groups as described in the study plan. Our ability to test Objective B will depend on movement of a portion of the radio-instrumented sea otters into oiled areas. Translocation is a necessary component of the rehabilitation process. There is no basis for the statement that translocation effects will likely play a larger role in survival than oil exposure. The circumstances involved in translocation in this study are not similar to those in historical translocations, and effects thus cannot be assumed to be the same as in previous translocations. Furthermore, because of our ability to monitor the radio-instrumented sea otters, we will be able to distinguish between mortality and emigration.

Comment: Field methods of this study are inadequately described: the frequency of relocation of instrumented animals is not given; the health assessment criteria are not described; and it is not clear how females will be distinguished from males during counts of the study populations. (ESC)

Response: As stated in the study plan, it was intended to relocate the instrumented sea otters at least biweekly. However, weather conditions in the Sound can be severe, especially in winter, and movements of the otters can make it difficult to track all of them on a regular basis. Health of the surviving otters is not being directly assessed; rather, we are determining biweekly rates of survival, where feasible. In this study, there are no counts being made on study populations that require distinguishing males from females. Sex is known for each of the instrumented otters.

Comment: Analytical methods are not detailed enough. Sample sizes may be too small to be meaningful. A sample of 45 rehabilitated otters with diverse characteristics is too small to detect differences that can be extrapolated to the rehabilitated otter populations. (ESC)

Response: A sample size of 45 instrumented sea otters is sufficient to measure effects that can be extrapolated to the rehabilitated otter population. The 45 animals are generally representative of the otters at the rehabilitation centers.

Comment: Study objectives are compromised by the fact that otters were captured, maintained in captivity, stressed and translocated. Oil exposure is only one factor that has potentially impacted the otters. Several otters were judged to be unoiled by otter center workers when they were admitted for rehabilitation, so the findings will pertain primarily to the effects of captivity and translocation. (ESC)

Response: We recognize that the fate of the sea otters following release may be influenced by various factors including oiling, cleaning, and captivity. Records were kept on the degree of oiling at arrival and the clinical history of the otters while at the centers, and these will be considered in interpretation of the data. Hydrocarbon burdens in blood and fat (collected prior to release) will be available for instrumented sea otters and will provide a basis for judging the effects of oiling on the fate of the otter.

TERRESTRIAL MAMMALS

Comments on Terrestrial Mammals Studies - General

Comment: Although the study descriptions are improved over those provided in 1989, the 1990 studies are inadequately detailed to make a proper scientific evaluation. (ESC)

Response: The Trustees believe that sufficient detail was provided to allow scientific evaluation. Additional information is available from referenced publications.

Comment: The omission of results from related 1989 studies (Terrestrial Mammal 1, Terrestrial Mammal 3, Terrestrial Mammal 4, Terrestrial Mammal 6) makes it difficult to understand the justification for their continuation into 1990. Given the lack of mortality, substantial indications of injury would be necessary in order to justify these studies. (ESC)

Response: Because these studies are conducted for purposes of litigation, results of studies are confidential; they will be made public either in the course of the litigation or after final reports are prepared and authorized for release.

Comment: Terrestrial Mammals 1, 3, and 4 lack evidence of exposure of these species to oil. There are no documented mortalities of deer, river otters, or brown bears in the 1990 study descriptions, so there is no reason to continue these studies. It is extremely unlikely that these species or black bear (Terrestrial Mammals 2) or mink (Terrestrial Mammals 6) could have been significantly impacted by the spill. (ESC)

Response: All of these species use intertidal habitats that were heavily impacted by oil. Therefore, there is significant potential for contact with oil and resulting injury.

Comment: Relevant law requires that the anticipated costs of the assessment be less than the anticipated damage amount in order for the assessment costs to be reasonable. Many of the studies, notably those regarding Terrestrial Mammals, violate this requirement. (ESC)

Response: The NRDA regulations, which are optional, indicate that the anticipated cost of the assessment should be less than the anticipated amount of damages. See 43 C.F.R. § 11.14(ee). There is no requirement that each individual element of the assessment meet this test. Rather, individual elements need only lead to an increase in accuracy and precision in the assessment that outweighs their costs. See Id. The Trustees believe that the assessment meets these standards.

Comment: The Plan contains studies designed to do scientific research that will not lead to identification of injuries, and the costs of such research cannot be recovered under the NRDA regulations, but should be funded by alternate means. Examples include Terrestrial Mammal 6, the toxicity study of which is an inappropriate laboratory simulation of actual environmental conditions. (API, ESC)

Response: Terrestrial Mammal 6 is very clearly focused on determination of injury from ingestion of sublethal doses of oil. The use of a laboratory simulation is a reliable, scientifically accepted technique that will produce results that can be extrapolated to mink and other related species impacted by EVOS.

Comment: The need for any studies of terrestrial mammals should have been motivated by 1989 data wherein injury to mammal populations, sufficient to merit further study to define restoration needs, was documented. Since it is very unlikely any such injury to terrestrial mammal populations was documented, the justification for these studies is highly unquestionable. (API, ESC)

Response: Terrestrial mammal studies are expected to provide information on injury and to support restoration planning. Specific results of 1989 studies are confidential.

Comment: The natural variability of species is not adequately addressed. (API)

Response: Studies are designed to account for major sources of natural variation.

Comment: The studies concerning Sitka black-tailed deer and black and brown bear disregard the fact that these animal populations are in good health and abundant, evidenced by the fact that the State still permits hunting of these animals. Had there been a sizable mortality of terrestrial mammals or a significant exposure potential to petroleum hydrocarbons, these species would have been investigated under the joint NOAA, ADF&G, and Exxon subsistence program. (ESC)

Response: The presence of a huntable surplus does not mean that significant injury did not occur as a result of EVOS. The joint subsistence program investigated the possible impact of hydrocarbon contamination on the health of humans who consume various species. It did not consider impact on the animals themselves.

Comments on Terrestrial Mammal Studies - Specific

Terrestrial Mammal Study No. 3 - River Otter and Mink

Comment: The study's overall objective, that of determining if the EVOS will have measurable effects on river otter populations, cannot be achieved given the absence of valid pre-spill population data. (ESC)

Response: Comparison of total numbers and survivorship between oiled and unoiled areas over several years will allow an assessment of injury to populations. Other information being collected on direct effects, food habits, and habitat use will be a valuable aid in interpreting population data.

Comment: Some of the specific objectives associated with food habits and habitat use may be achievable. However, observations of differences in certain parameters cannot be related to potential impacts from the EVOS. (ESC)

Response: All objectives were formulated with the expectation that differences can be related to EVOS. The study was designed to account for significant natural variation that could influence results, and, therefore, it is expected to detect injury from oil contamination.

Comment: The "food habitats" and "habitat use" sections of this study will not show any negative impacts on the population of otters. They may show otters are adjusting to new habitats. (API)

Response: It is reasonable to examine closely both food habits and habitat use because both are expected to show injury given the heavy contamination of intertidal areas that are critical for otter survival. Oil contamination does not create "new habitat". Any adjustments detected will be the result of otters responding to habitat injury.

Comment: This study will provide data that may be useful for long-term goals of managing Prince William Sound but not directly related to oil spill impacts. It will provide much information about the habitat use and movement patterns of this species, but it will not measure any population impacts. (ESC)

Response: This study focuses directly on investigation of injury from EVOS. Comparison of oiled versus unoiled areas is a key study design feature.

Comment: The Plan does not make clear that sampling programs will produce information necessary to prove that a statistically significant portion of the expected biological variability is a function of hydrocarbon contamination as opposed to other natural factors. Terrestrial Mammal 1, Terrestrial Mammal 3 and Terrestrial Mammal 4 suffer from this defect, such as severe winters, predator/prey relationships, and disease, which clearly affect key life cycle events of various species. (ESC)

Response: The study plan provides sufficient detail to allow evaluation of the statistical validity of the design. Additional details can be found in referenced publications.

Comment: This study will not identify avenues of oil contamination. It does not distinguish between contamination via digestion and contamination via thermal absorption or grooming. This study should provide for the coordination and integration of data from river otter food habits and from studies of the species on which they prey. This study will not detect simultaneous reductions in the populations of river otters and their prey species. (NWF)

Response: Identification of specific avenues of contamination is not part of this study. It will rely on other NRDA projects for information about contamination of the river otter food chain. A full suite of coordinated environmental studies is being conducted in the oiled area.

Comment: There is insufficient evidence that river otters were exposed to oil. (API)

Response: River otters were exposed to oil. Intertidal habitat critical to this species' survival was heavily impacted by oil.

Comment: "Direct effects" and "population change" parameters can show biological effects which cannot be quantified. (API)

Response: The study design is expected to allow quantification of both direct effects and population change resulting from EVOS.

Comment: It is inappropriate to compare an impacted site to a reference site for density comparisons when, in all probability, neither site has any valid pre-spill data on population trends or variance. (ESC)

Response: The lack of historical data on populations does not invalidate comparison of density between oiled and unoiled areas.

These two areas will be monitored for several years and they are similar enough that differences can likely be attributed to injury from the EVOS.

Comment: This study is not cost effective and will only assess short-term impact. There will be a quick recovery from any short term impact on otter density. River otters mature rapidly and have relatively large litters. The "takes" planned in this study will probably result in more otter fatalities than have been observed since the EVOS. Very little of this study will relate to natural resource injury. (ESC)

Response: It is anticipated that this study will be cost effective. The ability to detect injury over time is a function of the duration of the study. The design will produce reliable results and is focused on assessment of injury. Recovery rates for the otter population are difficult to predict. Plans to collect otters were canceled.

Comment: Study locations are not described well. (ESC)

Response: Sufficient detail concerning study locations was provided to allow evaluation of the project; more detailed descriptions might have jeopardized the study.

Comment : The radio transmitter and radioisotope implant techniques are not described adequately. (ESC)

Response: Sufficient detail concerning transmitter and radioisotope implants were provided to allow evaluation of these techniques. Additional detail is available in referenced publications.

Comment: Statistical procedures are vaguely defined. It is not clear how the effects of the oil spill are to be estimated and tested statistically. The level of effect being tested and the effort (number of samples, replicate subsamples, etc.) needed to detect that effect were not given. The sampling effort does not appear to be appropriate to meet objectives. The probability of declaring an effect when there really is not one (Type 1 error) is not given. The probability of declaring an effect when there really is one (Type II error) is not given. It will be difficult to determine if a statistically significant effect was due to the oil spill or to natural variation. (ESC)

Response: Sufficient detail concerning statistical procedures was provided to allow evaluation of tests. Additional detail is

available in referenced publications. The study is undergoing rigorous statistical analysis.

Terrestrial Mammal Study No. 4 - Brown Bear

Comment: Objectives A-C are concerned with possible physiological effects and mortalities of brown bear due to the EVOS, and cannot be achieved primarily because no direct exposure pathway to spilled oil is outlined. Also, there is insufficient information on how tissue and feces analyses are to be related with mortality. (ESC)

Response: Intertidal foraging is the likely exposure pathway. Other studies will provide details on contamination of forage species.

Comment: Objective D's estimation of the adult population density of the study area has nothing to do with natural resource damage assessment, particularly since no historical database exists. (ESC)

Response: Estimation of population impacts of the EVOS is an important part of damage assessment. Estimates over several years will provide trend information necessary to quantify injury.

Comment: Population estimates for only two years, 1990/1992, cannot be used to predict any trend or identify any impact from EVOS on brown bear populations on the Alaskan Peninsula. (ESC)

Response: Estimates will be obtained for several additional years if the study is continued. In addition, monitoring radio- collared bears will provide the opportunity to identify bear mortality and determine whether it is oil-related.

Comment: Two assumptions used in the model to estimate adult population levels are very weak: (1) the brown bear population is geographically and demographically isolated; and (2) all brown bear have equal capture probabilities that are constant over time. (ESC)

Response: Potential difficulties with these two assumptions are acknowledged in the study plan and details concerning how they will be addressed are presented.

Comment: The significance of hydrocarbons in fecal samples, particularly as it relates to ingestion, is not discussed in sufficient detail to determine its validity. No literature is

cited as to how this technique has been used with previous spills. (ESC)

Response: The presence of hydrocarbons in fecal samples will be an indication of exposure through ingestion of contaminated food. Other NRDA studies will provide information on contamination of individual food items. We know of no studies, other than EVOS, where fecal analysis has been used.

Comment: No explanation is given why blood is to be analyzed for packed cell volume and percent hemoglobin. These measurements are not likely to establish any impact on the bear from spilled oil. (ESC)

Response: Analysis of samples has been delayed pending additional review of the range of blood parameters that can be the most useful indicators of injury.

Comment: This study will provide data that may be useful for long-term goals of managing PWS but not data that is directly related to oil spill impacts. (ESC)

Response: This study is designed to focus specifically on assessment of injury from the EVOS, but does not relate directly to PWS populations.

Comment: Study areas in the Katmai National Park, on Kodiak Island, and near Black Lake are not described as to exact location and study area size. (ESC)

Response: Sufficient detail on study areas is provided to allow evaluation of the work.

Comment: The spill area site in the Katmai National Park is not a good choice for determining injury to brown bear from the EVOS. The bear population age structure, particularly for old males, would be quite different in Katmai because the bears are protected, not hunted. This contrasts with the control areas where hunting is permitted. As a result, some population difference might be improperly assigned to oil spill effects. (ESC)

Response: Age structure difference between the study areas is recognized and is considered in the study design. We expect it will be possible in analysis of the data to isolate this variable and, therefore, avoid improperly assigning differences to impacts of EVOS.

Comment: The Plan does not make clear that sampling programs will produce information necessary to prove that a statistically significant portion of the expected biological variability is a function of hydrocarbon contamination as opposed to other natural factors. Terrestrial Mammals 1, 3 and 4 suffer from this defect, such as severe winters, predator/prey relationships and disease, clearly affect key like cycle events of various species. (ESC)

Response: Sufficient detail is presented to allow evaluation of the statistical design and sampling programs. Natural variation is considered in selection of study sites and appropriate statistical tests.

Comment: The Trustees should consider collection of tissue samples from denning females and their cubs, as well as tissue samples from fetuses of necropsied adult females. (NWF)

Response: Collection of tissue from denning animals will be considered. A full suite of appropriate samples is planned for collection from any animals found dead.

Comment: The stress caused by the capture of live bears, the implantation of radio transmitters, and the drawing of blood has not been adequately considered. (API)

Response: Stresses caused by capture of bears are well understood and will be considered in interpretation of results. No transmitters are being implanted by this study. It is highly unlikely that drawing of a small amount of blood will cause any significant stress.

BIRDS

Comments on Bird Studies - General

Comment: The bird studies ignore current scientific literature on the effect of oil on birds, which indicates that bird populations recover extremely rapidly after an oil spill. They also ignore evidence of recovery of bird populations in PWS and the Gulf of Alaska, which confirms a healthy density and diversity of resident and migratory species there. Failure to rely on the existing literature, which would have enabled the Trustees to narrow the field studies, is contrary to the NRDA regulations. (API, ESC)

Response: The bird studies were developed with full cognizance of information available in the current scientific literature. There is considerable information in that body of literature to indicate that bird populations do not always recover rapidly after an oil spill. This is especially true of long-lived species with low reproductive rates. Further, it is essential to measure the impact resulting from individual environmental calamities to account for unique circumstances which may have a bearing on impacts to birds. The EVOS was unique in its size as was the biological richness of the area where it occurred. Observation that there are still birds in the spill zone does not constitute scientifically objective information that ". . . confirms a healthy density and diversity of resident and migratory bird species there." Studies are essential before any such conclusion can be drawn.

Comment: The Plan contains studies, such as Birds 4 and 5, that are designed to do scientific research that will not lead to identification of injuries. The costs of such research cannot be recovered under the NRDA regulations, but should be funded by alternate means. (API, ESC)

Response: All bird studies were designed specifically to provide information that would be used in assessing injury. Although some objectives, in and of themselves, are not able to define injury, they provide information that, in conjunction with other data, do support injury determination.

Comment: A disproportionate number of bird studies were discontinued with little or no explanation. The reference to cost-effectiveness in the introductory section to the bird studies suggests that the Trustees made a value judgment as to the relative costs of studying damages to multiple species and the injuries to those species without explaining their conclusions. Impacts to certain species cannot be ignored simply because they are more costly to study than other species. The impacts on one species are integral to understanding the impacts on other parts of the ecosystem. (NWF)

Response: The practicality of conducting scientifically credible injury assessment studies was a critical factor in determining whether studies should be conducted. Some studies were discontinued because it was determined that continuation would not provide substantially more information on injuries than had already been gathered. In a number of cases, elements of discontinued studies were incorporated into continuing studies or into base agency programs.

Comment: Birds 2, 3, 4, and 5 are not well integrated, as there is no apparent attempt to correlate census or distribution data with factors other than the presence of EVOS oil. (ESC)

Response: Efforts are being made to correlate survey data with factors other than the presence of oil. Information on water temperature, weather, and other factors are being considered.

Comment: The bird studies involve invasive procedures, including the killing of birds to determine the potential destination of birds that did not wash up on shore after the spill. (API)

Response: Certain bird studies involved the killing of specimens to gather information needed to assess injury, such as histopathology, condition, and hydrocarbon uptake. In all cases, studies were thoroughly reviewed by leading experts and agency representatives to insure that their methods were required, that the take was kept to a minimum, and that the number of birds taken was insignificant to the overall population.

Comment: Studies that disrupt breeding grounds during the nesting season or require the handling of birds to take blood samples should not be undertaken, unless the studies are clearly necessary. (API)

Response: No bird studies were conducted that involved disruption of breeding grounds. Surveys and censuses were conducted utilizing standard methodologies. It is necessary to gather blood samples to measure differences in blood chemistry parameters between populations in different areas.

Comment: Most of the Bird studies do not adequately account for the fact that there was substantial variability in resource levels before the spill or the fact that there is no reliable baseline data. Thus, the statistical detection of differences due to oiling will not be possible. These facts also make it impossible to develop sufficient data to describe the subtleties of historical populations dynamics or to relate any potential response to

extremely low hydrocarbon levels. (ESC)

Response: We recognize that there is a possibility of substantial variability in resource levels before the spill and have designed our program to consider this variability. For example, it is unlikely that variability between years would consistently be different between oiled and unoiled areas. The best way to address this variability for seabirds is to look at long term studies or monitoring efforts; these are available for murres at the Farallons, Semidi Islands, Pribilof Islands, and Bluff colonies in the Bering Sea. Some aspects of murre biology vary, but other aspects such as productivity vary very little. It appears that changes in numbers of murres may vary from one year to the next, but a long term change of any magnitude does not generally occur without some complicating factors of mortality such as oil spills or gill netting interferences.

Comment: The 1990 Plan still does not contain an adequate description of the studies for review purposes: survey techniques are not described in Birds 2, 3, 5, and 13 in sufficient detail to permit the reviewer to determine whether the stated objectives can be met; sampling approaches are defined only in general terms; and the descriptions of the application of statistical models to data obtained from the studies is brief and incomplete. (ESC)

Response: Efforts were made to provide sufficient information in the 1990 Plan to enable the public to understand how studies were to be conducted and how data would be analyzed.

Comment: Except for Birds 1, the studies will not render injury estimates. Birds 2, 3, 4, 5, and 13 fail to identify and consider variables, such as severe seasonal weather, food supply, disease, and commercial fishing activities, that could affect bird populations. Thus, any changes in population size cannot be linked to the spill or to other significant environmental conditions. (ESC)

Response: By utilizing appropriate comparisons (e.g., oiled vs. unoiled, pre-spill vs. post-spill) it is possible to account for these other variables. It is highly unlikely that these variables would consistently affect bird populations in oiled areas and not in unoiled areas. By looking at several species over a number of years at a large enough number of sites, these other causes can be evaluated. If any of these other causes are influential, then it should affect species and sites outside of the oil spill.

Comments on Bird Studies - Specific

Bird Study No. 1 - Beached Birds

Comment: The tracking of birds killed by researchers is an unnecessary study. It is inappropriate when considering the potential injury to the birds and the economic damages to be recovered. Other methods were available to test the accuracy of the count of the dead birds at the time of the spill. (API)

Response: Careful review by expert scientists concluded that, in order to calculate a more reliable estimate of the number of birds killed by the EVOS, it was necessary to kill and radio-track a small number of birds. Other methods were considered and determined to be inadequate to achieve a more reliable bird mortality estimate.

Comment: The killing of birds was not mentioned as part of the experiment, and this portion of the study was not subject to public comment. (API) Bird 1 would have been canceled by the Trustees if it had been made public prior to publication of the Plan in September of 1990. (APSC)

Response: Although detailed information on the collection of birds was not provided in the 1990 Plan, it was specifically noted that carcasses would be radio-tracked to determine recovery rates. The study was approved after thorough review. The number of birds killed was kept to an absolute minimum and the birds were taken from populations not affected by the EVOS.

Comment: The model to be used in Birds 1 is only vaguely referenced and cannot be evaluated without more detail, such as information regarding application of the model, the model's input parameters and its underlying assumptions, and the source and nature of the historical bird density data to be used in the trajectory modeling effort. Although two options for pursuing model sensitivity analysis are presented (but not well described), there is no mention of the criteria for choosing between them. (ESC)

Response: The findings of field studies conducted for Bird Study 1 affected the structure of the model to be used; therefore, it was not possible to describe the model in greater detail before field studies were conducted. General methodologies used may be found in the following references:

Ford, R.G., G. W. Page, and H.R. Carter. 1987. Estimating mortality of seabirds from oil spills. Pp. 848-751. In Proc. 1987 Oil Spill Conference, American Petroleum Institute, Washington, D.C.

Page, G.W. and H.R. Carter (eds.). 1990. Numbers of seabirds killed or debilitated in the 1986 Apex Houston oil spill in central California. Studies in Avian Biology. In press.

The two options discussed for pursuing model sensitivity analysis were presented in order for the reader to be able to evaluate the accuracy of the model results. It was not a matter of choosing between the two options.

Comment: Objectives B and D are not distinguishable as written. (ESC)

Response: Objective B addressed the portion of the study that would look at 10% of the birds recovered on beaches after the spill. Seabirds die for a variety of reasons and some of the birds collected could have died of natural causes and been oiled secondarily.

Objective D refers to assessing mortality of birds by adapting existing bird damage assessment models to estimate total seabird mortality.

Comment: Any mortality estimate rendered by Birds 1 will only be an order of magnitude approximation given the assumptions and uncertainties that modeling will require. (ESC)

Response: The estimate of the total number of birds killed by the EVOS that will result from the model will be significantly more precise than any of the current estimates. Current estimates do not consider the number of uncertainties such as sinking, scavenging, floating out to sea, and failure to recover that are analyzed in the model used in this study.

Comment: Radio-tagging of drifting carcasses may not yield useful information other than sinking rates because trajectories followed by floating birds can be controlled predominantly by weather patterns. (ESC)

Response: This comment is correct in stating that radio-tagging of drifting carcasses may not yield useful information other than sinking rates. The primary intent, however, was to determine sinking rates rather than deposition patterns. Information on decomposition and scavenging rates was also gathered.

Comment: There is insufficient information provided in the description of the carcass drift study for critical review. Lacking are: the source of carcasses for the drift study; the source of information describing the initial state of oiling and decomposition of the carcasses; the locations of carcass releases; the number of samples to be used; and the nature of the transmitters used. (The assumption that the transmitters will remain upright and exposed may be weak, depending on the sea state.) (ESC)

Response: The source of carcasses for the drift study was not mentioned because availability of birds, permits, and logistics of getting to various sources had not yet been fully determined. Carcasses were oiled using weathered Prudhoe Bay crude oil. Carcasses were moderately and heavily oiled. Great care was taken to ensure that carcasses were as fresh as possible. Location of carcass release was not discussed in advance of the release because winds, currents, and sea states had to be taken into careful consideration at the time of the release. Availability of aircraft and boats were also critical factors in deciding the locations of carcass release. Sample sizes were selected that would permit differentiation between effects of various species used, the degree of oiling of the carcass, and the release sites as sources of variation. It was not assumed that the transmitters used would remain upright. Identical transmitters were used in previous experiments with marbled murrelets and did, in fact, remain upright.

Comment: The use of decoys as a calibration tool has several weaknesses, e.g., that they do not match birds in profile and that decoys not found have drifted out of range. (ESC)

Response: Decoys were used in a previous experiment. They were weighted to simulate bird carcasses being used. They do, in fact, act as a reasonable control. Experimental results indicate that the decoys do float similarly to bird carcasses and they did not float out of range.

Comment: As described, the study does not take into account the sensitivity of eagle nests, seal and sea lion haulout areas, and seabird colonies. The 500-foot ASL flight altitude in flights "near the beach" could violate the 1,000-foot ceiling and the 1/4 to 3-mile buffer zones established by the Fish and Wildlife Service, the National Marine Fisheries Service, and the Alaska Department of Fish and Game. (ESC)

Response: Every effort was made to minimize these disturbances as a result of flights conducted for this study. The slight activity

generated by this study was minimal when compared to that generated by spill cleanup activities.

Comment: The assumption that the "average lineal density of carcasses for a given beach type in the unsampled area was the same as that in the sampled area in a given sector" is unsubstantiated. (ESC)

Response: The Trustees recognize the validity of this comment. However, this assumption can be tested by using ESI data (Sensitivity of Coastal Environments & Wildlife to spilled oil, Atlas of Coastal Resources) and comparing this data with oil deposition data. It will be corrected if a relationship is shown between the two.

Comment: The intended use of a 10% sample of freezer-stored birds to reflect the oiled/non-oiled distribution of birds on unsearched beaches may not be appropriate. (ESC)

Response: A 10% sample would give some indication of oiling trends, however, there are plans to look at a larger sample size during the 1991 season.

Comment: The intended use of bird carcass notes and logbooks to indicate the level of effort is improper since it may not indicate the intensity of effort applied at other locations where birds were not found. (ESC)

Response: Logbooks and bird carcass notes may not indicate the level of intensity of effort applied at other locations where birds were not found or they could, in fact, indicate intensity of effort in locations where birds were and were not found. Until logbooks and other sources of information were reviewed it was not possible to know what they would reveal. The model is not dependent upon any one piece of information such as effort.

Comment: There are no necropsies planned for oiled birds, which implies that any bird with oil on it expired as a result of contact with oil. This ignores natural mortality and post-mortem oiling. (ESC)

Response: A number of oiled birds were necropsied during the spill. Estimates of mortality will consider natural mortality. Numbers of dead birds found during 1990 response activities, as well as those found during 1990 damage assessment studies and other activities, will provide useful information in estimating natural mortality.

Comment: The assumption that carcass disappearance rates increase as the birds enter the nearshore environment is questionable. (ESC)

Response: This was simply a description of an understanding, at the time, of the physical process of carcass sinking. This assumption is not critical in any sense to the model.

Comment: This study should take into account the effects of the intensive search effort. (ESC)

Response: This study makes every effort to include all pertinent information on recovery of bird carcasses during the spill, including the intensive search effort.

Bird Study No. 2 - Censuses

Comment: Comparison of the 1990 and 1971 aerial data will not produce a valid determination of injury. This study does not explain how effects of oil spill will be determined. (API, ESC)

Response: Although more recent pre-spill survey information would have been preferable, the 1971 survey data are still useful and provide important information about distribution of birds throughout the Sound. The survey was designed as an index to migratory bird populations and was not designed to provide a total population of the study area. Because this study provides only an index to migratory bird populations, it will not measure actual numbers of birds lost to the oil spill, but will document displacement of birds and loss of habitat use.

Comment: Use of aerial surveys to provide census and seasonal distribution information for comparison with historical data from 1971 is inappropriate. Without knowing data from the surrounding years and being able to compare survey techniques used, it is not likely that the 1971 data are representative of the earlier time period and therefore an appropriate set of baseline data. Population status could have been affected by environmental and other unaccounted-for changes in the intervening years, which cannot be segregated from the effects of the spill. (ESC)

Response: We agree that a direct comparison of post-spill aerial survey data with 1971 aerial survey data may present problems in identifying other intervening events or changes that may have affected bird distribution and population. The aerial survey data provide valuable information on these parameters in 1989 and 1990 and will be used accordingly. Survey dates and methodologies between 1971 and 1989/90 are similar.

Comment: It may be impossible to establish a causal relationship between observed changes and the spill. Objectives A.3 and B.3 cannot be met without long-term studies; they will be compromised on account of the natural variability in waterbird and waterfowl populations. (ESC)

Response: Information from this study will be considered in conjunction with other information to determine causality of any documented changes. Additionally, this study compares data between oiled and unoiled areas.

Comment: The study does not indicate whether the level of effort, observer experience, or other critical factors affecting the accuracy of the boat surveys will match those of earlier surveys or whether a similar protocol will be used for collecting these survey data. Further, there is no way to evaluate the reliability or the methodologies of the earlier surveys since they are contained in unpublished reports. (ESC)

Response: Similar protocols to previous studies are used in current surveys, and in all cases, through training and selection of observers, a high level of observer accuracy is assured.

Comment: There is no discussion of count replication or any other survey strategy for achieving a 95% confidence limit, and it appears that the sampling effort will not take into account natural variability, thereby potentially precluding comparisons with historical data. (ESC)

Response: The plans for this study provide information on the number and timing of counts and the statistical tests to be applied.

Comment: The sampling design is not sufficiently described for review purposes. (ESC)

Response: The sampling design is described in detail in the study plan.

Comment: The methodology used to identify the presence or absence of oil during the boat surveys is not disclosed and it is not clear that other variables that can influence bird distribution and densities are being recorded. (ESC)

Response: The presence or absence of oil is being determined by use of available data sets on oil on water (ADEC and NOAA data) and oil on shorelines.

Comment: The assumption in the aerial surveys that visibility bias affecting surveys in different years with different conditions and different observers is similar probably is not correct. (ESC)

Response: The assumption by the reviewer that aerial surveys were conducted during 1989 and 1990 under different conditions and using different observers is incorrect. The visibility bias is similar because the same observers, pilot/observers, and aircraft were utilized for both years. Conditions (weather) were also similar in that minimum weather conditions for conducting the surveys were strictly adhered to. The timing was also similar since each survey in 1990 was accomplished within a few days of the date that survey was done during the previous year.

Comment: As described, the study does not take into account the sensitivity of eagle nests, seal and sea lion haulout areas, and seabird colonies. The 150-foot ASL flight altitude in flights 200 meters offshore appears to be in conflict with the 1,000-foot ceiling and the 1/4 to 3-mile buffer zones established by the Fish and Wildlife Service, the National Marine Fisheries Service, and the Alaska Department of Fish and Game. (ESC)

Response: Every effort was made to minimize the impact of these flights to bald eagle nests, seabird colonies, and seal and sea lion haulouts. The frequency of these flights resulted in substantially less potential disturbance than the more frequent flights and other human activity associated with EVOS cleanup activities. Flight 150 ft above sea level is necessary for accurate species identification. The 200 meter offshore distance was necessary for survey width in order to duplicate Haddock's aerial survey done in 1971 and also to cover the same area being surveyed by the boat crews. Once the 400 meter survey width (200 meters off each side of the survey aircraft) was started, it was continued for continuity of the survey data throughout the study. During 1990, no surveys were done during the eagle and seabird nesting period, as surveys were accomplished during the spring (May) and fall (October). Seal and sea lion haulouts were given a wider berth when possible. Very little disturbance was observed on the seal and sea lion haulout areas during the aerial surveys as the aircraft were operated at a reduced power setting (i.e., noise abatement procedures) in order to reduce the airspeed for survey purposes.

Comment: The Plan appears to put more emphasis, unjustifiably, on the more variable spring and fall surveys. (ESC)

Response: Greater emphasis is not placed upon the spring and fall surveys than on the winter survey which is considered to include

the most stable migratory bird population. If any emphasis is placed upon one survey over the other, it would be the winter and spring surveys because those cover the time period of the initial oil spill. The fall survey usually only covered PWS because inclement weather encountered on the Kenai Peninsula portion of the study area prevented complete survey of the Peninsula during both 1989 and 1990.

Comment: The statistical procedures for data comparisons are vaguely defined; it is not clear how spill effects will be estimated and tested. (ESC)

Response: As was previously stated, this survey is intended only as an population index to cover the entire shoreline of the study area. It was not a survey of selected sample areas that would then be extrapolated out into a total population of the survey area. All surveys were done using time proven, standardized aerial survey techniques used throughout the FWS for surveying migratory bird populations.

Comment: It is not clear from the Plan how studies at Naked Island reflect on injury elsewhere. While these studies may estimate changes in local density, they will not establish a causal relationship between such a change and the spill. (ESC)

Response: The availability of pre-spill information on certain species, such as pigeon guillemots, on Naked Island provided a valuable opportunity to compare pre-spill and post-spill information.

Comment: The ability to measure a change in marbled murrelets is debatable; the available historical data from the 1979-81 era may be less useful because of their age. (ESC)

Response: The boat surveys replicate counts made in previous years and will provide information on changes in marbled murrelets populations from previous years.

Comment: The proposed Kodiak Island transect surveys do not appear to have any baseline data for comparison. If this is the case, this work cannot be used to determine injury; it can only further research. (ESC)

Response: The Kodiak Island survey transects (winter) have 10 years of pre-spill data. There were no pre-spill summer surveys at Kodiak and these surveys have been discontinued.

Bird Study No. 3 - Seabird Colony Surveys

Comment: It is unclear, given the apparent similarities of Birds 2 and 3, why these two studies were not combined. (API)

Response: Bird Study 2 deals with distribution and abundance of many waterfowl and seabird species in all habitats throughout the year while Study 3 concentrated on seabird colony numbers and reproduction. They require very different methods and efforts.

Comment: Comparison of the 1990 and 1971 aerial data may not indicate injury. It is unclear how effects of oil spill will be determined in this study. (API, ESC)

Response: Bird Study #3 did not utilize information from any aerial surveys.

Comment: The use of the Semidi Islands as a control site is inappropriate because these islands are not representative of the habitat in the spill area. They are relatively far removed from many of the study sites and are affected by different oceanographic conditions and environmental influences. (ESC)

Response: Evidence suggests otherwise. If a control site such as the Pribilof Islands in the Bering Sea had been chosen, these comments might have had some validity. However, the Semidis are right on the edge of the spill, contain the closest and most comparable large murre colonies, are positioned on the continental shelf in a similar fashion as the Barrens, have exhibited similar sea water temperatures, and are in the same oceanographic regime as the Barren Islands, if not that of PWS. In addition, there have been feeding studies of diving alcids and the food they bring to their young which support this comparison. The Semidis are one of the few close sites in the Gulf of Alaska where we have a more continuous string of yearly data on both murres and their reproduction.

Comment: It is unclear whether the proposed census study properly accounts for the diurnal variability in nest attendance of the various species that occurs even during the stated study hours. (ESC)

Response: A number of studies have demonstrated that day-to-day variability is more of a concern when determining an adequate degree of precision than hourly or diurnal variation, provided that the hourly variation by censusing at certain hours is minimized. The stated study hours are the standards used at this time in Alaska.

Comment: The use of boat- and land-based surveys is problematic; the different levels of reliability of these surveys may make comparisons questionable. (ESC)

Response: Boat-based surveys are being compared to boat-based surveys and land-based are compared with land-based at particular sites, thereby coming up with consistent comparisons of relative indices. One type of survey may be preferable if choices are available since precision of estimates will be easier to refine, but standardized methods and enough replicate counts on different days will refine precision enough for either method to evaluate the large degree of change that is apparent at this time.

Comment: Much of the historical data is too dated to be valid. Its use will limit the Trustees' ability to measure population change for some species and will make difficult any link between change in population status and the spill. (ESC)

Response: If Bird Study 3 only concentrated its effort on one site where there were gaps in the historical baseline data, there would be more concern with this issue. Instead, the approach has been to look at many different sites and several different species, some of which have a much better historical baseline of data, with the idea that any effect caused by something other than the oil spill should show up at other sites and with other species in some consistent pattern. This certainly would be true for any large degree of change, if not small changes.

Comment: Statistical models are too vaguely defined. It is not clear how the effects of EVOS will be determined, particularly given the natural variation due to time and locations. The probabilities of Types I and II errors are not given. (ESC)

Response: This project has done no modeling. This study has relied on the advice of highly regarded professional statisticians who have looked at our data and treated them appropriately with programs such as SAS. Fieldwork has attempted to refine precision of estimates with as many standardized replicates as field conditions will allow.

Bird Study No. 4 - Bald Eagles

Comment: Bird surveys indicate that species density and diversity are returning to pre-spill norms; eagle surveys show more than 1,000 active nests in previously oiled areas with normal numbers of live chicks, and the subsistence study indicates that eagles' food supply and habitat are no longer in danger. This evidence should have been taken into account in the Plan. (ESC)

Response: Pre-spill norms for bald eagle density or of density, distribution, and diversity of prey are essentially unknown. FWS surveys found something less than 1300 bald eagle nests in the area of PWS that were surveyed. The survey area included portions of eastern PWS and areas not oiled in western PWS. Many of these nests were not active and many of the nests that were active in the early part of the breeding season were not successful. To say that there were 1,000 active nest in previously oiled areas does not consider all relevant data.

Comment: The eagle studies should be discontinued given the results of the 1990 surveys indicating the rapid recovery of this species and the health of its habitat. (ESC)

Response: Although 1990 surveys indicate eagle populations may be recovering from losses suffered in 1989, complete recovery may take several years. Long-term effects of losses of breeding and sub-adult eagles, the 1989 reproduction, and the progeny of these birds that were lost due to the spill will not be evident for at least one generation of eagles or 5-6 years (the time it would have taken for the lost progeny to be recruited into the population as breeding adults).

Comment: It is not clear that this study has addressed potential impact of radio tagging and the taking of blood from bald eagles. (API)

Response: Radio-tagging of bald eagles with transmitters similar to the ones used in this project has never been shown to have detrimental effects on study birds. Transmitters weighing up to 90g have been used in other studies, while those used in PWS weigh only 60g. To date no transmitter or harness-related mortalities have been documented. During this study a maximum of 13cc of blood was drawn from captured eagles. Studies by Dein (1986) and Cooper and Eley (1979) indicate up to 47cc may be taken without harmful effects to eagles.

Comment: Bird 4's use of eagles from the Copper River Basin in the survival and productivity research is inappropriate since eagle demographic data from that area (differences in habitat, food supply, and the timing of egg-laying), which is well outside the zone of the spill's impact, is not relevant to the determination of injury. (ESC)

Response: It is currently unknown where all eagles from the Copper River Basin winter. One objective of this study was to determine if birds from the Copper River were potentially impacted by the oil spill. Only one eagle from the Copper River was radioed in 1990.

This eagle is currently wintering in PWS. It is important to study areas adjacent to PWS for potential oil-related impacts since eagles range widely.

Comment: The population survey, radio-tracking, and productivity survey components of this study are research-oriented and should not be included in the Plan. (ESC)

Response: Without studying the population and productivity trends of bald eagles in PWS it is impossible to identify impacts of the spill. By comparing trends between oiled and unoiled areas within a similar geographic region, variation in environmental and prey base conditions are minimized. In addition, without radioing individuals, it would be unknown which areas have been impacted. For example, oiled material was found in one nest distant from oil impacted beaches. It is also important to identify how far eagles range to determine which areas may have been affected by oil or if eagles from oiled areas are moving to areas with cleaner shorelines. Radio-tagging also yields information on survival of eagles from oiled areas vs. eagles from unoiled areas within a similar geographic region. The location of radio-tagged eagles found dead is useful in calculating how many eagles may actually have been killed as result of oil spill. In addition, radio telemetry is useful in validating population surveys by helping to evaluate potential biases such as seasonal movements of eagles.

Comment: It is not clear whether Objectives A, B, and C can be met to the degree of accuracy and certainty stated in the Plan. Even if these objectives can be met, the poor understanding of the baseline may hamper injury determination efforts. (ESC)

Response: The survey of resident bald eagles as well as objectives B and C were met in 1990 by following the procedures outlined in the proposal. Wintering bald eagle surveys were determined to be unfeasible due to weather conditions. We believe comparisons of surveys conducted in 1982 to those from the current study are valid. Procedures established in 1982 were followed in 1989 and 1990. All population plots randomly selected in 1982 were flown in 1989 and 1990. In addition, the shorelines of all islands in PWS were surveyed in 1989 and 1990. By surveying all shorelines, populations can be analyzed on a micro scale (i.e. eagles/km of oiled vs. unoiled shoreline) as well as on a macro scale (east vs. west PWS in 1982, '89, '90). Continuation of these surveys will provide documentation of trends since 1989. Since 1982, with the exception of the oil spill, we see no reason for a decline in productivity or densities of bald eagles in PWS as data from other parts of coastal Alaska indicate bald eagle numbers have been increasing. Populations have undoubtedly been increasing in PWS since the bounty years, and prey species such as pink salmon have

increased in abundance due to growing hatchery production.

Comment: The highly weathered and non-toxic state of EVOS oil in 1990 suggests that costs and capturing activities associated with Objective D are not warranted. Short-term reductions in productivity have little affect on eagle populations. (ESC)

Response: There has never been an oil spill of this magnitude in an ecosystem similar to that of PWS. The long term sublethal effects of North Slope crude oil are unknown. Currently, too little is known about the survival of all age classes of eagles to create an accurate population model. Therefore, the effects of short term reductions in productivity in this long-lived species are unknown.

Comment: The 1982 baseline data is too dated to be valid and may not reflect pre-spill conditions. There is no assurance in the Plan that the data to be obtained in this study will be collected in a fashion similar to that of 1982. Other environmental factors may have affected eagle populations since 1982, so the study may not be able to demonstrate that a change in eagle populations between the two sets of data is spill-related. (ESC)

Response: Population surveys conducted during this study have been conducted in the same manner as those in 1982 (Hodges et al. 1984) as described in the review plan. Surveys plots, aircraft, and experience levels of personnel were similar. There has been no cause for a major decline in eagle populations between 1982 and 1989 in PWS, and the population should be stable or expanding. We are also comparing areas of oiled and unoiled shoreline within similar geographic regions to examine relative changes in the numbers and densities of eagles attributable to the spill.

Comment: The locations of the oiled and control sampling areas for the population surveys are not described and there is no indication of criteria that will be used to distinguish these areas. (ESC)

Response: Sampling areas vary depending on what is being sampled. Some sampling areas for this study are based upon the location of nest sites, and the amount of oiling along shorelines in the immediate vicinity of the nest can be determined by reference to maps developed by ADEC. Sampling areas for free flying birds is also based upon where they are found. The oiling status of the trapping site is, of necessity, a more or less well quantified measure due to the mobility of the eagles. Eagles trapped in eastern PWS were considered to have been from unoiled areas. Eagles from areas such as Northwest Bay were considered to have come from oiled areas. Eagles from locations such as the southern

shore of Green Island were identified as coming from unoiled shorelines as most shoreline in the area was untouched by oil. This conservative approach raises the likelihood that eagles exposed to oil were included in the pool of birds considered to be from unoiled areas,, but this strengthens the significance of differences that may be observed.

Comment: Plot selection criteria are not described adequately; plot selection methodology and number of plots are needed for a proper review. (ESC)

Response: For population surveys in PWS, all island shoreline was surveyed along with 23 randomly selected mainland plots. All of Kachemak Bay and 14 random plots were counted on the Kenai Peninsula coast. Methods were those described in Hodges et al. (1984).

Comment: The inclusion of areas well outside the spill area, such as Malaspina Glacier, is questionable. Acquisition of such data is more in the nature of research than damage assessment. (ESC)

Response: As stated previously, it is unclear how large an area was impacted by the spill as eagles may range widely. Therefore, it is necessary to sample areas with historical data distant from the immediate spill area.

Comment: Comparison of eagle productivity in widely separated areas such as PWS and Southeast Alaska is invalid. (ESC)

Response: Habitat and environmental conditions in southeast Alaska are similar to PWS, and long-term research in southeast provides a useful body of information for comparison. In addition, effects of the spill in areas adjacent to PWS were unknown, and southeast Alaska provided a safe control for some aspects of this study.

Comment: The application of "home range" implies two assumptions that may not be correct: one is that the level of use of the shoreline is constant throughout the home range; the second is that eagles lack the ability to avoid oil. (ESC)

Response: We defined a biologically meaningful "core use area" around active nests as the average length of shoreline in front of each nest used by the resident radio tagged eagles during the nesting season. Telemetry indicated that eagles with oiled shoreline in their core use areas continued to utilize this same area. Relative use of oiled and clean areas within a core use area is not possible to determine. Assuming acquisition of food is

the primary motivation for coming into contact with oiled beaches, eagles are not likely to differentiate between clean and oiled beaches or prey.

Comment: The comparison of survival between 15 adult eagles from oiled and 15 adult eagles from unoiled areas employs too small a sample to ensure that random samples across the age structure of the population are obtained. (ESC)

Response: Adult eagles are of indeterminate age and nothing is known about the age structure in adult bald eagle populations. With no knowledge of age structure in the population, it cannot be stated that the sample is too small. Individuals in a given age class have an equal probability of being captured, while younger year classes have a higher probability of being sampled given consistent annual mortality. Age structure is unlikely to be different in eagles trapped in east vs. west PWS.

Comment: The radio-tagging program does not account for the natural dispersal of immature eagles and could potentially increase the risk of mortality to fledglings, thereby creating a bias in the study. Also, there is no explanation of how the failure of radio tags will be taken into account. (ESC)

Response: It is undoubtedly true that the dispersal of juvenile eagles increases their risk of mortality compared to adults, but the risk is not associated with the natal area in normal situations. We are comparing survival of juveniles from oiled and unoiled areas that are subject to the same risks with the exception of the pollutants in the oiled area. Radio failures are equally likely for either group. Literature on the Kaplan-Meier procedure cited in the study plan (Pollack, 1989) discusses how missing transmitters are "taken into account".

Comment: The oiled and non-oiled sampling areas for the survival study are not described adequately to allow proper review. (ESC)

Response: Sampling areas are based on the occurrence of successful nests and where adults are found. Obviously, these cannot be determined until they are observed in the field. Of the 71 chicks radioed, 41 were from areas potentially impacted by oil (west PWS) and 30 were from known clean areas (east PWS). 37 adults were captured in west PWS while 29 were captured in east PWS. Specific oiling status is determined as described above. Survival estimates will be calculated on macro (east vs. west PWS) and micro (oil in vicinity vs. no oil in vicinity) levels.

Comment: Neither the number of blood samples nor the means of selection of the individual eagles to be tested was provided. (ESC)

Response: The number of blood samples taken was equal to the number of adult eagles trapped and from which a sample of blood was obtained. Fifteen individuals were selected from dispersed areas in west and east PWS. We trapped eagles in west PWS from areas with oiled shorelines. Subsequent radio telemetry of trapped and released eagles further defined potential exposure to oiling.

Comment: The post-mortem changes evident in dead eagles may invalidate the results of hydrocarbon analyses performed on recovered carcasses. (ESC)

Response: Post-mortem changes in eagles from oiled and unoiled areas are unlikely to be different. Determination of causes of mortality are being made by highly qualified professionals who are eminently qualified to determine whether the analyses performed provide reliable data.

Comment: The oiled and control sites for the toxic/sublethal effects portion of this study are not described sufficiently to permit review. (ESC)

Response: See response to similar comments above vis-a-vis the population surveys and survival study components of this study.

Comment: Statistical models are too vaguely defined. Study sites are neither disclosed nor described adequately, and the probabilities of Types I and II errors are not given. (ESC)

Response: Statistical models mentioned in the plan are routine tests presented in statistical texts. Study sites are discussed above. It is accepted statistical practice to set the Type I error at 5%, termed "significant", or at 1%, termed "highly significant". Type II error will be evaluated in consultation with statisticians.

Bird Study No. 11 - Sea Ducks

Comment: Better explanation is needed of the correlation between hydrocarbon intake and increased mortality and reproductive failure. There will be no real measurable data on effects without this. Objective A seems unattainable given the scope and design of the program. (API, ESC)

Response: Increased information on the correlation between hydrocarbon intake and increased mortality and reproductive failure is needed and will be gathered in 1991. Objective A is attainable

and is well underway. Food items from collected ducks have all been identified and the information entered into database files awaiting statistical analyses.

Comment: The statement in the Plan that seaduck collection will be integrated with other data to demonstrate that seaducks feed on contaminated prey reveals a bias in the study. (ESC)

Response: Seaduck collection was integrated with sample sites of blue mussels in exposed and unexposed areas of PWS to test the hypothesis that seaducks are exposed to petroleum contamination through their prey base.

Comment: Given the number of ducks to be collected in this study in 1990 and the fact that waterfowl hunting is still permitted, seaduck populations must be healthy. Thus, there is a question about the cost-effectiveness and reasonableness of this study. (ESC)

Response: The presence of a huntable surplus of ducks does not mean that significant mortality did not occur and, therefore, that injury from EVOS did not occur.

Comment: The study and control sites within PWS are not defined, the methodology used in selecting the individual seaducks to be collected at each site is not described, and the number of samples to be collected at the control sites is not given. The relatively small sample sizes will not justify the planned statistical work. (ESC)

Response: The exposed study site is the oil spill area of western PWS. The PWS control site is a series of bays and inlets north of Cordova in the unoiled area of the eastern Sound. Ten individual seaducks of each species per site is considered the optimal sample size. It is adequate to obtain information needed but will not exert undue population pressure. Statistical interpretation of small sample sizes has made considerable progress in recent years.

Comment: The use of a control site in Southeast Alaska is inappropriate since that area is not representative of the spill zone. (ESC)

Response: Use of a control site in southeastern Alaska is appropriate because intertidal habitats, where these ducks forage, are similar to PWS. Intervening sites along the North Gulf Coast

(Icy Bay, Yakutat Bay) had naturally occurring oil seeps and were deleted from consideration.

Comment: The predictive models for estimating the effect of oil on morbidity, mortality, and reproductive potential are not described. It will be subject to a large degree of uncertainty on account of the ranges of reasonable variables used for input. The use of a model in this fashion represents use of a non-standard technique for injury determination that is not widely accepted. This violates the NRDA regulations. (ESC)

Response: The study has evolved away from the predictive model postulated at early stages of the investigation into actual documentation of morbidity, population decline, and reproductive failure.

Comment: Integration of data from other studies likely will not be possible due to the high degree of spatial variation present even on a small scale. (ESC)

Response: Integration of data from a study of petroleum hydrocarbon levels in blue mussels and other intertidal forage species is possible and is proceeding.

FISH/SHELLFISH

Comments on Fish/Shellfish Studies - General

Comment: Fish/Shellfish studies 2, 5, 7, 8, 10, 17, 23, 27, and 28 will provide data that may be useful for long-term goals of managing Prince William Sound, but are not directly related to oil spill impacts. (ESC)

Response: These studies have components that will demonstrate exposure of fish and shellfish to oil (observations of oiling), bioavailability (hydrocarbon and mixed function oxidase analysis), or injury to individual organisms (histopathology). Taken together they are structured to determine damage to fish stocks. Damage due to the oil spill may require management actions that would otherwise not have been necessary and ancillary benefits improving the management of stocks in general may result from these studies as there are ancillary benefits for many kinds of scientific studies; however that is not the primary reason for conducting these studies.

Comment: Despite more complete descriptions for the 1990 studies, there are still problems with the changes these studies seek to measure. (API) Details are inadequate to support a comprehensive review of study design, field methods, or interpretation of results. (ESC)

Response: It is impossible to respond to unidentified problems or inadequacies. Each study is followed by a reference section of literature in the public domain from which the study designs, methods, and likely avenues of interpretation were derived.

Comment: Results of the 1989-90 subsistence program conducted by NOAA, ADF&G, and Exxon provide evidence that fish from the spill-impacted area do not contain hydrocarbons above background levels. (ESC)

Response: This statement is not entirely consistent with the results obtained to date. The subsistence tests focussed on hydrocarbons in edible fish tissues; however, fish (unlike clams) have physiological pathways by which they process hydrocarbons into forms soon unidentifiable as having originated from the EVOS (the fish themselves are largely composed of hydrocarbons). This does not mean that the fish have not been harmed by exposure to oil in either a short or a long term fashion nor that this harm cannot be assayed by means other than hydrocarbon analysis.

Comment: Except for those shellfish collected from the few obviously oiled areas, there are no problems. Even those few present extremely low risk for consumption. (ESC)

Response: It is unclear whether the first statement applies also to the general health of the shellfish or only to the question of human consumption. Shellfish containing hydrocarbon levels that would pose a risk if consumed were identified in certain areas. The NRDA shellfish studies are designed to assess impacts of the EVOS on the mortality rates and general health of certain shellfish. It is well documented that the *Amoco Cadiz* oil spill had a severe impact on shellfish in Brittany, France, and similar impacts could be expected here.

Comment: It is not apparent how the results of the fish/shellfish studies will provide data useful for the restoration effort. The lack of significant injury as shown by the record fishing season and the population management focus of many of the studies will not guide a reasonable restoration strategy if restoration is warranted. (ESC)

Response: It is impossible to restore anything until it is understood what has been lost. The fish/shellfish damage assessment studies are designed to identify injuries to these resources and provide the basis for restoration actions. The record fishing season was largely a function of good hatchery management and does not necessarily reflect returns to any particular oil-impacted stock, particularly wild stocks. Complex population management of the fisheries was in place prior to the oil spill, and management changes needed for restoration as revealed by these studies will have a very solid historical basis on which to build.

Comment: No information is provided describing the reasons certain studies were discontinued. Without access to the data generated during 1989, it is impossible to determine whether or not these decisions were justified. (UM)

Response: Some studies were completed and some did not show sufficient likelihood of demonstrating injury to justify continued investigation.

Comment: Other than analysis of gut contents, almost none of these studies (the rockfish studies being a notable exception) address key predator/prey interactions, and many do not even assess reproductive status of the adults. (UM)

Response: Fish/Shellfish studies being conducted were designed to get the most information for determining injury with the available funding. Fish/Shellfish 4 addresses predator/prey relationships between juvenile salmon and harpacticoid copepods. Other studies address broader predator/prey relationships. Histopathology in

some studies will touch upon reproductive status of the adults even though this is not the primary focus of the study. Observed recruitment will define ultimate reproductive effects in some studies.

Comment: Many of the studies have inappropriate reference lists. Some studies list almost no references, some have reasonable lists, and some list large numbers of reports, many only tangentially related to the particular study. (UM)

Response: Some of the areas being investigated received considerable attention before the oil spill and some were essentially new ground. Thus, there were many references appropriate for some studies and few for others. In accordance with accepted scientific publication practice, a reference section is only a list of all of the authors and their associated papers mentioned in the preceding text. Those must be listed if mentioned in the text whether the paper has a great deal of significance to the study or not.

Comment: There is convincing evidence that fishery resources are vital and productive: no fish kills were reported in 1989 and commercial herring catch rates and pink salmon harvest reached record levels in PWS in 1990. This evidence should be taken into account in the Plan. (ESC, API)

Response: Though dead adult rockfish were reported in 1989, many fish suffering oil-induced acute mortality, particularly small fish, would probably sink or be consumed by predators. Ultimate injury to the herring population will not be evident until the 1989 year class becomes susceptible to fishing or enters the spawning population in 1992. As noted above, the record pink salmon harvest was largely a hatchery phenomenon and was not reflected in wild stock returns in 1990.

Comment: Many fish and shellfish studies are too general for damage assessment purposes. (API)

Response: The Trustees disagree. The studies have been carefully peer reviewed and tailored to address injury assessment.

Comment: Studies are uncoordinated and perhaps repetitive. (API)

Response: The Trustees disagree. Every effort has been made to assure that the studies are complementary; the studies have undergone extensive peer review and synthesis processes.

Comment: The tagging of juvenile fish will cause stress that will result in physiological changes and increased mortality. The invasive techniques will create injury to the resources. (API)

Response: The tagging process has been exhaustively studied and reported in the fisheries literature for many years. Coded wire tagging possibly has the least effect on fish of any method employed. CWT associated mortalities are extremely small. This technique is so well understood and successful that many millions of salmon and steelhead are tagged by this method every year along the Pacific coast of North America. Nevertheless, the methods for all of the studies employing tagging include techniques for estimating tagging associated mortalities. Impact on the resource is negligible.

General - Sublethal and Chronic Effects

Comment: Expensive studies focusing on sublethal and chronic effects are problematic. Results found may not be the result of oil, and may be due to natural causes or the capture and handling of the fish. (API)

Response: Many of the individual assays may not demonstrate changes pathognomonic for *Exxon Valdez* oil. However, the combination of the results from these several types of assays may lead to the conclusion that the injuries observed were due to the EVOS. Changes due to capture and handling are distinguishable from oil-induced changes.

Comment: Many of the 1990 studies rely on non-specific or non-standard indicators to correlate evidence of hydrocarbon exposure to presume population impacts, which will not bear technically conclusive results. Examples of this include: biochemical measurements of bile fluorescent aromatic hydrocarbon concentrations and enzyme level changes in fish, which are highly variable in nature (Fish/Shellfish 18 and 24). (ESC)

Response: Assays of this nature employ appropriate and adequate controls in order to produce meaningful results. The Trustees believe that the results of the assays will be conclusive.

Comment: The Plan contains studies designed to do scientific research that will not lead to identification of injuries. The costs of such research should be funded by alternate means since they cannot be recovered under the NRDA regulations. Examples of this include: the use of mixed function oxidase levels in fish tissues to assess hydrocarbon exposure - this is an unproven technique that has yielded greatly varying results between

different life cycles, seasonal factors, and food sources; and Fish/Shellfish 13's use of mussel tissue to assess hydrocarbon contamination - in particular, to determine hydrocarbon concentrations, pathways, and effects. (ESC)

Response: The Trustees disagree with the first statement, particularly in reference to the examples cited. MFO and hydrocarbon analyses are recognized scientific techniques for demonstrating hydrocarbon contamination. When combined with other analyses in the studies these produce reliable evidence of injury. It is well established in the toxicological literature that MFO's are produced as a response to hydrocarbon exposure. MFO's, though a defensive mechanism, often convert these hydrocarbons into more toxic substances than the original compound and create ultimate carcinogens. Thus, these hydrocarbons can have acute toxic effects and long term mutagenic effects. Assaying for MFO's and hydrocarbons is clearly appropriate for identification of injuries.

General - Oiling Levels

Comment: The Fish/shellfish studies contain a fundamental flaw: their designs are based on detecting differences between oiled and non-oiled areas that cannot necessarily be attributed to the oil spill. Many of the study designs have statistical problems in identifying the effect of oiling, physical location, and timing. Too little consideration has been given in these studies to distinguishing effects of the spill from natural factors that can influence population sizes, productivity, or physiology. (ESC, API)

Response: Statisticians have reviewed the studies and have determined that the methods will take into account variables due to natural variation and other factors.

Comment: It is unlikely that the sampling design of the Fish/Shellfish 1, 3, 8, 18, 22, and 28 will be able to relate observed biological responses to any particular hydrocarbon concentrations since the areas to be sampled represent a wide range of hydrocarbon exposures levels. (ESC)

Response: These studies are not intended to be carefully controlled laboratory experiments. They are not bioassays to estimate a given concentration of oil in water. There are other tests by which we are attempting to do that. The Fish/Shellfish studies were designed to determine the injury done to fish as a result of the EVOS.

Comment: Many studies are based on the development of data from

oiled and control sites. Inadequate information is provided to document that control sites are ecologically similar to test sites to establish baseline information. (ESC)

Response: The control sites were carefully selected in order to accurately determine the differences between oiled and unoiled sties. Their use is not intended to provide pre-spill baseline information.

Comment: The criteria used to select stream and sampling sites for the Fish/Shellfish studies do not include the evaluation of the level of oiling. Some quantitative method of assessing the degree of oiling should be included in the site selection criteria since these studies are designed to evaluate the effects of oil on egg-to-fry survival. (ESC, API)

Response: Quantitative assessment of oiling was not possible when most sample sites were selected. Criteria were usually based on visual observations followed by quantitative assessment of the levels of oiling. In some of the streams involved in the egg to fry survival studies, oil has penetrated deep into the substrate. In some cases, fry incubating in the gravel may be adversely affected by chronic exposure to low levels of oil leaching out of the gravel.

Comment: A large number of salmon spawning areas have been retained for additional study, yet evaluation of the level of hydrocarbon contamination is limited to the visual presence of oil and the hydrocarbon content of bivalves at the mouth of these streams and rivers. (UM)

Response: As noted above, great care is being taken to accurately quantify levels of hydrocarbon contamination. Whenever possible, several means of estimating the presence of oil are compared. Bivalves are good indicator organisms because, unlike fish, they do not possess an MFO-like system for ridding themselves of hydrocarbons. Thus the presence of hydrocarbons in bivalves provides an additional indicator on the level of oiling to which other organisms were exposed.

General - Variable Methodology

Comment: The level of detail and justification provided in the Fish/Shellfish studies is extremely variable. Frequently great detail is given on the methods employed without any discussion as to the significance of the measurements to be made. (UM)

Response: Specific questions about the methods or the significance of the measurements should be directed to a particular study.

Comment: The methodologies used in the various studies seem highly variable. Analysis of parent hydrocarbons in tissues of organisms capable of rapid hydrocarbon metabolism is of limited value. Most fish and many crustacean species at developmental stages from larvae through adults fall into this group. (UM)

Response: Hydrocarbon analysis of organisms that can quickly metabolize them is of limited utility unless samples are collected very soon after exposure or there is a potential for continued exposure. Where neither of these is the case, other methods for establishing injury from exposure to oil are employed. The variety of methods reflects these considerations, among others.

Comment: Several methods are available to assess metabolite body burdens and effects. In some studies these are mentioned but in others they are not, and there is no explanation given for this apparent inconsistency. (UM)

Response: See response to comment above.

Comment: Different methods are being used to assess a biochemical measure of hydrocarbon exposure (induction of cytochrome P4501a1). In some cases analyses will be done on formalin fixed samples, in others on subcellular fractions of fresh tissue. No information is given that would allow an evaluation of whether theses methods will produce comparable results. (UM)

Response: The appropriate controls should allow for comparable results. Because the method of sample preservation limits the kinds of assays performed, the particular method chosen for each study that is assaying cytochrome P450 is somewhat dependent upon the other types of assays that will also be performed on the same samples.

Comment: Testing procedures are inconsistent. Mixed, fixed, and nested effects models are planned for data from the same field sampling protocols. In most cases the appropriate testing model was not determined before taking samples. (ESC)

Response: While general comments like this are difficult to address, the Trustees do not believe that testing procedures are incorrect nor do they need to be consistent from one study to another if the goals for each study or analysis are different.

Comment: Error terms for testing are infrequently documented. Often the proposed error term is incorrect. (ESC)

Response: Without specific examples, this comment cannot be addressed adequately.

Comment: Procedures for estimating the total effect of oil over the area impacted are not described. Estimates are likely to be biased and highly variable. (ESC)

Response: To the extent that this is possible, the combined results of all NRDA projects, not just the Fish/Shellfish studies, will achieve this. Because a variety of life forms over an immense area were affected, only an approximation will be possible. Every effort has been made to provide consistency among the NRDA studies.

Comment: Clark and Bernards' procedures, as planned for the tagging studies, are inappropriate and will reject the hypothesis of no effect too often. This is true for Fish/Shellfish studies 1, 2, 4, 5, and 11. (ESC)

Response: Clark and Bernards' procedures are not planned for any of the studies indicated. Where these procedures are being used, we believe they are appropriately applied.

General - Natural Variability

Comment: The Plan does not make clear that sampling programs will produce information necessary to prove that a statistically significant portion of the expected biological variability is a function of hydrocarbon contamination as opposed to other natural factors. Fish/Shellfish 1, 3, 8, 13, and 17 suffer from this defect. (ESC)

Response: Appropriate controls and continued sampling in post-spill years will address this concern. However, the premise is not that the observed biological variability is a function of hydrocarbon contamination in each case; rather, if biological variability is a function of hydrocarbon contamination, our methods will allow us to distinguish this from variability caused by natural factors. The studies are observational rather than experimental.

Comment: Most of the Fish/Shellfish studies do not adequately account for the fact that there was substantial variability in resource levels before the spill or the fact that there is no reliable baseline data. Thus, the statistical detection of

differences due to oiling will not be possible. This is particularly true of Fish/Shellfish 3, 8, 15, and 17. (ESC, API)

Response: For any study in which substantial random variability is expected, an increase in the number of sample sites and sizes improves the statistical power of the test. For those studies in which variability is expected to be large, statisticians have determined the number of sites and the number of samples necessary to demonstrate oil-related variability. Some of the observed pre-spill variability for which there is baseline data was harmonic area-wide. An absence of harmonic variation would point to EVOS effects. A return to harmonic variation would be expected as the area recovers.

Comment: It will be impossible to develop sufficient data to describe the subtleties of historical population dynamics or to relate any potential response to extremely low hydrocarbon levels, as these factors are not well understood by fisheries managers. This is true in Fish/Shellfish 3, 4, 5, 13, 17, and 27. (ESC, API)

Response: Some of the populations being examined lend themselves very well to the study of subtleties of historical dynamics. There will be some level of hydrocarbon exposure that will not produce observable effects. Examining fish with low levels of exposure as well as those fish with hydrocarbon levels that produce observable effects will help estimate the total injury to fish and shellfish as a result of the EVOS.

Comments on Fish/Shellfish Studies - Specific

Salmon Studies

Comment: The 1990 adult pink salmon catch consisted of fish present in PWS as sensitive juveniles in April 1989. The record catch in 1990 provides convincing information regarding the lack of injury to this population. The need for extensive study of potential oil impacts has been obviated. (ESC)

Response: The record catch was largely a hatchery phenomenon not necessarily paralleled by wild returns. Among other factors, hatcheries' net pens were shielded from the oil by booms or were outside the spill area and their fish were able to spend a month or longer in this protected saltwater environment before they were released. Wild fish did not have those options. PWS pink salmon are not a single population and, therefore, hatchery successes and failures are not the only criteria by which to determine the effect of the EVOS.

Fish/Shellfish Study No. 1 - Salmon Spawning

Comment: It is unclear whether studies are presuming organisms were exposed to oil in areas where oil was only visible on the water surface. DOI regulations require confirmation of exposure. It is not clear how exposure pathways will be verified. (API)

Response: Fish/Shellfish 1 collects mussels from the immediate vicinity of each stream in studies 1 and 2. These mussels will be analyzed for hydrocarbon uptake (bioaccumulation) to indicate oil impact. Adults will be collected from 22 streams (12 oiled, 10 not oiled) and analyzed for histopathological abnormalities as well as mixed-function oxidases (MFO's). Eggs and fry will be collected during study 2 and also examined for hydrocarbons, histopathological abnormalities, and MFO's.

Comment: Studies do not address issues such as error margins in egg counts and the impact of sampling frequency on fish migration. (API)

Response: All eggs and fry are individually enumerated not estimated; consequently, if an egg or fry is removed from the gravel, it is counted. The counting of adults during study 1 has very little or no impact on spawning. Egg and fry sampling takes place in mid-September to mid-October and again during mid-March to mid-April. This is after the fall spawning migration and before the fry emerge from the gravel to begin their spring migration.

Comment: The methodologies used for objective A, visual observation, aerial photography, and hydrocarbon analysis of tissue samples from intertidal mussels at stream mouths, are inappropriate for determining hydrocarbon concentrations, pathways, or their effects. (ESC)

Response: Objective A reads: "To determine the presence or absence of oil in the intertidal habitat used for salmon spawning." The collection of photos, visual observation data, and mussel hydrocarbon data will show presence or absence of oil.

An objective was added in the 1991 studies which reads: "Document the presence or absence of hydrocarbons from the EVOS in the tissues of adult salmon." This objective will be met by the collection of tissues from spawning adults in 12 oiled streams and 10 unoiled streams. These tissues will be analyzed for histopathological abnormalities and MFO's.

Comment: For objective B, documenting the physical extent of oil distribution on intertidal spawning areas is insufficient to

determine hydrocarbon concentrations, exposure pathways, or their effects. (ESC)

Response: See response to comment above.

Comment: Regarding objective D, no selection criteria ensuring that streams selected will be representative of PWS streams are presented. (ESC)

Response: Four streams were weired in 1990. One on the east side of PWS and the other three in southwest PWS (2 unoiled, 1 oiled). Stream selection was made by biologists familiar with the area and based on subjective criteria.

Comment: In objective E, the correction factor for one stream does not include the variables which would allow that correction to be applied to 138 or 218 other streams. (ESC)

Response: Objective E estimates bias between aerial and ground surveys for 138 streams and estimates accuracy of the 2 methods for 4 weired streams. A correction factor can be estimated for the weired streams.

Comment: Objective F will likely be compromised through biased criteria used in determining in-stream residence time of young salmon. (ESC)

Response: Average stream life in this case is the number of days that adult pink or chum salmon spend in the stream from the time they enter the stream during their spawning migration until they die.

Comment: Objective J, the recalculation of historical escapement from 1961 to 1988, is of little relevance to impact assessment for a 1989 spill. The assumption that survey and environmental parameter estimates based on the conditions of the past 2 years can be applied as a correction to the past 30 years is invalid. (ESC)

Response: This comment apparently addresses objective G. Historically, escapement estimations in PWS have been more of an index program than an actual escapement estimate. Basically the same survey methodology using only 3 or 4 different observers has been used to build the historic database. Once a satisfactory methodology has been obtained for all 138 streams, estimates of historical escapements will be made. Knowledge of salmon total run (catch + escapement) is essential if a loss is detected during any of the life stages (studies 1, 2, 3, 4, and 28).

Comment: For objective H, no attempt is made to identify or measure other variables that may affect available spawning habitat. (ESC)

Response: The incorporation of instream flow models to obtain refined spawning area estimates for 138 streams would be too costly (both in terms of manpower and money). The stream area provides an accurate estimate of relative stream size.

Comment: Regarding objective I, a catalog of aerial photographs and detailed maps of spawner distribution is not necessary for use in designing sampling transects. (ESC)

Response: The catalog makes it more efficient to locate and plan the egg/fry sampling for study 2 and provides reproducible maps for stream surveyors to use in recording counts by stream zone. This data will be useful for detecting a change in spawner distribution (such as a decrease in intertidal spawners).

Comment: The relationship between hydrocarbon data from mussels taken from the intertidal area and salmon exposures in the stream is questionable. (ESC)

Response: Up to 75% of the PWS pink salmon spawn intertidally. The mussel data will indicate if the intertidal areas of the stream were impacted by oil.

Comment: The study plan does not identify the selection criteria or a plan for developing criteria to select the appropriate technique for evaluation of stream life. (ESC)

Response: The stream life estimates will be tested against what is observed at the weirs. Weirs provide known escapements based upon daily stream walks to provide numbers of live and dead fish.

Comment: The number of fish tagged weekly (80) to determine stream life is static and may be inappropriate for streams where the weekly escapement can vary by several thousand fish. (ESC)

Response: It is assumed that fish are randomly tagged (each fish present has an equal chance of being tagged). The number of fish tagged needs is based upon the need to have sufficient recoveries to provide a meaningful estimate. It was determined that 30-40 recoveries would provide such an estimate.

Comment: The visual observations used to define the levels of hydrocarbon contamination and to categorize stream zones is an inappropriate methodology. (ESC)

Response: Visual observations only provide the presence or absence of oil. Levels are determined by analysis of mussels (this study) and sediments (other studies).

Comment: The criteria used for separation of streams based on their exposure to oil is unclear. In one section the plan says it will be based on visual inspection, in another on levels of hydrocarbons in mussel tissue sampled near each stream. Both methods have weaknesses that will affect the basic categorization of streams. This categorization is the basis upon which the data will be evaluated. (ESC)

Response: Data from both methods as well as other sources will be used for the final oiling categorization of streams.

Comment: Statistical procedures are vaguely defined. It is unclear how the effects of EVOS are to be estimated and tested. The sampling effort may not be appropriate to meet objectives. (ESC)

Response: Study 1 provides stream oiling information, effects of oiling on adults that incubated in oiled substrate, and an estimate of adult escapement. These data will be used by the other salmon projects (Fish/Shellfish 2, 3, 4, & 28) to determine injury to the population. Type 1 and 2 power calculations will be made as the studies progress.

Comment: The probabilities of type 1 and type 2 errors, finding an effect when there is none and failing to find an effect when there is one, are not given. (ESC)

Response: Study 1 provides stream oiling information, effects of oiling on adults that incubated in oiled substrate, and an estimation of adult escapement. This information will be used by the other Fish/Shellfish projects dealing with pink and chum salmon.

Comment: Criteria for selecting treatment and control sites are not given. (ESC)

Response: This study is not designed as a traditional treatment-control experiment. The oiling data will go into the determination of "treatments" and "controls" for study 2.

Comment: The type of data resulting from this study has large variances among sites and times. It will be difficult to determine if a statistically significant effect is due to EVOS or natural variations. The study methods and analytical approach do not address or control for these potential problems. It is not clear that the sampling program will provide the information to prove that a significant portion of variability in escapement is from oil contamination. (ESC)

Response: This study is not intended to show statistically significant impacts due to oiling. It is a source of supporting data for studies 2, 3, 4, & 28. The combination of these studies will determine the impacts.

Comment: The number of streams used in this study (138) seems quite high considering that only 41 appear to be in the affected area. A reasonable evaluation of potential damage to spawning areas could have been done on a much smaller sample size with good statistical sampling design at a lower cost. (ESC)

Response: This study was designed to estimate escapement throughout PWS. Sound wide estimates are required in conjunction with coded-wire tag results (Fish/Shellfish 3) to obtain wild catch contribution for use in run modeling (Fish/Shellfish 28) to estimate potential numbers of fish impacted for the 41 streams.

Fish/Shellfish Study No. 2 - Egg/Fry

Comment: It is unclear whether studies are presuming organisms were exposed to oil in areas where oil was only visible on the water surface. DOI regulations require confirmation of exposure, and it is not clear how exposure pathways will be verified. (API)

Response: Samples of eggs and fry will be collected from each stream zone for each stream. These samples will be examined for histopathological aberrations as well as mixed-function oxidases (MFO's).

Comment: Studies do not address issues such as error margins in egg counts and the impact of sampling frequency on fish migration. (API)

Response: All eggs and fry are individually enumerated, not estimated; consequently, if an egg or fry is removed from the gravel, it is counted. The counting of adults during study 1 has very little to no impact on spawning. Egg and fry sampling takes place in mid-September to mid-October and again during mid-March to

mid-April. This is after the fall spawning migration and before the fry emerge from the gravel and begin their spring migration.

Comment: For objective 1, no effort is made to identify the level of accuracy expected from density estimates, or to determine if the damage resulting from sampling is greater than that attributable to EVOS. (ESC)

Response: The level of sampling for density is a tradeoff between what is required to achieve a specified level of precision, what is practical with regards to time spent sampling, and loss of eggs and fry from the salmon population. The Trustees believe that this study provides a proper balance of these considerations.

Comment: For objective 2, no effort is made to identify the level of error in mortality estimates, or to identify factors other than oil that may lead to over-winter mortality of eggs. (ESC)

Response: This study is a "control-treatment" experiment. Error rates were estimated using data collected during the mid 1970's. This information was used to estimate the number of streams required for the experiment. Because of the "control-treatment" design, sources of mortality other than oil should be common to both groups; consequently, an increase or decrease in mortality can be linked to oiling.

Comment: Objective 3 reflects an assumed increase in over-winter mortality in oiled streams. The significance of this cannot be determined as no methods are given for estimating adult returns. (ESC)

Response: Adult returns will be estimated for studies 1, 3, and 28.

Comment: Regarding objective 4, the use of mixed function oxidase levels in eggs and alevins as a means of assessing hydrocarbon contamination is an unproven technique and clearly research. The MFO technique is greatly variable with different life stages, seasonal factors and food sources. The use of mussel tissue to assess hydrocarbon contamination is not appropriate for determining hydrocarbon concentrations, exposure pathways, or their effects on the salmon species being studies. (ESC)

Response: Peer reviewers and experts in biochemistry, toxicology, and pathology have recommended proceeding with the MFO analysis as well as examination for histopathological abnormalities.

Comment: There are no controls for the comparison of alevin samples for tissue analysis. The method of collection does not preclude contamination, so no accurate control values can be expected. (ESC)

Response: Alevins collected for hydrocarbon analysis were collected using a rake and strainer pre-rinsed in dimethylchloride. The fry were stored in pre-rinsed glass jars. Alevins collected for MFO and histopathological analysis were not affected by the sampling methods.

Comment: Although a sample of mussels near the stream bed will be used to determine the amount of hydrocarbon impacting the stream, there is no attempt to test the assumption that hydrocarbon levels in those mussels are representative of fish exposures to hydrocarbons in the stream bed. This methodology is inappropriate to measure hydrocarbon contamination and undermines the basis upon which the data are being evaluated. (ESC)

Response: Levels of hydrocarbon in mussels near the stream bed are indicators of impact upon the spawning gravel and the eggs and fry in the gravel. Eggs and fry are collected for further analysis for MFO and histopathological abnormalities.

Comment: Visual assessment to determine degree of oiling is inappropriate to define levels of hydrocarbon contamination for impact assessment. (ESC)

Response: Visual assessment provides a starting point for categorization. This information is refined with mussel hydrocarbon data, fry hydrocarbon data, egg and fry MFO data, and histopathological data.

Comment: Statistical procedures are vaguely defined. It is unclear how the effects of EVOS are to be estimated and tested. This study does not identify the effect due to EVOS and the effort needed to detect that effect. The sampling may not be appropriate to meet objectives. (ESC)

Response: A nested analysis of variance will be used to estimate effects on egg and fry mortality as well as over-winter survival. Power of the study was estimated using similar data collected during the mid-1970's.

Comment: The methodology for injury determination is not clearly stated. (ESC)

Response: See response to comment above.

Comment: MFO analysis of eggs and fry is an experimental methodology and is inappropriate for injury assessment. (ESC)

Response: It is well established in the toxicological literature that MFO's are produced as a response to hydrocarbon exposure. MFO's often convert these hydrocarbons into more toxic substances than the original compound and create carcinogens. Thus, these hydrocarbons can have acute toxic effects and long-term mutagenic effects. Assaying for MFO's and hydrocarbons is clearly involved with identification of injuries. Peer reviewers and experts in biochemistry, toxicology, and pathology have recommended proceeding with the MFO analysis as well as examination for histopathological abnormalities.

Comment: There is no evidence that sufficient parameters are being considered by which to identify major aspects of variability in egg to fry mortality. It is not clear that the study will obtain information that will enable an accurate assessment of oil effects versus other environmental factors. (ESC)

Response: Since the oil spill was not anticipated, few pre-spill samples existed. The study will sample both oiled and unoiled areas. As differences between these areas begin to disappear as the environment recovers, it will become more apparent that the initial differences were due to oiling rather than other "natural factors." In the absence of known parameters that identify variability, our statisticians have identified those parameters from the literature and from their experience that most likely indicate variability in egg and fry mortality versus other environmental factors.

Comment: Generalization of results from this study to all 900 anadromous streams in PWS is inappropriate as the streams used in this study are the better, more consistent salmon producing streams. (ESC)

Response: Not all of the streams selected for this study are the better, more consistent salmon producers. Selection criteria included "sufficiently large adult salmon returns to indicate a high probability of success in egg/fry digging." F/S-1 allows us to estimate the stream life for streams that might otherwise fall below the level of practical egg/fry sampling. Using streams ranging from the high end producers to the very low end will allow extrapolation of results to the remainder of the streams.

Fish/Shellfish Study No. 3 - Wire Tagging

Comment: It is unclear whether studies are presuming organisms were exposed to oil in areas where oil was only visible on the water surface. DOI regulations require confirmation of exposure. It is not clear how exposure pathways will be verified. (API)

Response: Fish Studies 1 through 4 provide a comprehensive approach to assessing the impact of oil exposure on pink salmon. Samples of pink salmon eggs, fry, and juveniles have been collected for confirmation of oil exposure using the best available methods. The presence of tagged fish in oiled areas will allow stock specific confirmation of oil exposure for fish from both oiled and unoiled areas. Extensive collections of mussel samples from the intertidal zones of spawning streams will provide confirmation of the presence of oil at specific sites.

Comment: The study does not address issues such as error margins in egg counts and the impact of sampling frequency on fish migration. (API)

Response: Egg counts are used by hatchery operators to properly load incubators with salmon eggs. Outmigrations of fry from the incubators are monitored with electronic fry counters. Fish/Shellfish Study 3 uses fry outmigration counts to determine release numbers and the proportion of tagged fish in the release.

Comment: It is unclear how objective 1 will be used to evaluate effects of the spill on hatchery-released salmon. The data will be of use to hatchery managers, but they will not be valid for injury assessment. The Plan's statement that "outmigrating smolt and returning adults from these hatcheries are exposed to oil at varying degrees" is a nebulous tie to oil effects. (ESC)

Response: Determining the catch and survival rates for wild salmon and salmon released from five hatcheries in PWS will allow investigators to estimate differential survival based on their exposure to contaminated waters. A history of exposure to oil can be confirmed with results from Fish Studies 2 and 4 and used to tie in the effects of oil to losses in production.

Comment: Using the tag results as indicated in objective 2 may obtain a rough estimate of the catch of wild stock pink salmon, but is unlikely to produce information on spill-related effects. (ESC)

Response: Adult returns to the pink salmon streams will be determined by operating weirs at each site rather than by using stream surveys. Knowing the catch and escapement, differential

survival of salmon between oiled and unoiled areas can be investigated. Returning tagged fish that stray to streams other than their natal streams may provide evidence of lost populations and habitat.

Comment: Field methods are not detailed enough in Objective 3 to evaluate the validity of this study. (ESC)

Response: Detailed methodologies for coded-wire tag application to wild and hatchery fish is readily available in the literature. Weir operations also have well established methodologies and standard operating procedures.

Comment: The results for Objective 5 will provide little insight into the effects of the spill on any detected differential in survival rates. There is no measurement of exposure to oil, nor is there adequate baseline data for historical comparison. (ESC)

Response: Objective 5 calls for the identification of relevant injuries for which methods of restoring lost use, populations, and habitat must be developed. This objective summarizes the long term goal of all damage assessment studies to identify injured populations. Identifying these populations can be accomplished by satisfying objectives 1 through 4 of this study. These results, along with those of other salmon studies, will identify where and how restoration of injured populations can best proceed. There are other NRDA studies addressing the oil exposure of salmon. These studies rely on coded-wire tagged fish to verify the origin of captured fish. There is a great deal of historical data relevant to the salmon populations of PWS as well as information on the effects of exposure to crude oil on salmon.

Comment: The tagging methods have little application for evaluating effects of the oil spill. (ESC)

Response: The presence of marked fish will allow investigators to confirm stock specific exposure to oil as well as to estimate catch and survival rates for returning adults. Tagging allows identification of fish that stray from their natal streams, which is important to document true returns to streams.

Comment: The methods used to capture sensitive wild stock pink salmon fry are not specified and could have significant effects on the success of the program. (ESC)

Response: The method used to capture wild pink fry in the intertidal zone employed a modified fyke, a common gear type used to collect juvenile salmon.

Comment: The study proposes tagging coho from Valdez, Esther, and Fort Richardson (for release at Whittier and Cordova) hatcheries, and chinook from Esther Hatchery. These releases are not in oil-affected areas and it will be difficult to link results to oil. (ESC)

Response: These releases will provide a control for releases in oiled areas.

Comment: The evaluation of tag return data uses standard analytical methods, but has little application for determining the effects of the spill. (ESC)

Response: The data obtained from tag returns will allow the catch and escapement of hatchery and wild fish to be determined. This information is needed to evaluate the potential numbers of salmon lost to oil contamination. The results obtained from meeting the objectives of Fish Studies, 1, 2, 3, and 4 all apply to the effects of oil exposure on the same specific stocks of fish.

Comment: Inter-annual and inter-facility survival variation for hatchery stocks has been so large that observed differences will be difficult to interpret. It is unlikely that those differences in survival could be linked to the spill and used for damage assessment, even though the observed survival fits a pattern based on the possibility of effects. (ESC)

Response: The use of multiple tag codes at each hatchery and wild stream allows for information from individual release groups to be compared between hatcheries or within the same hatchery. Observed survival differences can therefore be examined more closely than simply between years or facilities. The use of multiple tag codes verifies the presence of fish in contaminated waters during their early marine life and will also help identify injuries and further link the exposure history to losses in production.

Fish/Shellfish Study No. 4 - Early Marine Salmon

Comment: It is unclear whether studies are presuming organisms were exposed to oil in areas where oil was only visible on the water surface. DOI regulations require confirmation of exposure, and it is not clear how exposure pathways will be verified. (API)

Response: It is not assumed that juvenile salmon captured in oiled areas were exposed to oil. Mixed-function oxidase and hydrocarbon analyses are being performed to determine if organisms were exposed to oil. Experiments will be conducted by the NMFS in 1991 to obtain more information about pathways of exposure and effects on growth.

Comment: The definition of technical terms is inadequate. (API)

Response: This comment does not provide enough information for a response.

Comment: This study does not address issues such as error margins in egg counts and the impact of sampling frequency on fish migration. (API)

Response: Egg counts from the hatcheries are used to estimate the numbers of fry released. This issue is addressed in Fish/Shellfish 3. The applicability of a Maximum Likelihood Estimator of fish migrations will be determined. The effect of sampling frequency will be determined at that time.

Part I

Comment: For objective A, the study assumes all fry released together remain so and grow at a proportional rate. This may be biased if groups of fish from a release move to different habitats or grow at different rates. Nonrandom distribution of sizes along the migration corridor, which is likely, can cause bias. Sampling one segment in an oiled area, and one in a non-oiled area, could lead to incorrect conclusions on relative growth rates. (ESC)

Response: It is not assumed that fry released together remain so and grow at a proportional rate. Fry have been sampled at many sites in both oiled and unoiled areas to minimize any bias resulting from local effects. Analyses of stomach fullness will be used to assess differences in feeding rate in oiled and non-oiled areas.

Comment: Regarding objective B, the study is unlikely to give precise enough data to detect differences in migration speed and patterns caused by oil-related effects. (ESC)

Response: The applicability of a Maximum Likelihood Estimator of fish migrations will be determined. Questions relating to migration speeds and patterns will be addressed at that time.

Comment: No information is given on the method for determining hydrocarbon content in tagged fry captured in 1989. (ESC)

Response: Individual tagged fry were placed in clean glass vials immediately after capture. They remained in these vials until shipment for hydrocarbon analysis. Mass spectrophotometry is used to estimate hydrocarbon content. The ratio of the metals vanadium and nickel is used to identify oil from the *Exxon Valdez*.

Comment: The methods used to determine growth, migration paths, and migration speeds are imprecise and based on assumptions regarding behavior and swimming speed that are likely to be invalid. The variability of these estimates will be too great to determine changes caused by EVOS. (ESC)

Response: More precise estimates of fry growth will be obtained from otolith microstructure analysis. The applicability of a Maximum Likelihood Estimator of fish migrations will be determined. Questions relating to migration speeds and paths will be addressed at that time.

Comment: Differences in migration distance and patterns will be analyzed with ANOVA, but no information on how these parameters will be quantified is given. They are likely to be highly variable and of marginal use for evaluating spill-related effects. (ESC)

Response: The applicability of a Maximum Likelihood Estimator of fish migrations will be determined. Questions relating to migration distance and patterns will be addressed at that time.

Comment: Migration rate estimates will be influenced by the sampling frequency. Insufficient information is provided to evaluate the appropriateness of this method. (ESC)

Response: The applicability of a Maximum Likelihood Estimator of fish migrations will be determined. Questions relating to migration distance and patterns will be addressed at that time.

Comment: There is no indication of how differences from geographical effects will be separated from effects due to presence of oil, where the primary definition of oiled and unoiled is based on geography. As most of the oiled areas occur in one part of the Sound and the unoiled in another, factors other than history of oil exposure would affect the variables measures. (ESC)

Response: Fry have been sampled at many sites in both oiled and non-oiled areas to minimize any bias resulting from local effects.

However, it is recognized that geographic effects confound oil effects. A bioenergetics model, multiple regression techniques, and analyses of stomach fullness will be used to evaluate growth conditions in oiled and non-oiled areas. All available data on environmental conditions in oiled and non-oiled areas will be used in these analyses.

Comment: The study design introduces a stock-related bias that is not controlled or tested. There are potential stock-area interactions that are not controlled or tested. (ESC)

Response: Repeated measures analysis of variance will be used to determine if there are differences in fry growth among tag lots. Data from tag lots that are not significantly different will be pooled into groups. Comparisons of growth between oiled and non-oiled areas will be made within these groups. Refer to the previous comment/response for a discussion of area effects.

Comment: The methods for injury determination are weak: they consist of testing for growth differences, migration speed, migration distance, and migration patterns between oiled and unoiled areas. The criteria used to define oiled and unoiled are not given. The definitions of growth, migration speed, distance, and pattern are not given or are deficient. (ESC)

Response: Results from mixed-function oxidase and hydrocarbon analyses of fry will be used to determine the level of oil exposure of fry in different areas. This information will be compared with all available data on hydrocarbon contamination in the environment. Cumulative growth will be estimated by regression of final body weight on time for fish within tag lots or groups. Growth of individual fry over short time periods will also be estimated from otolith microstructure analysis. The applicability of a Maximum Likelihood Estimator of fish migrations will be determined. Questions relating to migration speed, distance, and patterns will be addressed at that time.

Part II

Comment: The detailed measurements and analyses to evaluate effects on abundance, distribution, habitat utilization, size, growth rate, feeding habits and migratory behavior are governed by the appropriateness of the field sampling program. This program may not have adequately included geographic effects or other natural variabilities. (ESC)

Response: The investigators considered geographic variation and other natural variabilities. Study sites were chosen to minimize

geographic differences while maintaining the treatment difference of oiled versus unoiled sites. Environmental parameters were monitored at each site to determine the extent of physical differences.

Comment: The abundance and distribution of copepods is dependent on factors other than oil, which are not addressed sufficiently to determine species abundance or distribution in a statistically significant manner. (ESC)

Response: Sampling to evaluate the effects of sediment contamination on harpacticoid copepods in 1990 was designed to reduce geographic variability by comparing heavily oiled and lightly oiled beaches within the same contaminated embayment. Substrate composition and algal coverage, as well as sediment hydrocarbon contamination, were quantified at each transect to determine their effects on the observed numbers and species composition of copepods. Procedures for collection were consistent across all sampling locations.

Comment: The abundance and distribution of meiofauna is dependent on factors other than oil, which are not addressed sufficiently to determine species abundance or distribution in a statistically significant manner. (ESC)

Response: The meiofauna recolonization experiment is a field-manipulative study involving azoic sediments that have been quantitatively contaminated with crude oil. Control and treatment sediments were randomly placed along the same beaches. Any differences observed in recolonization among treatment levels can thus be directly attributed to oil contamination.

Comment: Insufficient information is given to evaluate the appropriateness of the sampling frequency, which will influence the estimates of migration rates. (ESC)

Response: Coded-wire tagged juveniles represent groups of fish released at specific locales and times. Recoveries of these fish yield information on average rate of movement and general direction of movement within and between habitat types.

Comment: The comments made above in Part I regarding stock and location effects that are not controlled by this study design also apply to Part II. (ESC)

Response: The investigators considered geographic variation and other natural variables. Study sites were chosen to minimize

geographic differences while maintaining the treatment difference of oiled versus unoiled sites.

Comment: The study design does not indicate that variables that affect biota or biological endpoints are being considered when establishing a cause and effect attributable to oil. (ESC)

Response: The investigators considered natural variables. Environmental parameters are monitored at each site to determine the extent of physical differences. The study design selected oil and control sites in comparable habitat areas to minimize the effects of other variables.

Fish/Shellfish Study No. 5 - Dolly Varden Char and Cutthroat Trout

Comment: The Trustees will not be able to attribute differences in survival or growth to oil. The assumption that the differences in average growth rate are attributable to an external disturbance assumes that pre-spill growth and survival rates were similar in both control and treatment streams and any differences are entirely caused by spill-related effects. Natural variability or geographical differences are not considered. (ESC)

Response: It is important to point out that fish were sampled before any potential exposure to an oiled marine environment since the Dolly Varden and cutthroat trout were overwintering in freshwater when the oil spill occurred. Given this, the first sample from each stream (the emigration during 1989) provides the baseline data for stocks in control and oiled groups. These data indicate mean-length-at-age was similar among control and oiled groups which indicate that fish of the same size grow at the same rate regardless of their overwintering location. Since overwintering populations of Dolly Varden and cutthroat trout are composed of many genetic stocks and the ambient climates in the experimental areas of PWS are similar, differences in average growth rates were not expected. Therefore, large differences in average growth rates between control and oiled groups would be attributed to some external disturbance so long as initial size of fish is corrected for.

We do not have a direct measurement of pre-spill survival rates among the treatment groups but since the mean-length-at-age were similar between control and oiled groups this would indicate that survival rates were probably similar. If one of the treatment groups had higher survival rates a greater difference in the mean-length-at-age would be expected and in particular in the older age classes (age 4 and older) but this was not the case.

The experimental design, which includes replicate sites in both

treatment groups, **does** take into consideration both natural variability and geographical differences. The study tests for differences in growth and survival between treatment groups only with tagged fish. The analysis tests to see if the differences in growth and survival are greater between control and oiled groups than differences within each treatment group.

Comment: There are no baseline data to show populations in all study areas had equal growth and survival rates prior to the spill. (ESC)

Response: See the preceding response.

Comment: Differences in survival and growth rates are likely due to natural differences. There is no indication of how results will be analyzed to show a link between the oil spill and survival or growth differences. Data are not being gathered to analyze for spill-related effects. (ESC)

Response: See the preceding response.

Fish/Shellfish Study No. 11 - Herring Injury

Comment: It is necessary to account for natural variables that would give the same results when estimating the proportions of dead herring eggs from oiled areas. (API)

Response: It is because of the natural variables that control sites are included with the same treatment (depth and replicate level) parameters as the oiled sites.

Comment: Estimates of biomass often have sampling errors. (API)

Response: Sampling errors can be measured using the sampling techniques employed in the study and an accuracy goal (± 25% of the true mean, 95% of the time) has been met for the 1989 and 1990 biomass estimates.

Comment: The herring season yielded over 8300 tons in a 20-minute season, a record catch rate. Since herring do not die after spawning, living to spawn in several successive years, most of the 1990 spawning population was present in PWS in April 1989 when potential exposure to oil was greatest. As the 1989 herring season was closed, the harvestable surplus was not taken, resulting in a

larger fish population in 1990. This should have decreased fears of an impact on population, and resulted in reductions to the study program. (ESC)

Response: Much of the study is designed to measure the sublethal impacts (effects on egg production, larval survival, possible metabolic affects due to ingestion of oil, etc.), that proved to be significant in 1989. The sublethal impacts occurring from exposure of eggs, larvae, juveniles, and adults could affect populations for many years and affect egg survival of the 1990 production year. As a result, the study was continued to enable researchers to further define the potential impacts (complicated by sublethal impacts) and to further refine results analyzed from 1989 and 1990.

Comment: It is very unlikely that the determination of biomass to within ± 25% of the true value, a goal of objective 1, will provide the sensitivity to determine the impact of EVOS. (ESC)

Response: The biomass estimate may be utilized to examine the effects of EVOS on a population level, and if this were the only tool available to determine impacts, the above statement would be true; natural variability may mask some subtle impacts. However, this is not the only tool being employed to measure impact and, as stated in previously released results, sublethal impacts have been observed in early life stages of herring.

Comment: The oil level information from maps and analyses of mussel tissues does not represent hydrocarbon exposure of herring in PWS, and will not be useful in determining any impact from EVOS. (ESC)

Response: The Trustees disagree. Mussels are recognized in scientific literature as indicators of oil contamination. Additional analyses on herring will confirm effects of oil exposure of herring.

Comment: Mortality of eggs in the field is a function of density dependent survival and natural factors. The goal of objective 4 appears to be the development of egg loss information for better management of herring. (ESC)

Response: One of the goals in the study is to insure the accuracy of the spawn deposition biomass estimate. Since the egg loss factor is directly tied to biomass improvements in the egg loss factor and development of an associated error will result directly

in improving the accuracy of the biomass estimate. The fact that it will improve herring management is incidental to the determination of injury and may aid in future restoration of the herring stock.

Comment: The evaluation of embryonic and larval tissue for MFO is an experimental technique which is variable depending upon season, life stage, food type, etc. Impact assessment should not be used to develop experimental techniques. In 1989 NOAA found that DNA/RNA ratios did not provide significant endpoints, and there was no need to repeat this effort in 1990. (ESC)

Response: Use of MFO analysis has been demonstrated in the literature as a viable technique to document hydrocarbon exposure. Use of this technique has been recommended by expert peer reviewers.

Comment: The field methods indicate that the unacceptable ± 25% biomass estimation could be compromised by logistical problems. The Plan indicates that this work augments the ability to manage the resource so that EVOS damage can be predicted. This does not fall within the purview of NRDA damage assessment. (ESC)

Response: The Trustees disagree with this comment. Management of a potentially injured resources can only be done wisely with improved resource knowledge. As management of the resource hinges on the injury that may have occurred, augmentations of management techniques to aid in determination of injury are not only essential, but fall within CERCLA guidelines, and are economical.

Comment: The biomass to be estimated in 1990 will not include the fish that are the product of 1989 egg production. The plan provides that there were no significant 1989 adult mortalities. Thus, biomass estimation is necessary for herring resource management but has little to do with EVOS impact determination. (ESC)

Response: While adult mortalities may not have been documented, there may have been significant sublethal injuries to adults including: reduced reproductive potential, lower egg survival, and genetic aberrations to adults' tissues, including reproductive tissues. Further injury may be minimized through management adjustments, which is why accuracy in the biomass estimate and forecasted biomass is essential.

Comment: An estimation of fecundity is included, but the literature provides no evidence of fecundity effects on adult fish from one acute exposure to hydrocarbons. (ESC)

Response: The Trustees believe that there is a substantial scientific basis for estimation of fecundity. Some Literature shows that not only are eggs resorbed in exposed adult females, but oocyte-loss can be measured and quantified. In addition, there is no evidence that adult herring in PWS received "one acute exposure;" for example, Knight Island was heavily oiled, and it is possible that in 1989, adult and juvenile herring in this area were repeatedly exposed to various levels of toxic hydrocarbons. Samples of adult tissues, including sac roe collected in 1989 and 1990, may reveal sublethal injury.

Comment: The measurement of growth will be unable to discriminate differences with regard to EVOS. Growth is simply a parameter necessary for better management of herring. (ESC)

Response: Exposure of herring larvae to oil in the laboratory impedes growth which is a quantifiable injury. Whether differences could be detected in the field can only be answered by processing samples RNA/DNA. The RNA/DNA analyses have been run and future analyses to determine growth are not necessary. Knowledge of larval growth, using RNA/DNA techniques is not necessary for better management; growth in adults is measured during standard AWL sampling in the spring which is not funded by NRDA monies.

Comment: Herring exhibit density dependent survival. There is no relationship between herring spawning biomass and later recruitment, so the death of eggs is meaningless in this study. (ESC)

Response: The Trustees disagree. In a year where density dependent factors do not interfere and a cohort from a hatch will become a large part of the biomass in four years, oil exposure has the potential to inflict significant injury to that cohort and resulting returning biomass. There is no proof that the 1989 cohort would not have contributed significantly to the future biomass whether or not the stock was impacted. Therefore, the study was necessary to discover the potential impacts and to aid in possible restoration planning. In addition, death of eggs, whether from a strong recruiting cohort or not, is significant to PWS food chains, because herring are a prime link in the ecological chain in the Sound every year.

Comment: The statistics appear to be aimed toward the development of models with which to manage herring, rather than to detect impact attributable to EVOS. (ESC)

Response: The Trustees disagree. Statistical models are designed to address population injuries. Any management benefits are serendipitous.

Comment: The methodology focuses on modeling the population based on the number of eggs laid. The size of the 1989 year class will be estimated and compared with what it might have been based on measurement of 1989 egg loss. This may be impossible, as egg numbers do not equate directly to fish numbers. Number of eggs spawned will explain only a portion of the variation in abundance among brood-years, due to density dependent survival. (ESC)

Response: Estimation of eggs laid is used to back-calculate the year's spawning adults, not to predict the return from the eggs laid. Since fecundity, density of spawn, and extent of spawn are all well known, numbers of adults can be back-calculated using an estimated egg loss component, with relative accuracy. It is from the spawn biomass estimate that the next year forecast is made employing age dependent natural and fishery mortality components in the model. In addition, other models, such as catch-age analysis, are currently being employed to compare various estimation models and to provide an index of accuracy.

Fish/Shellfish Study No. 13 - Clam Injury

Comment: It is unlikely that objectives A-D will be attained, as the study design greatly underestimates the natural variability in all the biological and chemical parameters that will be measured, although the available literature on the effects of oil on intertidal clam populations is considered. (ESC)

Response: Incremental growth data (both pre-and post-spill) will be available for comparison of the growth rate by site.

Comment: The field sampling strategy is flawed. Hydrocarbon analysis is done on sediments and clams collected from the lower intertidal zone along transects oriented perpendicular to the shore. As samples are composited into single samples, gradients of chemistry and biological response at different shore levels are obscured, and sample variance is increased. (ESC)

Response: Due to the need to take samples in triplicate, it was deemed prohibitive to take triplicate sediment samples at each tide height that was sampled.

Comment: Except for the largest site differences, the amount of sample replication at each site may be insufficient to detect statistical differences. Differences due to natural causes will be difficult to distinguish from those due to oiling. (ESC)

Response: Stepwise regression using level of oiling, tide height and incremental growth will help distinguish natural effects from oil effects.

Comment: Necropsy analysis is improperly applied to mean histopathological examination. Necropsy would be unlikely to yield useful information. (ESC)

Response: The term "necropsy" will be changed to "histopathology" in appropriate studies.

Comment: Methods used to count live and dead clams are invalid. As it is usually impossible to estimate accurately how long dead shells have been in sediments, the presence of dead shells cannot be used to estimate the number of clams killed by the oil spill or later cleanup effort. (ESC)

Response: The enumeration of dead shells is only one method for possible differences between oil impact levels.

Comment: As the parameters measured are variable over small temporal and spatial scales, it will be difficult to characterize the baseline condition. Quantification of injury from the spill or later cleanup efforts may be difficult. (ESC)

Response: Characterization of the baseline growth rate in clams is accomplished by measuring annuli which are retained.

Comment: As background histopathology is poorly understood, it will not be possible to link any observed effects with EVOS. Relationships have not been established between observed histopathology and oil-related effects on the survival potential of natural mollusk populations. The significance of observed effects is questionable. (ESC)

Response: Histopathology results must be linked with data on the level of oiling in sediments, growth rate prior to the spill and growth rate after the spill.

Fish/Shellfish Study No. 15 - Spot Shrimp Injury

Comment: Estimates of biomass often have sampling errors. (API)

Response: This study does not attempt to estimate biomass.

Comment: The shrimp study focuses on the changes in individual organisms, rather than in the population. For this type of organism, without a demonstrated effect on a population, no injury should have occurred. (API)

Response: The study in 1991 is focusing on potential differences in the 1991 year class, not individuals.

Comment: Objective D are the study will test the hypothesis that hydrocarbon levels are not related to site contamination levels. The methods do not give procedures for collecting water/sediment samples to define the level of contamination at a site. (ESC)

Response: The two oiling categories are based on the initial path of the oil spill. The study has not continued to document oiling in the environment because the project assumes only an impact to the 1989 year class, which was in the water column at the time of the oil spill. The 1989 year class settled to the bottom in mid 1989.

Comment: For objective E, the methods do not describe what is meant by injury to tissues, what tissues will be studied, or how injury will be determined. (ESC)

Response: If hydrocarbon testing indicates exposure, then whole shrimp samples will be submitted for histopathology.

Comment: There is no documentation that selected control sites are sufficiently similar to test sites for baseline production of shrimp, and other environmental factors that could affect the results of the study. Aside from CTD water column profiles, there is no indication that environmental data will be collected. (ESC)

Response: The major focus of this study for 1991 is to determine if a difference can be detected between the two oiling categories for the 1989 year class. CTD water profiles are collected during each sampling period. The bottom salinity, temperature, and dissolved oxygen will be compared between oiling levels.

Comment: The oiled test sites have varying degrees of exposure to floating and stranded oil. The criteria given for selecting impact and control sites, and how those sites chosen will be documented for specific levels of oiling or exposure, is insufficiently explained. (ESC)

Response: The path of the oil spill was initially documented by aerial surveys. For the purpose of this study, sites were chosen as either oiled or unoiled based on surface oiling. No attempt was made to document the degree of oiling.

Comment: The shrimp pots described are designed to catch adult shrimp of commercial market size and are inadequate for the objective of determining if the 1989 year class had a high mortality rate in areas of high oil impact. (ESC)

Response: The shrimp pots utilized in this study capture male, transitional, and female spot shrimp. Occasionally juvenile shrimp are captured, however they are not fully recruited to the sampling gear. To determine if the 1989 year class was impacted, the year classes are separated using modal analysis. For the purpose of this study there is a lag between the time of capture and full recruitment for the 1989 year class. Alternative methods to capture shrimp smaller than 20 millimeters have not been developed.

Comment: How samples for hydrocarbons and fecundity will be handled and preserved in the field to ensure sample quality and integrity are maintained until analysis in the laboratory is not revealed. Chain of custody and QA/QC procedures are not discussed. (ESC)

Response: Samples for fecundity are frozen on board the research vessel. Each fecundity sample has a unique sample label, which accompanies the sample. The label identifies the location where the shrimp was captured. Upon return to port, the samples are transferred to a freezer at the Alaska Department of Fish and Game facility in Cordova. All hydrocarbon samples are maintained under strict QA/QC guidelines as established by the management ream. This includes chain of custody.

Comment: Except for tissue hydrocarbon measurements, no information is given as to what criteria will be applied for attributing differences to oil and what level of effects will be tested. (ESC)

Response: In addition to tissue hydrocarbon measurements, histopathology may be conducted if hydrocarbons are present. Significant differences in fecundity, egg mortality, catch per unit

effort, and year class strength will be compared between the levels of oil impact.

Comment: The probabilities of statistical Type I and Type II errors are not given. The sampling effort may not be appropriate to meet statistical analysis objectives. (ESC)

Response: The probabilities of 0.05 and 0.10 for Type I and Type II errors respectively are given in the "Methods" section of this study plan. Technical experts and statisticians have determined the sampling level that is appropriate and adequate to meet this study's objectives.

Comment: The number of individuals required per sample, as well as the interpretation of the results, will vary greatly depending upon what is sampled for tissue hydrocarbon analysis, which is not sufficiently described. (ESC)

Response: The objective of this comment is not clearly stated. The types of tissues being tested are muscle and egg. The types of hydrocarbons for which these tissues are being examined are listed in Appendix A. The number of specimens to be examined was determined, as noted above, by technical experts and statisticians.

Comment: There is insufficient information regarding the method for treating composited samples for hydrocarbon analyses in the analysis of results. (ESC)

Response: The tissues contributing to a composite sample are pooled prior to processing, thus the resulting values obtained refer to the entire composite sample rather than to any component of it.

Comment: Inadequate information is provided to determine what statistically significant differences will be detectable within the study design. (ESC)

Response: The differences the study is designed to detect, if they exist, are listed in the objectives of this study plan.

Comment: The objectives and methods do not indicate the study will lead to a quantification of the baseline condition, the level of injury, the variance of degree of injury in space, the length of time over which injury will persist, the likelihood and rate of recovery, or the link between EVOS and the injury. There is no indication that an exposure pathway will be documented. (ESC)

Response: Quantification of the baseline condition of the population was not an objective of this study. However, the study does attempt to assess the survival of the 1989 year class of spot shrimp that was in the water column as zoea larvae at the time of the oil spill and to view survival of this 1989 year class in the context of year class survival both pre- and post-spill. The study will also assess the survival of the 1989 year class in oiled and unoiled areas.

Fish/Shellfish Study No. 17 - Rockfish

Comment: This study is not consistent with the exposure requirements for conducting natural resource studies. (API)

Response: The Trustees disagree.

Comment: Ocean floor studies should be done only when there is data showing high concentrations of oil and a long residence time. If such data exists, it has not been made available. (API)

Response: Hydrocarbons were found in rockfish species that dwell on or near the bottom. Therefore these studies are appropriate. The aspects of the study involving sediments and sessile organisms were warranted to help determine route of contamination based on presence of hydrocarbons in bile from demersal rockfish.

Comment: The presence of hydrocarbons does not presumptively indicate injury. Evidence of the causality of the oil to injury must be shown. (API)

Response: Presence of hydrocarbons in organisms in treatment and not in control sites warranted efforts to determine presence or absence of injury. Further studies, specifically histopathological evaluation and MFO sampling, will help in establishing injury.

Comment: The study methods and data analysis sections do not describe how objective C, toxicological analyses of effects on growth and reproduction, will be conducted. (ESC)

Response: This portion of the study has been discontinued for 1991.

Comment: Objective D, the determination of the feasibility of using microstructure to evaluate depressed growth from oil contamination, implies an experimental technique of a research nature. (ESC)

Response: Use of otolith microstructure to show environmental stress is a proven technique. The feasibility aspect of this study is to ascertain its applicability to showing stress relative to the oil spill.

Comment: The reference to Rosenthal which cites seasonal variations in abundance in nearshore habitats contradicts the premise that demersal rockfish complexes have a high degree of fidelity to their habitat and are relatively sedentary. The study of reef habitats for histopathological and other long term effects may be invalidated by mixing of populations. (ESC)

Response: Rosenthal's study involved species counts using underwater transects. In that reference Rosenthal attributes changes in abundance and species composition species disappearing or becoming more secretive. This, in light of other studies, (especially Carlson and Barr, 1977), indicates that demersal species go into hiding during the winter months rather than leaving the area. Pelagic species will move into deeper waters.

Comment: Sampling locations are not identified, and the criteria for choosing sites does not indicate adequate scientific control or baseline determination. It is not clear whether the test sites are representative of the entire resource. The appropriateness of sampling sites as controls and test sites cannot be evaluated adequately, particularly regarding other important variables, such as other sources of petrocarbons. (ESC)

Response: Sample sites and selection techniques were identified in the methods section.

Comment: Sampling design is inadequately addressed and biased to improperly sample target fish species. (ESC)

Response: Demersal rockfish, specifically yelloweye rockfish, were being specifically targeted because during 1989 they were the species which were found dead immediately after the spill and also showed elevated hydrocarbon levels in the bile. The sampling design was not designed to get a random sample but directed to get a representative sample of the demersal fish at each site.

Comment: The level of effect from EVOS which will be tested for, and the probabilities of making Type I and Type II errors are not specified with respect to experimental design, sampling strategies and statistical significance. (ESC)

Response: The level of effect for our hydrocarbon analysis with a sample size of 40 fish in the treatment group will allow us to detect a difference of 20% with the probabilities of type I and type II errors of .05 and .2 respectively. The histopathological samples with a sample size of 60 fish will allow us to detect a difference of 15%.

Comment: The appropriateness of sample sizes specified cannot be evaluated. (ESC)

Response: See answer to previous comment.

Comment: How the different levels of variability (geographic, oiling, and reef communities) will be handled in the analysis is not explained. (ESC)

Response: The Trustees are not trying to account for different levels of oiling, but determining the presence or absence of hydrocarbons.

Comment: How samples for hydrocarbons and fecundity will be handled and preserved in the field to ensure sample quality and integrity are maintained until analysis in the laboratory is not revealed. Chain of custody and QA/QC procedures are not discussed. (ESC)

Response: Sample handling and chain-of-custody procedures were discussed in the methods section.

Comment: Bile, which is non-specific to hydrocarbon source and may be subject to interference by exogenous and endogenous compounds, cannot be analyzed to determine whether EVOS hydrocarbons are present in demersal rockfish. (ESC)

Response: The hydrocarbon analysis may be non-specific, however the presence of hydrocarbons in bile, in concert with other results, may lead to the conclusion of contamination by EVOS.

Comment: Tissue analysis to detect EVOS hydrocarbons is questionable due to the efficient, and possibly selective, metabolic functions in fish. (ESC)

Response: The primary indicator of exposure to hydrocarbons is bile. Other tissues will be analyzed only if results of bile analysis indicate further investigation is necessary.

Comment: Specific techniques for determination of hydrocarbons in sediments and tissues are inadequately described. How contamination will be defined and determined is not stated. (ESC)

Response: All samples for hydrocarbon analysis were sent to Auke Bay NMFS laboratory for analysis on site or through sub-contractors.

Comment: It is unclear how descriptions of otoliths are to be interpreted. It is not possible to determine how otolith-derived age composition and mean length-at-age data are to be used. (ESC)

Response: Otoliths and length data are collected as ancillary information to better describe the organisms being sampled.

Comment: The objectives and methods do not indicate that this study will result in a quantification of injury to resources. The objectives are split between documenting exposure and identifying aspects of injury. There is no indication that damage will be assessed beyond testing the statistical significance of its occurrence, or will be related to EVOS. (ESC)

Response: This study is designed to produce a qualitative assessment, rather than quantitative assessment.

Fish/Shellfish Study No. 27 - Sockeye

Comment: Studies appear to penalize potentially responsible parties for the increase in pink salmon population to the level which would occur without commercial fishing. That more fish is an injury defies common sense, and appears to be utilizing damage assessment in a manner inconsistent with Congress's intent. No evidence is cited which proves injury to spawning habitats, or elsewhere, resulted from the elevated population. (API)

Response: This is a sockeye directed project and the intent is to investigate the potential damage of sockeye overescapements to future sockeye production and to lake (freshwater) ecosystems where spawning and rearing occur. Given the sockeye salmon life-history (5-7 years), the evaluation of injury will be derived from studies being conducted in this and subsequent years.

Comment: This study does not account for the State's management of this ecosystem. Overescapement is the result of fishery management practices. Thus, this is not an EVOS impact assessment study. Measures could have been taken in anticipation of injury caused by the closure of commercial fisheries, such as the use of weirs, to

minimize effects. These measures would have been less invasive than those found in other fish studies. Studies should evaluate the impacts, if any, of historic management practices. (API, ESC)

Response: Overescapement is the result of not being able to harvest adult sockeye in traditional fisheries because of the presence of EVOS oil on the fishing grounds.

Comment: Evidence may exist that shows that salmon population levels have been artificially deflated by commercial fishing. The increase in salmon population should not be assumed to be injury, as positive effects are seldom injurious. (API)

Response: A basic tenet in the management of pacific salmon (all species) is that escapements beyond a specific level results will decrease numbers of adults in future populations. It may be true that sockeye production in some systems has been limited by heavy fishing pressure. However, the evidence for the sockeye systems being studied here is that escapement levels consistent with established goals will produce the greatest yields.

Comment: The study methodology does not provide data useful for correlating oil exposure with any potential observed fishery effects. (ESC)

Response: Sockeye salmon overescapements were caused by the lack of fishing pressure on the stocks due to the presence of oil on the fishing grounds. With the inclusion of non-impacted study sites, potential fishery effects can be factored out.

Comment: The determination of number, age, and size of sockeye salmon juveniles is selected freshwater systems is of marginal use in determining EVOS injury as no oil reached this freshwater spawning habitat. (ESC)

Response: Oil did not directly reach this spawning habitat, but may have reached the spawning grounds through contamination of adult fish. However, the main objective of this study is to document injury as the result of overescapements. These freshwater ecosystems are very oligotrophic and large numbers of predatory sockeye juveniles can disrupt the entire food chain of these lakes. Once disrupted, the food chain is difficult to restore, e.g., lost species of zooplankton.

Comment: The field methods were developed to perform fisheries research unrelated to EVOS. (ESC)

Response: The field methods employed in the EVOS related fisheries projects were, in large part, developed in research projects totally unrelated to the EVOS. This project uses those methods proven to be scientifically accepted.

Comment: The determination of injury in this study has no relation to EVOS. (ESC)

Response: The Trustees disagree. The injury to the freshwater ecosystem as the result of sockeye salmon overescapements may be linked to the EVOS.

Fish/Shellfish Study No. 28 - Run Reconstruction

Comment: There should be a modeling effort comparable to the one proposed in this study to assess damage to other components of the ecosystem. (UM)

Response: Pacific salmon support immense commercial, sport, and subsistence fisheries, and, for this reason, their life histories and population dynamics have been exhaustively studied for the past century. It is only because of this historical information that the run reconstruction study is possible. The governments intend to determine injury to the rest of the ecosystem and to restore these other components.

Comment: The salmon population dynamics in PWS indicate that the status quo is not stable, but transitional. Since even obvious factors affecting salmon population dynamics are not fully understood by area fisheries managers, it will not be possible to provide the input to describe the subtleties of historical population dynamics. (ESC) The effects noted as oiling values for parameters consider only negative values. (ESC)

Response: This comment is not clear. However, using the run reconstruction model to estimate catch and escapement counts in the absence of the oil contamination, the effects of the spill will be determined by the difference between these estimates and the observed catch and escapement counts.

Comment: The comprehensive timing model of Schnute and Silbert (1983) may not represent the salmon dynamics of Prince William Sound. (ESC)

Response: The timing model of Schnute and Silbert was developed for a terminal fishery. The PWS study deals with several stocks, which will add another dimension to the model. Using the

historical tagging data, the study will obtain estimates of district-to-district transition probabilities for each stock, allowing the addition of the Markovian exchange process to the timing model (Hilborn, 1989).

Comment: Testing the model parameters against a single year class will not be adequate to prove that the model works. (ESC)

Response: There exist thirty years of catch, fishing effort, and escapement data that can be used not only to fit the model, but also to evaluate its effectiveness. Moreover, simulation is also a commonly used technique in evaluating a model's effectiveness.

Comment: The model and the input data are not sufficiently described to determine if this modeling procedure is technically sound. It is necessary to know what EVOS effect the model is intended to detect and the Type I and Type II errors expected. (ESC)

Response: The references of Schnute and Silbert (1983) and Hilborn (1990) outline the timing model and procedures for obtaining maximum likelihood transition probabilities from tag recoveries. The study plan outlines how the two techniques will be combined for the PWS run reconstruction.

The model will provide estimates of the catch and escapement counts in the absence of the spill. Obtaining any probablistic confidence in these estimates (type I and type II errors of a hypothesis test, for example) will have to be done through simulation. Only until we have developed the model can we evaluate it.

Comment: The utility of models such as this is to provide a range of possible future conditions. Such models lack precision. Managers have had the data necessary to construct similar models for years, and have not done so due to their limited validity and application. (ESC)

Response: On the contrary, these models can be effective in environmental assessment and decision making. The models require an enormous data base source, a comprehensive understanding of the dynamics of the phenomenon to be modeled, and the latest in numerical software and computer hardware. This modeling effort will use publications of this past decade for its mathematical foundation and will utilize the thirty years of catch, fishing effort, escapement, and tag recovery data that is available.

Comment: The Plan states that these models will be useful for establishing harvest policies and for allocating fishing activities among areas and times. The investigators' approach appears to focus on the development of data for guiding fish allocation policy decisions and not on NRDA impact assessment. (ESC)

Response: The inspiration for the development of this model is for NRDA impact assessment. Once the model is built and the database developed, it can be used for future management decisions.

Fish/Shellfish Study No. 30 - Salmon Database Management

Comment: There is no timetable for accomplishing this study, and no explanation of the need for it in light of the salmon database management tasks being undertaken in Technical Services 3. (UM)

Response: Technical Services 3 provides a geographic information system. This project develops a biological database, and should terminate within one year after completion of field data collection and completion of laboratory analysis.

Comment: Although described as a study, the objective of this program is to develop the computing capacity and facilities to manage historic and spill-related data for the Trustee Council's efforts in the Fish/Shellfish area. The construction of a database system to maintain both historical and spill-related data does not fall within the purview of the NRDA regulations, nor does the structural facility to house that database system. (ESC)

Response: Development of the database is necessary for analysis of data collected in NRDA field projects. The hardware required by this project is limited to that necessary to accomplish the work.

COASTAL HABITAT

Comments on Coastal Habitat Studies

Phase I

Comment: The description of Phase I does not include enough information to ascertain whether the study has been designed to be statistically valid or how extrapolation from specific stratified random sample sites to all possible sites in a given category can be accomplished. (ESC)

Response: The objective of the 1990 plan was to provide summary information on individual studies, adequate for reviewers to understand the scope of the study. Statisticians have been consulted during the plan development to ensure that appropriate statistical designs are followed to allow for extrapolation.

Comment: No criteria for understanding how potential study sites were ground-thruthed have been included in Phase I. (ESC)

Response: As stated on pages 11-12 of the 1990 plan, the potential study sites were visited by coastal habitat personnel examining the sites' physical and biological attributes to verify their appropriateness as a matched pair to respective oiled or control sites.

Phase II, Part A

Comment: The study design of Coastal Habitat 1 does not permit the Trustees to estimate chronic or sublethal effects, particularly in fish. (NWF)

Response: The coastal habitat study is designed to measure sublethal effects to the intertidal fauna and flora considering such factors as mussel reproduction, intertidal fish parasitism, respiration, and growth.

Comment: This is one of the most important studies of the whole plan, yet it has improved only marginally in detail from 1989. The description of the study plan indicates that analysis of the 1989 samples was not sufficiently complete to be used to modify the 1990 sampling plan. Considering the funds expended, this is reprehensible. (UM)

Response: Sufficient analysis of the 1989 field samples was completed before the 1990 field work began. The study was modified to reflect the results of this analysis, including the pairing of sites, the selection of new study sites, and the addition of site-specific biological experiments.

Comment: Hydrocarbon analyses of plant and algal materials is still lacking. It is impossible to tell if productivity of subtidal plants and algae is being assessed. (UM)

Response: Due to the large number of field samples, the process of hydrocarbon analysis is taking a long time to complete. This information is being analyzed together with field measurements to determine the direct and indirect effects of oil, and the effects of cleaning on plant survival and productivity.

Comment: Although in the study description it is stated that an "integrated ecosystem approach" will be stressed, only lip service is given to assessment of the functioning of the ecosystem and potential for trophic transfer of contaminants. From the information presented it is impossible to tell if this will be accomplished. (UM)

Response: The coastal habitat study is founded upon an ecosystem approach to determining injury. By examining biotic and abiotic links within coastal habitat zones, and by providing information to those responsible for other damage assessment studies, it is expected that a comprehensive, ecosystem-wide determination of injuries may be established. A synthesis process integrating appropriate resources has been initiated.

Comment: The bibliography supplied is very dated in most cases, and the relevancy of the references chosen is somewhat questionable. (UM)

Response: The 1990 study plans included bibliographies of only selected literature; moreover, the quantity of literature pertinent to cold northern climates is sparse. A complete listing of appropriate literature is being assembled and likely will be made public.

Comment: This study may be continued in an attempt to document recovery of areas where significant effects are observed. Clearly, this and other studies where significant effects of the EVOS are observed should be continued at least until some estimate of the recovery period can be made. (UM)

Response: Coastal habitat data collection is scheduled to be conducted over a three-year period that began in 1989. Several samplings per year are being collected to assess potential injuries and recolonization (recovery) rates of intertidal flora and fauna.

Comment: Some measure of both aerobic and anaerobic carbon cycling, such as respiration and sulfate reduction, should be made to assess potential effects of the EVOS on energy flow in these systems. (UM)

Response: These measures are beyond the scope of the coastal habitat study.

Comment: There is no way to determine whether the study's objectives will be met. Without adequate description, it is impossible to tell whether results can be extrapolated to other sites exposed to oil. (API)

Response: The objective of the 1990 plan was to provide summary information on individual studies, adequate for reviewers to understand the scope of the study and the interrelationships between studies, and the scope of the overall damage assessment program. The Trustees believe there is sufficient information provided for that type of review.

Comment: Although the Coastal Habitat Study claims to be following an ecosystem approach, the level of detail provided makes it impossible to determine how well this will be accomplished, and to what extent community structure or function will be addressed. (UM)

Comment: The damage assessment section has been significantly expanded from the 1989 plan, but the information is still inadequate to determine how well injury will be assessed. (UM)

Comment: The Coastal Habitat study fails to recognize the findings of the Net Environmental Benefit Analysis, which indicates that oil-impacted areas are recovering. (ESC)

Response: The 1990 study has again been reviewed extensively by appropriate experts for design and cost-effectiveness and, where appropriate, has been revised accordingly. We have reviewed the findings of the Net Environmental Benefit Analysis and have incorporated any applicable findings into the study design.

Comment: Much of this year's work will be the "analysis of samples obtained in 1989." In 1989 "specific methods" were developed for each component of the study, but are listed by title only. Most of these are very procedural, ("locating quadrants, sample identification and chain of custody, sample storage and identification", etc.), somewhat generic, and necessary for any study. Usually, this information would appear in the QA/QC plan, which were not, other than the analytical chemistry and histology

groups, submitted as part of either the 1989 or 1990 plans. Only a few titles in this list indicate what type of data they are generating. (UM)

Response: The work performed in 1990 involved the completion of a limited amount of sorting and analysis of 1989 samples, and the collection and initiation of sorting and analysis of 1990 field samples. A detailed study plan of data analysis, collection techniques, and QA/QC standards was not included because the plan is aimed at providing a summary of individual studies adequate for reviewers to understand the general scope of the studies, and the interrelationships between studies.

Comments: To be reviewed adequately, the "Specific Methods" developed for this study would have to be available to qualified experts. (UM)

Response: The specific methods in the coastal habitat study may produce results used in litigation. They therefore constitute confidential information unavailable during the study process. A less detailed review version is provided to allow reviewers to understand the scope of this study and its interrelationship with other studies.

Comment: The "Specific Methods" section should be expanded to include measures of both primary and secondary productivity in matched oiled and unoiled habitats in the supratidal, intertidal and subtidal zones. (UM)

Response: Due to the extent of the spill-affected area and the study's primary objectives of estimating the quantity, quality, and composition of critical trophic levels in moderate-heavily oiled sites relative to non-oiled sites, an estimate of community function cannot be directly determined. The study, however, does take an integrated ecosystem approach to assessing the interrelationships between and within the intertidal community.

Comment: The flora and fauna of the intertidal communities of Prince William Sound and the Gulf of Alaska are thriving. Thus, the justification for the Coastal Habitat study is questionable. (ESC)

Response: Our data do not support the conclusion that these communities are thriving. The data to date have been extensively reviewed by experts, resulting in the continuation of the coastal habitat project.

Comment: The Plan does not address QA/QC or chain-of-custody issues. (ESC)

Response: The QA/QC standards were established by the analytical chemistry portion of the damage assessment process and are appropriately included in that section of the plan. There is no need to duplicate these standards in the coastal habitat study plan.

Comment: The Coastal Habitat study does not describe how information gained from subtidal sites can be related to the stratified random sample sties since subtidal sites were chosen independently of the intertidal and supratidal sites. (ESC)

Response: The subtidal portion of the study is not directly linked to the stratified random sampling design of the intertidal and supratidal portions of the study. The subtidal study is now incorporated into the Subtidal study 2, to which it was linked last year.

Comment: It is unlikely that the Coastal Habitat study will yield an objective quantification of injury and recovery since lightly oiled shorelines were eliminated from study and moderately and heavily oiled shoreline were combined into one category for the stratified random sample study. (ESC)

Response: Detailed hydrocarbon analysis is being performed on samples from each location that will yield a range of precise levels of hydrocarbons. This range in levels will provide the means for extrapolating injury.

Comment: There is no indication in the Coastal Habitat study of the total number of sites samples or their distribution between control and oiled sites; among Prince William Sound, the Gulf of Alaska, or Kodiak Island; or among habitat or the five shoreline types. Nor are the five shoreline types identified. There is no mention of whether any of the sites were sampled more than once in 1990 or the number of sites that were sampled in both 1989 and 1990. It is not known from the write-up of this study whether the same criteria were used to select sites in both years. (API, ESC)

Response: Page 10 of the 1990 plan identifies that there were 102 sites to be studied in 1990. These are distributed equally between control and oiled sites with 42 sites in PWS, 27 in CI/KP and 33 in KAP representing the five following habitat types: (1) exposed rocky shores; (2) fine textured beaches; (3) coarse textured beaches; (4) sheltered rocky shores; and (5) sheltered estuarine shores. Seasonal and annual collection of data has been integrated

into the study design integrating 1989 and 1990 sampling sites. A discussion of the site selection process is given on pages 10-12 of the plan.

Comment: Estimation of recovery rate in Phase II - Part A requires several sites visits. The study does not explain how seasonal changes will be integrated into the estimation of impact/recovery or what parameters will be used to predict recovery rate and potential for restoration. The habitat types examined in the stratified random sample are not provided. And the degree of oiling is not clearly defined. (ESC)

Response: Coastal habitat data collection is scheduled to be conducted over a three-year period that began in 1989. Several samplings per year are being collected to determine potential injuries and recolonization (recovery) rates of intertidal flora and fauna.

Comment: Methods are not given for random selection of sites in Phase II - Part A. Inclusion of nonrandom sites, chosen in 1990 for Coastal Habitat 1, may make the whole sampling design nonrandom. Thus, it may be difficult to extrapolate impacts to the entire spill-affected area. None of the statistical procedures for detecting differences are described. (ESC)

Response: The selection process is explained in the August 1989 and the 1990 State/Federal Natural Resource Damage Assessment and Restoration Plans. As explained in the 1990 plan, the additional 1990 sampling sites were deductively selected to provide additional spatial and habitat distribution thus providing a paired comparison that maintains the statistical validity of the design. Statisticians were consulted during the development of the 1989 and 1990 study plans to ensure that appropriate statistical designs were met.

Comment: The Coastal Habitat study contains no reference to the determination of appropriate restoration techniques or the assessment of the effectiveness of natural recovery. (ESC)

Response: Coastal habitat data collection is scheduled to be conducted over a three-year period that began in 1989. Several samplings per year are being collected to assess potential injuries and recolonization rates of intertidal flora and fauna. This information will be used to determine appropriate restoration techniques.

Comment: None of the methods used to determine hydrocarbon concentrations in sediment and soil are given in Phase II - Part A. Objective B of this study should be to "measure" rather than "estimate". (ESC)

Response: Hydrocarbon analysis of sediments and soil samples collected by the coastal habitat project will be analyzed in Technical Services study 1. The analysis will measure concentrations of petroleum hydrocarbons and their metabolites.

Phase II, Part B

Comment: The use of historical data in Coastal Habitat 1 may not be relevant because there is no information provided on the location of the ten historical sites from which mussel and sediment contamination data have been collected. If they are from low-energy, low gradient beaches at the head of embayments, they are not typical of most of the oiled sites in Prince William Sound. It is unclear from the Plan whether the methods for detection of petroleum hydrocarbons in the mussel tissues is the same for the historical and the post-spill samples. The presence of hydrocarbons in mussel tissues should not be considered an injury unless it can be shown that these oil residues are causing biological damage. (ESC)

Response: The historical sites and sites established just prior to the spill were placed at low energy sites where fine sediments are available. Although some of these sites received light oiling, they are not typical of the exposed areas that received moderate to heavy oiling. The information from these sites will provide a basis for evaluating the extent of oiling and impact in protected areas adjacent to high energy oiled areas. Analytical methods for the historical samples and post-spill samples are the same. The presence of hydrocarbons in mussel tissues are used as an indicator of availability to organisms of hydrocarbons in the water column.

Comment: Since no information is given as to the locations of the ten historical sites, it is not possible to know whether they are in areas that were affected by the oil spill. There is no explanation as to how the ten historical sites or the ten new sites were selected. (ESC)

Response: Most of the ten historical sites were outside the spill area with two or three exceptions. These are located in areas considered most likely to be oiled in the event of a spill. The ten additional sites were established during the early days of the spill in areas that were most likely to be oiled.

Comment: Increased efforts at modeling historical data and that obtained as part of the NRDA to predict both effects and recovery has only been given limited attention. (UM)

Response: Currently the historical hydrocarbon data are being examined in detail. Individual concentrations of aromatic hydrocarbons in sediments and mussels in spring, summer, and fall periods for the years 1977-1980 are being summarized. Results from NRDA samples will be compared to the historical data.

Comment: Part A of Phase II of the study contains only a general list of methods: there is no description of the number of transects per site or the number of tide levels sampled at each site; methods for sampling and analysis of biota and sediments are not given; there is no description of the tests of biological conditions and community function; and none of the methods for injury determination are included. Consequently, it is not possible to assess the technical soundness of this program. (ESC)

Response: One transect is sampled per site. Sampling on the transect is described in the study plan. Hydrocarbon analysis of sediments and mussels by GS/MS will occur under Technical Services 1. Direct injury will be documented if community changes are found on the photo transects.

Comment: There has been no consideration of shoreline treatment procedures in site selection for phase II - Part A and only one level (moderate to heavy) of oiling is being compared to control conditions, so the "response to varying degrees of oiling and subsequent clean-up procedures" cannot be measured. And it may not be possible to demonstrate any biological response unless all control sites in the stratified random sampling were randomly selected. (ESC)

Response: Sites were selected before any oil reached them and prior to shoreline treatment. Two sites subsequently received extensive cleanup and two received moderate to light cleanup. The sites included heavily, moderately, and lightly oiled sites. All sites were selected according to a stratified random procedure. They are all in protected bays, but the sediments vary somewhat.

Comment: There is insufficient information in Objective B of Phase II to determine whether field sampling or laboratory analysis methods used to collect the historical data are the same as those employed in selecting the 1989-90 data. No methods are outlined for determining whether differences measured over time can be attributed to the spill or to natural or anthropogenic changes. (ESC)

Response: The historical and new sites are treated the same for field sampling and laboratory analysis. Hydrocarbons in sediments over the baseline levels can be linked to Prudhoe Bay crude oil through the compounds analyzed under Technical Services 1.

AIR/WATER

Comments on Air/Water Studies - General

Comment: Other than a comment stating that extremely low concentrations of hydrocarbons in water and air observed during the 1989 sampling indicated that further sampling of these compartments was no longer needed, no rationale was given for why specific studies were excluded from the 1990 plan. Many of the species and life stages covered by the canceled studies are important resource species and/or sensitive components of the life cycle which could sustain damage in years subsequent to the spill. It would seem premature to abandon these studies so early in the damage assessment process. (UM)

Response: The portions of the Air/Water studies that were discontinued and not combined with another project were activities that the Trustees determined had little potential to contribute to the documentation of resource injury.

Comment: These studies are not cost-effective. (API)

Response: The Air/Water studies focus on a broad and complex ecosystem that provides the habitat for a large variety of organisms. Most of these organisms serve as prey items for higher trophic levels in the food chain. The overall documentation of the extent and persistence of EVOS hydrocarbons in the environment, and the pathways by which habitats became contaminated and the contamination entered the food chain, will continue to be understood poorly unless these studies are conducted. The Trustees have determined that the expense of conducting these studies is justified by their overall contribution to the documentation of injury.

Comment: These studies consist of basic research. They are not targeted to show specific injury and are not consistent with DOI damage assessment regulations. (API, ESC)

Response: An evaluation of injuries to the benthic resources and habitats addressed under the Air/Water studies is a critical component in assessing the overall injuries to natural resources caused by the EVOS, and is consistent with the DOI damage assessment regulations.

Comment: The only available techniques to measure the effects the studies are attempting to measure are unreliable. Sediment toxicity assays and their application are still being developed by the scientific community. Toxicity source identification methods for sediments are unavailable. (API)

Response: The GC-MS analysis performed on sediments under Technical Services 1 is a well developed scientific technique. It can identify enough hydrocarbon compounds in sediments so that major sources can usually be identified.

Comment: Major components of all three studies, particularly Study AW6, are research. Methods proposed for trace hydrocarbon analysis (AW2) and toxicity testing (AW6) are neither standard nor accepted for this purpose and any new methods will have to be developed as part of the studies. (ESC)

Response: The techniques used to document injury to the benthic resources and habitats addressed under the Air/Water studies are well established and documented in scientific literature.

Comment: The study plans are flawed in that they assume that the chemical analyses from sediment samples are related to the oil spill. The methods fail to take into account effects that have occurred over time from other sources. (API)

Response: The GC-MS analysis performed under Technical Services identified enough compounds so that EVOS oil should be distinguishable from hydrocarbons from other sources. Air/Water Study 6 examines long-term toxicity of weathered Prudhoe Bay crude oil and oxidation products of oil.

Comment: Site selection was not random. (API)

Response: As a random site selection approach to subtidal sediment sampling over the entire spill area is cost prohibitive, a paired sampling approach using oiled and unoiled areas is used. The Air/Water 6 study relies on the measurement of hydrocarbons in sediments under Air/Water 2 (samples were shared) to establish which sampling sites were oiled.

Comment: There are potential methodological problems with chemical analyses of sediment. (API)

Response: The GC-MS technique used to analyze sediments will provide a detailed breakdown of the hydrocarbon compounds present in sediment samples. This is a well established analytical technique accepted in the scientific community.

Comment: The method used most frequently to measure petroleum hydrocarbons in water and sediments (UV fluorescence) is specific for aromatic hydrocarbons and is not always conclusive in

distinguishing between aromatics from the oil spill and aromatic hydrocarbons from other sources. (ESC)

Response: The UV fluorescence method is used primarily as a screening device to determine whether hydrocarbons are present in a sample and to guide selection of samples for more detailed analysis.

Comment: Air/Water 2, 3 and 6 are not well integrated internally or with each other or with Coastal Habitat 1. (ESC)

Response: The sampling locations of these studies and the logistical support (vessel charters) are well-coordinated. Air/Water studies 2 and 6 share sediments from the same samples. Due to the stratified random site selection approach used for the Coastal Habitat 1 study for 1990, it was not practical to coordinate Air/Water study sites with that project. The subtidal eel grass bed sampling portion of the Coastal Habitat study was coordinated with Air/Water 2 sampling sites however.

Comments on Air/Water Studies - Specific

Air/Water Study No. 2 - Subtidal Sediments

Comment: It is questionable whether the budget cuts made as a result of combining Air/Water Studies 2 and 4 are appropriate since there is no line item in the budget for sample analysis. (NWF)

Response: Air/Water 4 was combined with Air/Water 2 in 1990. Collections for these studies were combined on tightly coordinated cruises that maximized the efficiency of the field sample collections. Air/Water 6 samples were taken on the same cruises. Sample analysis was performed by the individual components of Air/Water 2 with a major portion of the costs for hydrocarbon analysis of sediment samples included in Technical Services 1.

Comment: Proposed analytical methods are inappropriate to distinguish various hydrocarbon sources from EVOS. (ESC)

Response: Technical Services Study 1 established the quality control procedures for hydrocarbon analysis for EVOS oil. The methods employed will allow the identification of North Slope crude oil in cases where the analysis is being performed directly on oil found in the sediments sampled by Air/Water 2.

Comment: It is unclear whether gas chromatograph methods described in Technical Services 1 can be used to distinguish between weathered EVOS oil and oil from other sources for studies Air/Water 2 and 6. (ESC)

Response: The compounds analyzed under Technical Services No. 1 will include aromatic compounds and the C10-C34 alkanes, which will provide sufficient analytical information to describe different weathered states of oil and distinguish North Slope crude oil from other sources.

Comment: Although the description of samples to be taken and the methodology to be employed are much more complete than that presented in the 1989 plan, the actual number of samples that will be eventually analyzed is not stated. (UM)

Response: Currently, 385 sediment samples are being or have been analyzed from those collected in 1990. Additional samples may be submitted for analysis once the results from these initial samples are available.

Comment: Statistical tests of hypotheses are vaguely defined, and it is not clear how abundance and biomass are to be tested. (ESC)

Response: A Kruskall-Wallis and a multiple comparison test for significance will be used to test for differences in total abundance and biomass between stations sampled each year and in multi-year data sets. The tests will be made on the abundance and biomass of selected predominant taxa at stations. Analysis of variance (ANOVA) has been added to the statistical analysis. ANOVA will be used to test differences in abundance and biomass between predominant taxa for stations at similar depths within oiled and unoiled bays.

Comment: It is unlikely that the statistical analysis of the benthic infauna will have much meaning considering the numbers of both oiled (6) and unoiled (6) sites to be sampled. Furthermore, because the geochemical techniques being employed will not discriminate the various sources of hydrocarbons (biogenic, pyrogenic, and other petrogenic) the statistical analysis will be unable to correlate any effects observed with EVOS oil or its weathering products. (ESC)

Response: Sample size is minimal. However, it is expected to be adequate to detect major faunal differences between sites. It will be possible to correlate effects with EVOS oil because chemical analysis of sediments at sample sites will allow identification of oil.

Comment: It is proposed that injury determination will be accomplished by correlating the results of the chemical analyses (HPLC) with the Microtox measurements (as a measure of toxicity) and with the deep benthos biological statistics for oiled and unoiled sites. It will be impossible to determine EVOS-imposed injury in this manner because: (1) it will not be possible to quantitatively discriminate an EVOS signature from other hydrocarbon sources, and (2) the Microtox tests are invalid tests of toxicity as explained above. (ESC)

Response: Preliminary tests with Microtox in 1990 indicated low sensitivity to *Exxon Valdez* oil in sediments and this technique was discontinued. The analysis for aromatic compounds and the C10-C34 alkanes in sediments under Technical Services 1 will allow the separation of North Slope crude oil from other sources of oil.

Comment: The site selection procedure, the number of sites selected, and the hydrocarbon chemistry methods to be used, preclude the use of deep benthos infaunal species diversity, species abundance, and total biomass from being used to assess EVOS-related injury to subtidal marine resources. Further, the site selection procedure precludes extrapolation of the site data to the entire region. (ESC)

Response: The site selection procedure is appropriate for assessment of total abundance and biomass using Kruskal-Wallis and multiple comparison tests. The results will be useful for investigating major faunal differences between oiled and unoiled sites. The study was not designed to enable extrapolation to the entire region. Subtidal benthic systems differ sufficiently so that area-wide extrapolation is not possible. However, common fauna between benthic sites are typically found, and differences in these predominant and ubiquitous faunal components may be extrapolated.

Comment: Objectives A-H. The small number of sites and the method of their selection are such that it is unlikely that the major objectives will be realized in a manner that will permit them to be extrapolated to the region as a whole. Therefore, it will not be possible to obtain one of the main goals in the study which is to "evaluate the extent of subtidal hydrocarbon contamination in PWS, along the lower Kenai Peninsula, and near Kodiak Island." (ESC)

Response: Sampling was conducted in a paired design (treatment/control pairs of sites). The number of pairs was limited by the number of adequate control sites. The main objective of Air/Water 2 is to determine the distribution, composition, persistence, and toxic effects of petroleum

hydrocarbons in bathymetric space. Air/Water 2 is not designed to extrapolate sampling results "to the region as a whole." This requires a random stratification approach and a sampling effort that is cost prohibitive for the required subtidal sampling.

Comment: One study uses the Microtox test for toxicity. This method is not accepted as a sole indicator and should be used in conjunction with other methods to determine the toxicity of sediments and the effect of oil exposure. Microtox bacteria would not be expected to be a part of the sediment infauna, thus the relationship of the test to the environment is not clear. (API)

Comment: The Microtox assay, although very quick and relatively inexpensive to perform, is at best a very crude barometer of the relative toxicity of these sediments. Comparisons between toxicity estimated with Microtox and more routine acute toxicity yield highly variable correlation coefficients depending on species compared. Attempts to use the Microtox assay as a direct measure of sediment toxicity have indicated that toxicity results are highly dependant on the method used to obtain an aqueous sample from the sediment under consideration and suggest that further method development is needed. Even the study by Schiewe et al. (1984) cited in the plan points out many of the limitations of this assay in addressing sediment toxicity. (UM)

Comment: When compared experimentally, the Microtox assay was found to be less sensitive than either the *Daphnia magma* 48-hour lethality assay or the *Hexagenia limbata* 168-hour lethality assay in assessing the toxicity of a freshwater sediment contaminated with aromatic hydrocarbons and metals. (UM)

Comment: The Microtox bioassay, based on the response of a marine bacterium to methylene chloride extracts of sediments (used in Studies AW2 and AW6) is not an appropriate method for estimating the toxicity of in-place oiled sediments to marine organisms. Recent studies of sediments from Puget Sound show that results from Microtox bioassays of methylene chloride sediment extracts do not correlate with the toxicity of the sediment interstitial water or to concentrations of polycyclic aromatic hydrocarbons in the sediments. (ESC)

Comment: Microtox bioassay is considered a poor indicator of the toxicity of the lipophilic organic compounds, such as petroleum hydrocarbons. (ESC)

Comment: The microtox bioassay is an EPA water quality test and its application to sediment extracts is inappropriate. (ESC)

Comment: The Microtox measurements proposed will be unable to attribute dose response relationships to an EVOS component. (ESC)

Response: This responds to the preceding 7 comments. Preliminary tests with Microtox in 1990 indicated low sensitivity to *Exxon Valdez* oil in sediments and this technique was discontinued.

Comment: Bioaccumulation, toxicity, and growth should be assessed in a number of representative benthic organisms, as is suggested in the proposed update of the EPA ecological evaluation of dredged material. (UM)

Response: Sediment toxicity and its effect on test organisms will be addressed in 1991 in Subtidal #3.

Comment: The HPLC/fluorescence method chosen to estimate petroleum hydrocarbon concentrations has the advantage of allowing large numbers to be processed relatively quickly and inexpensively, but it is not very specific. Will it be used only as a screening tool to identify samples with elevated levels to be analyzed by more conventional methods with better accuracy? If not, erroneous conclusions on levels of hydrocarbon contamination could be made. (UM)

Response: Under Air/Water 2, the HPLC/fluorescence method will only be used as a screening tool.

Comment: There is no reason given for the fact that detailed sediment sampling is scheduled to take place three times while the biological samples will only be collected in June/July. It is questionable whether measurable differences in sediment concentrations over that short a time period exist that long after the spill. If they do, the frequency of biological sampling should be increased. (UM)

Response: The expense of collection and laboratory processing of the infaunal samples rendered the cost of seasonal assessments of the deep benthos prohibitive. Collection and analysis (in conjunction with HPLC/fluorescence) of sediment samples is much less expensive, and is providing for the opportunity for seasonal hydrocarbon sediments collections.

Comment: Using a 1 mm sieve on the benthic infaunal sampling will miss many of the numerically dominant species, including most invertebrate larvae and some very important meiobenthic prey species for salmon fry such as harpacticoid copepods. Many investigators of soft-bottom community structures require 0.5 mm mesh sizes or smaller. (UM)

Response: Both 1.0 and 0.5 mm sieves have been incorporated into the sampling. The benthic study was designed to assess macrofauna, and was not intended to examine meiofauna quantitatively. However, use of the 0.5 mm screen should allow quantitative examination of the larger meiofaunal taxa.

Comment: The total number of sites, the manner in which they were selected, and the numbers of samples to be collected may be inappropriate for a statistically based study. (ESC)

Response: Sampling was conducted in a paired design (treatment/control pairs of sites). It was not the goal of the study to extrapolate results over the entire spill-impacted area. This is cost prohibitive considering the extensive subtidal sampling that is required.

Comment: Since only 6 oiled and 6 non-oiled sites will be investigated for effects on the structure of subtidal benthic communities, it is extremely important that the control and oiled sites be well matched for sediment characteristics, depth, light and nutrient conditions if potential effects of the EVOS are to be assessed adequately. Potential effects on benthic community structure should be a key component of the NRDA. (UM)

Response: Although it is difficult to match completely all sites with all characteristics, sea grass beds at the heads of bays were chosen as the common denominator that is expected to have an important influence on the benthic environment of all sites. A sea grass system can be expected to flux a sizable and annually reliable amount of organic carbon to the subtidal environment. Similar benthic faunal components responding in a roughly similar manner would then be expected in the subtidal sites selected.

Comment: The field program is very inefficient and is therefore not cost effective. The total number of sites, the manner in which they were selected, and the number of samples to be collected may be inappropriate for a statistically based study. Non-random site selection can yield biased results. (ESC)

Response: The field program was greatly increased in efficiency in 1990 by combining the sampling needs of all Air/Water 2 (including previous Air/Water 4) and Air/Water 6 program components into the same cruises.

Comment: The biological sampling plan for the intertidal zone (along a 30 m transect parallel to the shoreline in the range +1m to -1m relative to mean lower low water) is inappropriate due to the pronounced stratification of biota in that zone. (ESC)

Response: It was appropriate to sample the intertidal zone as this zone is most likely to contain infauna in association with fine sediments.

Air/Water Study No. 3 - Geographic and Temporal Distribution of Hydrocarbons

Comment: Sediment traps will be deployed at only a very limited number of locations and can only assess the concentrations of petroleum hydrocarbons on particulate material settling out of the water column. (UM)

Response: The sediment trap study is designed to monitor suspended particulates and hydrocarbons settling out of the water column. With the exception of control sites, the traps are located at sites believed to be most likely to still have detectable, mobile hydrocarbons in the water column. Sediment traps will measure both adsorbed hydrocarbons and hydrocarbon "globules." Previous studies have shown both forms to be important components of hydrocarbon mobilization and subsequent deposition.

Comment: Although use of caged mussels is a well accepted approach, particularly in areas with more heavily oiled sediments, some analysis of the concentration and patterns of petroleum hydrocarbons in the dissolved or whole fraction of the water column would seem to be warranted. Measurements of this type will be of particular importance to calculate the flux of hydrocarbon material out of sediment reservoirs. (UM)

Response: By 1990, water column concentrations of petroleum-derived hydrocarbons were below detection limits using practically sized samples (i.e., up to about 5 liters) in PWS.

Comment: Objective 1. Sediment traps are not appropriate for determining particulate transport of hydrocarbons in shallow-water environments. (ESC)

Response: The sediment traps have been designed to account for a range of environmental conditions encountered in nearshore subtidal areas where they are deployed. While the traps are not designed to quantify flux rates, they are effective at capturing particulates to determine the presence or absence of hydrocarbons.

Comment: Objective 2. This objective does not relate ambient water quality or mussel hydrocarbon burdens to EVOS. (ESC)

Response: Methodology relating PAH concentrations in sediments and in mussels due to the EVOS with resource injury and lost services is not within the scope of Air/Water 3, although it is within the scope of the overall NRDA process and is based on the integrated results of the individual projects. Project investigators have coordinated studies to the extent considered necessary to facilitate an integrated assessment of resource damage. The linkage of this study to other NRDA studies consists primarily of demonstrating the transport and availability of spilled oil from the beach and surface waters to the water column and subtidal sediments where it is available to marine organisms.

Comment: The depth(s) of deployment of the sediments traps are not given. Justification for why three sampling periods were chosen instead of one deployment, possibly for a longer period, should be given. For some compounds four weeks is too short a time period. (UM)

Response: The depth of deployment was given as less than 20 meters below MLLW. In practice, the traps were deployed at approximately 10 meters. Sampling periods were chosen to correlate with naturally occurring erosional and depositional events. The length of deployment is intended to maximize deposition while minimizing naturally occurring degradation of any hydrocarbons present.

Comment: The field extraction method for the sediment trap samples is not described. Other than attempting to determine differences in hydrocarbon concentrations between samples and sites, no methods describe how any of the results from these efforts can be attributed to EVOS. (ESC)

Response: The field extraction method for sediment trap samples are described in the 1991 plan. Clear differentiation of sources of hydrocarbon burdens will be accomplished using details provided by the GC/MS analyses, and by comparison of these details with historical data on hydrocarbon burdens of various compartments within PWS.

Comment: Because body burdens of hydrocarbons in mussel tissue can change fairly rapidly, levels in caged mussels will only be indicative of ambient water column concentrations if the concentration of these components in the water column is somewhat constant during the exposure period. (UM)

Response: From the definition and magnitude of the bioconcentration factor of polynuclear aromatic hydrocarbons (PAH) for mussels, the rate of depuration is several orders of magnitude less than the rate of uptake. In particular, accumulated PAHs have an apparent half-life on the order of 2 weeks in mussels. A 4-week exposure period was chosen as a sufficient time period for accumulation of some PAH to occur. The study objectives do not include an attempt to calculate absolute seawater PAH concentrations on the basis of concentrations found in mussels.

Comment: Use of sediment traps to measure transport of petroleum hydrocarbons to offshore sediments will not produce information enabling the Trustees to relate hydrocarbon levels to population impacts on benthic organisms because sediment traps are not useful for predicting the rate of flux of suspended particles to the bottom and, if they are mounted near the bottom, they measure mainly sediment resuspension. (ESC)

Response: The sediment trap study is designed to determine the continuing mobilization of hydrocarbons. This study will be integrated with the results from other studies to address the question of continuing temporal and spatial exposure of benthic organisms to hydrocarbons. The sediment traps are designed to minimize capture of resuspended sediments.

Comment: The geographic distribution of study sites is not adequate: Only 5 of 20 sediment-trap sites are listed and referenced figures for caged mussel sites are not included in the document. The use of sediment traps for measuring flux to the subtidal region is not a valid or standard technique in shallow-water environments. Neither the sediment trap-design nor the periods of deployment are set forth. No field chain-of-custody is described nor are QA/QC procedures for field-extraction of the particulates. (ESC)

Response: The geographic distribution of study sites is adequate to monitor suspended particulates and hydrocarbons settling out of the water column. With the exception of control sites, the traps are located at sites believed to be most likely to have detectable, mobile hydrocarbons in the water column. The sediment traps are not designed to measure flux rates but rather the presence or absence of hydrocarbons. This study follows the standard chain-of-custody procedures for all NRDA studies. Standard QA/QC procedures have been established.

Comment: These injury pathway studies do not attempt to differentiate hydrocarbon burdens found from EVOS, pyrogenic, natural sources (seeps), or other (boating) sources. (ESC)

Response: Clear differentiation of sources of hydrocarbon burdens will be accomplished using details provided by the GC/MS analyses, and by comparison of these details with historical data on hydrocarbon burdens of various compartments within PWS.

Comment: No methodology is provided which will tie differences in hydrocarbon concentrations in the sediment traps and mussels to resource injury and lost services. The few sites that are proposed to overlap with Coastal Habitat Study No. 1 and Air/Water Study No. 2 will not "provide a comprehensive picture of damage." (ESC)

Response: This study will provide documentation of the pathway of hydrocarbon contamination that eventually reached a number of marine organisms. This study, in concert with other NRDA studies, will tie hydrocarbon contamination to resource injury.

Comment: The linkage between this study and the other injury-related studies is not apparent. (ESC)

Response: Close coordination between this study and other studies has been carried out throughout the NRDA process.

Comment: Only two control sites are listed for the caged-mussel studies and none are specified for the sediment trap deployments, making it impossible to evaluate whether the baseline determination will be adequate. (ESC)

Response: In addition to the control sites in PWS, mussels collected from an uncontaminated site on Admiralty Island in S.E. Alaska will provide a reference.

Air/Water Study No. 6 - Fate and Toxicity of Oil

Comment: Objectives A-C. The study is of limited value in estimating injury from weathered crude oil in sediments. Because of the study design, these objectives will not be accomplished in a scientifically defensible manner. (ESC)

Response: Because the information on the persistence and toxicity of oil and its oxidation products in the marine environment is very limited, this study was initiated in 1990 to provide this type of documentation. The information developed will support other studies by confirming or eliminating potential sources of injury to marine organisms.

Comment: Objectives D. This study cannot be performed in a technically sound fashion and is of no use for identifying restoration needs or quantifying injury to natural resources. (ESC)

Response: The establishment of an understanding of the fate of the EVOS oil over time and space, in concert with other NRDA studies, will help further the understanding of how the environment was affected by the EVOS. The cost of meeting this objective is minimal as existing information from other sources will be used to construct the fates model.

Comment: Air/Water 2, 3, and 6 are not well integrated internally or with each other or with Coastal Habitat 1. (ESC)

Response: Air/Water 2 and Air/Water 6 are closely coordinated with each other and the Coastal Habitat studies. Subsamples of the same sediments from the same suite of sites are subjected to chemical analysis and toxicity testing. See also response to this same comment in the general comments in this section.

Comment: It is not possible to ascertain from the Plan whether there is duplication of effort in the studies of petroleum hydrocarbon concentrations in Coastal Habitat 1 and Air/Water 6. (ESC)

Response: Although sediments are sampled under the Coastal Habitat study, they are subjected to more detailed testing for toxicity and the presence of oxidation derivatives of oil in Air/Water 6.

Comment: Air/Water 6 does not contain sufficient specificity regarding the construction of a "summary budget or 'mass balance' summarizing the fate of spilled oil." It fails to indicate when this calculation will be made and to explain how the calculation will be utilized in the assessment of damages. (NWF)

Response: Primary sources of information have been identified for the synthesis of a budget for the fate of oil, and contacts have been made to help ensure the compatibility of the data to be synthesized. The budget will represent a best synthesis effort with the information that is available. While not directly documenting damage, this information will support damage assessment by providing an overall picture of how the oil was distributed in the environment.

Comment: The data generated by Air/Water 6 will not be sufficient to construct an accurate mass balance of the spilled oil. It is extremely unlikely that a mass balance, even if constructed, would be sufficient for quantifying injury to natural resources. (ESC)

Response: The primary sources of information that have been identified for use in constructing the budget are detailed enough so that a representation of the general distribution of oil in the environment can be produced. While not directly documenting damage, this information will support damage assessment by providing an overall picture of how the oil was distributed in the environment and was available to organisms.

Comment: There is no statement in the study plan as to how the mass balance would be used in restoration or injury determination and quantification. Because of the imprecision of the fate estimates, the results of this mass balance will not be useful for injury determination. (ESC)

Response: Although the oil fates budget will not have a direct use in documenting injury to organisms, the background information on spatial and temporal distribution of oil in the environment it provides will aid in understanding how and when oil was available to various organisms and in extrapolating injury beyond immediate study areas.

Comment: The introduction to the study states that effects of petroleum hydrocarbons themselves are well enough documented in previous work to allow accurate predictions in the case of EVOS without additional study, but this is questionable. Although a substantial body of work does exist on the WSF and OWD of different petroleum products in laboratory conditions, these studies may not adequately assess the long-term, sublethal effects of petroleum hydrocarbons on all key components of the ecosystems. (UM)

Response: Not everything is known about the long-term sublethal effects of oil on all components of the ecosystem. However Air/Water 6 is designed to address two fundamental issues: 1) whether residual oil exerts acute toxicity on test organisms, and 2) whether polar breakdown products contribute to any of the observed toxicity.

Comment: There are no details regarding how the mass balance will be attempted. The Plan states that recognized experts will be consulted in its execution, but that progress will be heavily influenced by timely reporting of data from other groups, and the suitability of these data for constructing the mass balance. The timely reporting of data from different members of the damage

assessment team, and the compatibility of the different data sets were one of the major concerns with the original 1989 damage assessment plan. (UM)

Response: Primary sources of information have been identified for the synthesis of the "oil fates" budget. Not all of these are within the damage assessment arena. Current plans are for this budget to be completed by the fall of 1991.

Comment: This study lacks baseline measurements, so it will not be possible to compare toxicity of polar fractions of organic extracts of oiled and unoiled sediments. Therefore, the increment in toxicity of sediments due to oil cannot be measured. (API, ESC).

Response: Where baseline data does not exist, a comparison of the toxicity of sediments from oiled and unoiled sites has been utilized. The measurement of oil in the sediments (from the same sample) from Air/Water 2 are being used to confirm whether oil is present at a sampling site.

Comment: The analytical methods will not allow definitive identification of EVOS oil as the material causing toxicity in sediments. Therefore, there will not be a clear link established between the injury (toxicity of intertidal and subtidal sediments) and the EVOS. (ESC)

Response: The sampling for the sediment toxicity survey included 7 sites designated as unoiled or very lightly oiled. For the polar fractionation/toxicity study, one unoiled site was included for comparison. The detailed chemical information from all the sites will provide further basis for determining the sources of any toxicity that may be found.

Comment: Twenty "heavily oiled" sites were chosen for this study, but no other information is given: Are these sites representative? If so, of which of the oiled habitats? What range of grain size or organic carbon content was chosen? (UM)

Response: Sites were selected under Air/Water 2 to represent a broad range of characteristics and geographic coverage. Unoiled reference sites are included to permit assessment of oil-related toxicity.

Comment: Use of the Microtox test to assess sediment toxicity is of value only as a screening tool. This is a source of concern in

this study especially because it will be used to assess whether or not the polar fraction is more or less toxic than the complete sediment. (UM5)

Response: Microtox is used only as a screening device. It is expected that Microtox will respond to epoxides and free radicals, if present, even though the microorganism does not generate those compounds itself.

Comment: Only the toxicity study (Objectives A-C) includes field methods that are a part of this study plan. Sampling is restricted to the intertidal/subtidal areas of 20 heavily oiled sites and, therefore, probably is most representative of the worst case situation. (ESC)

Response: Results should not and will not be extrapolated from either the 2 heavily oiled sites used for the fractionation and toxicity testing of polar constituents or the 20 oiled sites used for the field toxicity survey. However, objective inferences may be drawn from these results regarding the magnitude and extent of potential toxicity to marine organisms and the relation of the toxicity, if any, to polar constituents.

Comment: Samples for whole animal sediment toxicity tests are not the same as those used for extraction, fractionation, and testing with the Microtox bioassay. Therefore, the results of these two phases of the project cannot be compared and extrapolations cannot be made about the contribution of polar degradation products of petroleum to the toxicity of oiled sediments to marine animals. (ESC)

Response: Objective inferences may be drawn from these results regarding the magnitude and extent of potential, if any, toxicity to marine organisms and the relation of the toxicity to polar constituents.

Comment: There is no explanation given for using *Mytilus edulis* instead of *Mytilus trossulus*, the species that was used in the bioaccumulation studies and that presumably is indigenous to the area. (UM)

Response: The purpose of the bioassays is to verify whether residual oil might exert some acute toxicity to indigenous organisms. *Crassostrea gigas*, not *Mytilus*, was used in the Air/Water 6 bioassays because of the availability of spawning stock at the time. *M. Trossulus* is the correct name for Pacific mussels previously referred to as *M. edulis*.

Comment: Although the authors state that well-established protocols exist for this assay, it is unclear from the references listed what they are basing this information on. Varying results are obtained in sediment toxicity bioassays depending on whether whole sediment, diluted sediment, pore waters, or elutriate are used. (UM)

Response: The purpose of the bioassays is to verify whether residual oil might exert some acute toxicity to indigenous organisms. Standard bioassay species and protocols are used for this purpose.

Comment: In determining the toxicity of sediments, a test with benthic larvae, which would be most likely exposed to these sediments, should be employed. The *Ampelisca* sediment toxicity study is well documented, but toxicity to additional species should also be assessed. (UM)

Response: It is desirable to work only with organisms that are indigenous to the spill area. However, the availability of test organisms and the fact that the protocols for certain historically used species are well established ruled out the use of local organisms.

Comment: One primary aspect of the toxicity of hydrocarbon metabolites concerns their susceptibility to be metabolized to electrophilic epoxides, a reaction prokaryotic microorganisms such as those used in the Microtox assay cannot perform. Consequently, the appropriateness of using the Microtox assay to assess the toxicity of metabolites is questionable. It is questionable whether methylene chloride will extract sufficient quantities of polar metabolites to address adequately their contribution and toxicity in these sediments. (UM)

Response: Microtox is only used as a screening device. It was expected that Microtox would respond to such epoxides and free radicals, if present, even though the microorganism does not generate those compounds itself. Mixtures of ethyl acetate and methylene chloride were used in the final study to ensure more complete extraction of polar constituents.

Comment: It is unclear whether gas chromatograph methods described in Technical Services 1 can be used to distinguish between weathered EVOS oil and oil from other sources for studies Air/Water 2 and 6. (ESC)

Response: The compounds analyzed under Technical Services 1 will include aromatic compounds and the C10-C34 alkanes, which will provide sufficient analytical information to describe different weathered states of oil and distinguish Prudhoe Bay crude oil from other sources.

TECHNICAL SERVICES

Comments on Technical Services - General

Comment: Most technical services studies are not detailed enough to be evaluated. (API, ESC)

Response: The Trustees disagree. Detailed documentation on analytical procedures, including: 1) data documentation and reporting and 2) quality control measures and the acceptance criteria associated with these procedures, as implemented by each laboratory analyzing NRDA samples, have been developed. The QA/QC standards are contained in Appendix A.

Comment: Technical Services appears to be little modified from the 1989 plan. (UM)

Response: The nature of the support provided by the technical services projects has not varied from the originally established quality control measures and procedures for data control, sampling, and reporting.

Comment: Technical Services is very limited in scope, providing descriptions of the chemical and histopathological analysis of samples only. Similar sections are needed for the other measurements being made, as well as some mechanisms to insure coordination between methods and sampling between different parts of the plan. (UM)

Response: Technical Services currently encompasses chemical analysis and mapping. Histopathology has been discontinued as a separate support service although continuing analysis of histopathology samples will be conducted as part of specific NRDA studies. Descriptions of protocols and methods for sampling and other measurements being made by NRDA studies are contained within the specific studies, cited references, and appendices to this document. Technical Services is intended to provide support of a kind required by many NRDA studies and this can best be accomplished by a single support function.

Comment: Due to concerns regarding the invasive tests conducted, the benefits of the histopathology study are questionable. (API)

Response: Histopathology is no longer addressed by a separate Technical Service program. Histopathology continues to be considered within specific studies as needed. Every effort is being and continues to be made to ensure that the number of animals collected is kept to a minimum and that individual takes are essential to assess injury.

Comment: The proposed audits of field and laboratory procedures, as described, are inadequate: only chemistry audits are mentioned. Other areas should be audited as well, such as sample analysis, biological observations, database input, chain of custody, and mapping. (ESC)

Response: Sufficient detail for adequate review is provided in Appendices A & B, and Technical Services Studio 1, 2, and 3.

Comments on Technical Services - Specific

Technical Services No. 1

Comment: Technical Services 1 will make extensive use of UV fluorescence, which is not always conclusive in distinguishing between aromatic compounds from the EVOS and the petrogenic or biogenic aromatic hydrocarbons from other sources. (ESC)

Response: UV fluorescence is being used extensively only for the analysis of bile for petroleum hydrocarbon metabolites and for the determination of oiled versus unoiled sites in Coastal Habitat. This method is well documented as an indicator of exposure to petroleum hydrocarbons (Varanasi et al.)

Comment: It is unclear whether gas chromatograph methods described in Technical Services 1 can be used to distinguish between weathered EVOS oil and oil from other sources in Air/Water Studies 2 and 6. (ESC)

Response: The compounds analyzed under this study will include aromatic compounds and the C10-C34 alkanes, which will provide sufficient analytical information to describe different weathered states of oil and distinguish Prudhoe Bay oil from other sources.

Comment: Insufficient information is given in Technical Services 1 and Appendix A to allow evaluation of analytical methods, adequacy of the number of samples analyzed, or sample identification procedures. (ESC)

Response: Detailed documentation of analytical procedures, including data documentation, reporting, quality control measures, and the acceptance criteria associated with these procedures, as implemented by each laboratory, has been developed. The number of samples to be analyzed is determined on a project by project basis by the Project Leaders in consultation with biometricians using the Technical Services 1 procedures.

Comment: The statement in the Quality Assurance plan for chemical analyses in Technical Services 1 and Appendix A that "unacceptable performance in the intercalibration exercise will result in the discarding of associated data" is unclear. Intercalibration after samples have been analyzed may result in the discarding of valuable data and may bias results. Data should instead be reported with qualifications. (ESC)

Response: To date, no laboratory analyzing NRDA samples has performed unacceptably in the intercomparison exercises. If this occurs, the data associated with that laboratory for that time frame will be flagged in such a manner that they will not automatically be incorporated into data retrieval.

Comment: The list of calibration compounds in Technical Services 1 is insufficient to distinguish *Exxon Valdez* oil from hydrocarbons from other sources. It focuses on C12-C20 alkanes and ignores the C21-C31 alkanes that can indicate whether sediment hydrocarbons are predominantly biogenic rather than from the oil spill. (ESC)

Response: The list provided in the plan is a minimum. Analytical data are being collected on C10-C34 alkanes.

Comment: The analytical methods of Objective A cannot be judged since no details were provided, other than a minimum list of compounds, which are probably calibration standards. (ESC)

Response: Detailed documentation on analytical procedures including data documentation, reporting, quality control measures, and acceptance criteria associated with these procedures, as implemented by each laboratory, has been developed.

Comment: Details of the QA/QC plan for sample collection procedures were not provided in Objective B and cannot be fully evaluated. It is unclear how the sample labeling plan guarantees "unique" sample numbers across the entire 1990 program. (ESC)

Response: See Previous Response.

Comment: Data should not be excluded or discarded simply because unnecessarily tight performance standards are being applied in Objective C. It is not clear from this objective what "associated data" means. (ESC)

Response: Data that do not conform to the established standards are flagged in such a manner that they will not be automatically retrieved into a data sort. Associated data means those data developed by the indicated laboratory during that time.

Comment: The audits proposed in Objective D are incomplete. (ESC)

Response: The audits proposed meet federal standards. Refer to the Toxic Substances Control Act, part 792, Good Lab Practices Standards.

Comment: Construction of a material balance on the fate of spilled oil is a complex task that will be compounded by the use of data generated by possibly inadequate analytical techniques. (ESC)

Response: The methods that will be used to construct a material balance on the oil are well represented in the literature. For references see Boehm, McKay, or Payne.

Technical Services No. 3

Comment: Although the necessity and goals of the geographic information system (GIS) are clearly laid out, no information is given as to how this is to be accomplished or what specific products will be available. Considering that in the Coastal Habitat study much of the 1990 activities will involve completion of processing of samples taken in 1989, data completion and management is clearly a problem. (UM)

Response: Implementation of Technical Services 3 objectives will be accomplished with an interdisciplinary mapping and analysis team using state of the art mapping science methods and technology. Both hard copy and digital map products are being made available to ongoing study participants.

Comment: Insufficient information is given in Objective 1 regarding the specific types of maps and analytical products to determine whether this program will provide valuable products in monitoring geographic distributions of data pertinent to the assessment of injury from the EVOS. (ESC)

Response: Map types and analytical products are litigation sensitive; however, accepted mapping science methods will be used recognizing all data limitations.

Comment: The specific objective concerning the type of database(s) to be developed and organization of data is not provided. (ESC)

Response: Development of database(s) will include a geographic component that will provide for commonality of data types.

Comment: There is insufficient information given to allow the reader to determine the adequacy of quality control on the inputting of data to the mapping process. There is nothing that indicates how the data, once it is in the mapping database, compares to the original data. (ESC)

Response: Technical Services 3 adheres to accepted mapping methods using state-of-the-art technology that includes quality assurance steps that compare data input with source information and with subsequent iterations of database development.

Comment: No information is given regarding the statistical treatment to be used to average data values for input to the mapping process. Similar problems exist with respect to database quality control. (ESC)

Response: Real data will be inputted to the mapping process. Source data will be used to verify database input and output.

Comment: It cannot be determined from the Plan whether objective, "multi-thematic atlases of pre-spill data" exist on the same scale as post-spill data. Thus, it is not possible to assess whether this work will contribute to the objective quantification of injury to resources or whether it is cost-effective. (ESC)

Response: Objective "multi-thematic" atlases of pre-spill data exist and are central to the objectives of Technical Services 3.

ARCHAEOLOGICAL RESOURCES

Comments on Archaeological Resources

Comment: The studies evaluating and quantifying injuries to archaeological resources are beyond the scope of the Trustees' authority as these resources are man-made under the definitions found in CERCLA and the Clean Water Act. Under these federal statutes, costs cannot be recovered for restoration, replacement, or lost use of such resources. Archaeological resources are addressed in other federal statutes, such as the Archaeological Resources Protection Act, and study of damages to these resources should not be funded under the NRDA. (API, ESC)

Response: A valuation of the committed use of the cultural attributes of natural resources, as well as the natural components of cultural sites, is properly within the CERCLA/Clean Water Act damage assessment process. While other statutes may address injuries to archaeological resources, they do not preclude damage assessment activities undertaken pursuant to the CERCLA/Clean Water Act.

Comment: This study is poorly discussed and supported. Objectives and field, analytical, and statistical methodologies are not adequately described to allow review and comment. (API, ESC)

Response: The objective of this study is clearly stated to be the assessment of injuries to archaeological resources as a result of the EVOS. The study design is to request proposals from the professional community to meet the objective of injury assessment most efficiently and then to award a contract to perform the study. Because archaeological investigations are by nature labor intensive and therefore costly, the approach adopted is to use sample sites and statistically project injury estimates. This statistical approach is similar to the random stratified approaches adopted in other damage assessment studies. Final approval of the methodology will occur when competing proposals to perform the study are evaluated.

Comment: This study does not take into account data gathered during beach cleanup. Much of the information to be generated by this study is already available to the Trustees because of the extensive beach surveys undertaken as part of Exxon's clean-up operations. Site survey and site selection efforts will duplicate Exxon's existing documentation. (API, ESC)

Response: The principal purpose of Exxon's beach survey work was to identify sites for cleanup. Archaeological investigations of the sites was limited. However, the data gathered by Exxon in 1989 and 1990 contributed to the development of a list of archaeological resource sites that were injured, from which selected study sites

were chosen. This study will intensively examine injuries through subsurface testing of sites and sampling of deposits to determine the extent of oiling contamination. Information obtained from Exxon-generated reports will be made available to investigators.

Comment: There is no explanation as to why surveys will be made in non-oiled areas. Site injury is a function of many factors (shoreline type, stratigraphy, location, degree of oiling, cleanup techniques and artifacts present) and the unique nature of individual sites, the range of their distribution and the diversity of time span make it inappropriate to extrapolate from control sites to oiled areas. (ESC)

Response: Archaeological sites are individually unique. As a result, the cost of investigating archaeological sites is high and the funds available to determine injuries are limited. Therefore, archaeological sites will be defined by site types and injuries will be determined from a statistically derived sample. In order to describe the population of sites most accurately and to give a basis for statistical treatment, a sample of study sites located in the general spill area was selected rather than biasing the study by only looking at oiled sites.

Comment: The costs of the study appear excessive. (ESC)

Response: Archaeological investigations are labor intensive and involve complicated and expensive laboratory analyses. Tests necessary to identify the presence of oil are costly. Additionally, the geographic study area is extremely remote. This factor causes very high logistical costs both for access and safety reasons.

Comment: There is insufficient information provided in the Plan to determine whether the methods to be employed will meet the standards and guidelines for archaeology and historic preservation set forth in 48 Federal Register 44716-44740 (September 29, 1983). (ESC)

Response: Because the Trustees are required to comply with applicable federal regulations, the procedures and investigators used to perform the study will be required to meet the standards presented by the Secretary of the Interior.

Comment: There is insufficient information to evaluate how the significance of historical properties, typologies, site

investigations, impacts resulting from interviews, soil column characteristics and analysis, radiocarbon dating of artifacts, vandalism, and erosion rates will be determined. (ESC)

Response: The significance of historic and prehistoric properties will be determined using processes outlined in existing federal regulations. The issue of site significance was addressed in the Memorandum of Agreement signed by Exxon, Federal agencies, the State Historic Preservation Officer, and Native Corporations. The validity of typologies, adequacy of site investigations, and effects of archaeological investigations will also be addressed following existing federal procedures and normal scientific archaeological standards. The degradation of spill-affected historic properties will be compared with properties that have not suffered oil spill-related injuries to arrive at rates of degradation.

Comment: There is no indication of methods for preventing bias from response workers and government employees who are interviewed from entering this study. Nor is there any information on how results will be used to quantify injury. (ESC)

Response: Information received from interviews will be evaluated for bias and verified. One of the goals of the study is to document injury to sites both quantitatively and qualitatively. Once the types of injury are estimated, those injuries can be projected statistically to the total body of archaeological data in the study area.

ECONOMICS

Comments on Economics Studies - General

Comment: Although some investigation of loss of private use values may be undertaken for reference, the NRDA process does not allow for recovery of such damages or for investigation for private interests. (API)

Response: The Federal Trustees do not intend to include loss of purely private use values in their damage claim.

Comment: The economic studies do not appear to be tied in any way to the Clean Water Act standards for measurement of damages based on cost of restoration. These studies attempt to estimate foregone use and non-use values without applying the results to the determination of whether restoration costs are grossly disproportionate to the value of the injured resource or the identification of the most cost-effective restoration alternative. The NRDA regulations do not permit the Trustees to recover for lost use values. (ESC)

Response: The Federal Trustees have not determined the extent to which the economic damage assessment will adhere to the NRDA regulations (43 C.F.R. Part 11). It is the Federal Trustees' intention, however, to base their claim on the cost of restoration, replacement and the acquisition of equivalent resources plus the interim lost use value of the injured natural resources as authorized in Ohio v. Department of the Interior.

Comment: It is not reasonable for the Trustees to expend large sums of money on studies of lost use before determining whether natural recovery will be chosen as the means of restoring the environment. (ESC)

Response: Lost use will continue to occur until natural and/or man-made recovery of the natural resources takes place. The Federal Trustees will continue to expend such funds as are necessary to accurately measure those lost uses for as long as it is prudent to do so. Length of recovery and restoration options are being studied in other components of this NRDA process and are communicated to the economic experts regularly.

Comment: Several of the economic studies are double-counting alleged damages: those relating to non-use losses of natives; changes in property values which include separately measured use value effects; and separately alleged losses in sport fishing and charter boat operations. There is no mention in the Plan of any methods for accounting for double-counting, which implies that the Plan will lead to an inflated damage award. (ESC)

Response: The steps that are necessary to eliminate all double-counting in the estimates of lost value will be taken. There will be no double-counting in the federal economic damage claim.

Comment: Since the State's economic studies are not included in the Plan, there is a great likelihood that the federal and state economic studies are not coordinated or overlap. This will inflate assessment costs, reduce study quality and will double-count losses. Failure to include the State's studies in the Plan makes comment on the federal economic studies meaningless. Studies not contained in the Plan are "not reimbursable or admissible in the NRDA under federal law." (ESC, NRDC)

Response: The Federal Trustees are not aware of the contents of the State of Alaska's economic studies plans. Furthermore, the State of Alaska has chosen not to include any information about their economic studies in this document. The Federal Trustees do not view comments on their own economic studies plans as meaningless in the absence of information about the State of Alaska's economic studies plans.

Comment: The economic studies lack sufficient description of study objectives and methodologies to permit a thorough evaluation. (ESC, API)

Response: The economic study plans are intended to provide general notice of the types of economic studies that are being carried out or are contemplated. The Federal Trustees believe that the descriptions of the studies are adequate for that purpose.

Comment: Since the assumptions, tasks and objectives identified in the 1989 and 1990 Plans were the same and a budget of $2.8 million was allocated for the economic studies in 1989, the status of the 1989 economic studies and expenditures made should be made available for evaluation of the 1990 study plans. (ESC)

Response: Information about the status of the previous years' efforts is litigation sensitive. The Trustees cannot reveal detailed information about that subject.

Comment: Many of the economic studies are undertaking expensive efforts to obtain data that should be available without cost from government and business sources. These include the demand for cruise ship tours, subsistence use data, identification of research studies underway before the spill, and data on the quantity and quality of fish. (ESC)

Response: All data necessary for estimating economic damages is being obtained at the least possible cost.

Comment: The Plan does not indicate that available substitutes for services affected by the spill, such as those existing in the unaffected areas of Alaska, Prince William Sound and the Gulf of Alaska, will be considered. Without this evaluation, the economic analysis will not be valid. (ESC)

Response: Where appropriate, availability of substitute resources and services will be taken into consideration in all of the economic studies.

Comment: The Trustees, in responding to public comment on the 1989 Plan, recognized that the NRDA regulations require the use of a 10% discount rate, but the 1990 Plan does not indicate that this rate is being used or, if it is not, how a different discount rate can be used. (ESC, APSC)

Response: The Trustees recognize that the NRDA regulations by reference to an Office of Management and Budget directive, require a 10% discount rate. Nevertheless, the NRDA regulations are optional, and there is no consensus among economists which would specify a particular discount rate as the only correct one.

Comment: The Trustees cannot select those portions of the regulations, such as the contingent valuation methodology, that inflate their claims and ignore others, such as the willingness-to-pay methodology. Willingness-to-pay is the only acceptable methodology for estimating damages using the contingent valuation technique. (ESC)

Response: The Trustees have selected economic methodologies that will result in the most accurate valuation of natural resource injury. The Trustees have not selected only those methodologies that will inflate their claims.

Comment: Economics 4, 8 and 9 are measuring speculative or potential, rather than committed, uses. Expenditures for this purpose are contrary to 43 C.F.R. Section 11.83(b). (ESC)

Response: The Federal Trustees will not include purely speculative damages in their natural resource damage claim.

Comments on Economics Studies - Specific

Economics Study No. 1 - Commercial Fisheries

Comment: This study fails to explain how it will exclude from consideration damages which are the subject of private economic claims. Hence double-counting will occur. They are not compensable under the laws and regulations that govern natural resource damage assessment. (ESC)

Response: The Federal Trustees have taken all steps necessary to eliminate double-counting from their final economic damage estimates. The Federal Trustees do not intend to include private damages in their claim.

Comment: There is no description of the methods to be used to measure the economic loss to seafood consumers. (ESC)

Response: The purpose of this plan is to provide public notice of the types of economic studies contemplated by the Federal Trustees. It is not intended to provide detailed descriptions of the specific methods being used owing to the litigation sensitive nature of the study.

Comment: The losses this study purports to measure are known already to be negligible. Salmon supply increased significantly in 1989 and prices decreased for reasons not associated with the spill. The net result did not have a detectable influence on consumer surplus. (ESC)

Response: The Federal Trustees are not aware of any studies that show that the EVOS caused only negligible losses to consumers of seafood products.

Comment: Modelling of the effects of the spill on seafood quality and quantity changes on consumers is unnecessary because quantity was substantially higher at every market level and because the State of Alaska assured that no quality-deficient seafood reached the market. (ESC)

Response: Appropriate data sets on the landings and values of Alaskan seafood products will be analyzed for evidence of quantity and quality changes caused by the EVOS. Other data, as appropriate, will also be collected and analyzed. Since it may be several more years before the spill's long-term effects on fish populations is known, it is premature to draw firm conclusions about the potential damages to consumers of seafood products.

Comment: There appears to be no relationship between this study and the numerous fish injury assessment studies. (ESC)

Response: This study will make use of the results of the fish injury studies, as appropriate.

Comment: Much of the data necessary to estimate commercial fisheries losses is available from state and federal sources, so the efforts to collect such data in this study are unnecessarily costly and duplicative. (ESC)

Response: The Trustees will use all accurate available data sources. No unnecessarily costly or duplicative data will be collected by the Federal Trustees.

Economics Study No. 4 - Public Land Effects

Comment: Nothing in the Clean Water Act or the NRDA regulations permits the Trustees to recover for damages such as those being measured by Economics 4: the purported losses are those to the commercial value of public lands if those lands are sold to a third party by the government. They are not natural resource losses. (ESC)

Response: The Federal Trustees believe that public lands constitute public natural resources. Thus, any change the EVOS caused in the value of public lands is a natural resource injury.

Comment: Description of the methodology of this study is extremely vague and insufficiently detailed to permit a thorough evaluation. (ESC)

Response: The purpose of this Plan is to provide notice to the public of the types of studies being carried out or contemplated. This notice is not intended to provide information sufficient for a thorough evaluation of all aspects of the studies.

Comment: The study does not identify the public lands to be included in the assessment. Damages cannot be assessed for lands not directly impacted by oil. (ESC)

Response: The study will identify all public lands that the Trustees believe were impacted by the EVOS.

Comment: The study cannot meet its objective of determining the change in market value of public lands simply by estimating pre-

and post-spill prices. It must take into account factors unrelated to the spill such as changes in interest rates, but there is no indication of the method by which this will be done. (ESC)

Response: This study will take into account all relevant factors appropriate for estimating damages. It is not the purpose of this Plan to present detailed information about the methods and data being used to estimate damages for this (or any other) category of loss.

Comment: The study must also factor in the effects of spill-related increases in land values. Land values in the affected area are influenced by the dominant role of public lands, use restriction, severe weather, poor access and low population density. Also, there is nothing in this study indicating methods for determining whether lands affected by previous spills are comparable to lands in this area or for determining the comparability of EVOS to prior spills. (ESC)

Response: This study will take into account all relevant factors appropriate for estimating damages. It is not the purpose of this Plan to present detailed information about the methods and data being used to estimate damages for this (or any other) category of loss.

Comment: This study will lead to the double-counting of some damages because damages for some uses of public lands will be covered by other studies, e.g., recreation and foregone use. (ESC)

Response: This study will not necessarily lead to double-counting of damages. The Federal Trustees will ensure that the final damage estimate does not contain any form of double-counting.

Comment: Reduced land values become actual losses only to the extent that sales actually occur during the period of depressed value, so the study must focus only on losses actually incurred, not hypothetical losses. (ESC)

Response: Property values in the region affected by the EVOS may have been damaged, regardless of whether the losses were actually realized through transactions which occurred during the period of depressed land prices.

Comment: The Plan incorrectly assumes that losses in sale prices of public land leased or sold in 1989 apply to all public land in the affected area. (ESC)

Response: The economic methodology contemplated for this study does not necessarily assume that all public land in the region has been adversely affected by the EVOS.

Comment: There is a great number of near substitutes for almost any parcel of land in Alaska, so compensable damages to land values should be very low, due in part to the fact that a large percentage of land in the state is publicly owned and is rarely subject to sale. Given these facts, it is likely that the study costs will be unreasonable. (ESC)

Response: There are many factors that contribute to the value of any given parcel of land. All relevant factors will be taken into consideration in the assessment of damages to public lands. The Federal Trustees will not incur unreasonable costs in the pursuit of the NRDA for this or any other category of loss.

Comment: Paired-sale data should not be used since it is not appropriate to compare pre-and post-spill selling prices. (ESC)

Response: Paired-sale data will be used in this assessment only when doing so is consistent with appropriate economic and legal theories.

Comment: There is no provision for the recovery of land value that stems from cleanup and restoration. (ESC)

Response: All damages to land values consistent with appropriate economic and legal theories will be estimated.

Comment: The status of the 1989 study and the corresponding expenditures should have been made available for review of the 1990 Plan since there was so little change in the study premises and objectives between the two years. (ESC)

Response: The purpose of this Plan is to provide the public with a general notice of the types of studies being carried out or contemplated for the NRDA. Hence, unless the type of study described in the Plans of earlier years has changed, there is no reason to revise the general description provided previously. Detailed information about the status of the studies and expenditures to date is litigation-sensitive and therefore has not been included in this public document. The Trustees believe that they have provided adequate information to achieve the intended purpose of this Plan.

Economics Study No. 5 - Recreation

Comment: This study fails to explain how it will exclude from consideration damages which are the subject of private economic claims. Hence double-counting will occur. (ESC) Nor does it explain how double-counting of recreational fishing and boat charters for sport fishing and sea kayaking and boat charters for kayak transportation will be avoided. Also, damages included in this study duplicate in part those included in Economics 4. (ESC)

Response: No duplication or double-counting will be permitted in the estimation of natural resource damages caused by the EVOS.

Comment: Economics 5 does not define "natural resource services" precisely, which may result in the underestimation of damages: recreational fishing is defined from the global perspective rather than by species of fish; no distinctions are made for the wide variety of camping activities in Prince William Sound. The categorization of recreationists is unrealistically simple and not useful. Visitors to the Sound normally engage in a multiplicity of activities that overlap rather than individual ones. Placing each recreationist into one category lowers the value of the experience of that recreationist in the wilderness of the Sound, which can underestimate damages. (NWF)

Response: The Federal Trustees have never suggested that they intend to categorize recreationists in such a way as to be "unrealistically simple" for purposes of the economic assessment. Recreation damages will be estimated using state-of-the-art methods consistent with sound economic theory.

Comment: The study's assumptions ignore the facts that the most popular sea kayak and charter boat destinations (College Fjords and Columbia Glacier areas) were unaffected by the spill and the fact that increased escapement due to closure of commercial salmon fisheries led to increased sport fishing catches. If considered, these facts would influence study design and scope. (ESC)

Response: The study design and scope have been influenced by all relevant information about factors such as salmon fishing, recreational use patterns, and areas impacted and non-impacted by the EVOS.

Comment: Without details concerning its application to this study, it is not possible to ascertain whether the use of contingent valuation will provide valid or reliable results. It is an unproven and controversial methodology. (ESC)

Response: The Federal Trustees believe that contingent valuation is an appropriate method for valuing natural resource injuries. Use of contingent valuation methodology was approved by the court in Ohio v. Department of the Interior.

Comment: It is not clear from this study whether losses to commercial providers of recreational services will be estimated. They should not be since compensation is available to the Trustees only for foregone public use of publicly owned natural resources. (ESC)

Response: The Trustees do not contemplate estimating purely private losses.

Comment: There is no description of the methodology to be used for determining the spill's effect on the demand for cruise ship tours to Prince William Sound. (ESC)

Response: This Plan is not intended to provide detailed descriptions of the various economic studies. The Federal Trustees believe that the study descriptions provided are sufficient to provide general notice of the types of studies contemplated.

Comment: There is not enough detail to assess how substitution will be accommodated. (ESC)

Response: The availability of substitutes will be considered in all studies that measure the value of goods for which substitute goods are available.

Comment: The Plan indicates that virtually no work on this study was carried out in 1989. It is important to obtain data relevant to the purposes of this study while it still can be recalled accurately by the source. (ESC)

Response: The Federal Trustees agree that much of the data is time-sensitive. The Trustees have made every effort to gather all data as expeditiously as possible.

Comment: There is no reference to which "existing model for recreational fishing in the KP area" will be considered, the criteria that will be used to determine its applicability, what will be done in the event that the model is determined to be inapplicable or the geographical area to be examined. (ESC)

Response: The Federal Trustees do not intend for this Plan to include all details of the damage assessment methods they will be using.

Comment: Much of the data to be acquired in this study, such as cruise line bookings and sport fishing catch rates, is available from federal, state and business sources. Duplicating this data is unnecessary and costly. (ESC)

Response: The Federal Trustees will use the most cost effective sources they can identify to obtain data necessary for the estimation of economic damages.

Economics Study No. 6 - Subsistence

Comment: Documentation of the study plan is inadequate and there is no explicit objective stated in the Plan. Methods are not provided. (ESC)

Response: The economic study plans are intended to provide general notice of the types of economic studies that are being carried out or are contemplated. The Federal Trustees believe that the descriptions of the studies are adequate for that purpose.

Comment: This category of alleged losses is the subject of other claims, including those by native groups. This study may double-count these losses. (ESC)

Response: The Federal Trustees will take all necessary steps to eliminate double-counting from their economic damage estimates.

Comment: Alleged losses of non-use values by subsistence communities are included in Economics 7 and 9. There is no method described in this study for distinguishing subsistence populations from the relevant populations in Economics 7. Nor is there a method provided for quantifying archaeological-based non-use values referred to in Economics 9 or reducing the non-use values estimated in other studies accordingly. These deficiencies will produce double-counting. (ESC)

Response: The Federal Trustees will take all necessary steps to eliminate double-counting from their economic damage estimates.

Comment: To the extent that contingent valuation will be used in this study, it should be noted that this is an unproven and controversial technique and there are not sufficient details in the

study description to determine whether its use will produce reliable or valid results. (ESC)

Response: The Trustees believe that contingent valuation is an appropriate method for valuing natural resource injuries. Use of contingent valuation methodology was approved by the court in Ohio v. Department of the Interior.

Comment: There is no indication that the study will take into account the actions undertaken by Exxon Shipping Corporation, such as delivery of food and materials and payment for cleanup employment, to offset losses sustained by subsistence groups and to explain why they ceased to rely on traditional sources. (ESC)

Response: The Federal Trustees will take into consideration all relevant factors appropriate for accurately measuring economic damages.

Comment: The description contained in the 1990 Plan indicates that virtually no work was done on this study in 1989. The Trustees should make available the expenditures and status of this study. (ESC)

Response: Detailed information about the status of the studies and expenditures to date is litigation-sensitive and therefore is not included in this public document.

Economics Study No. 7 - Contingent Valuation

Comment: To the extent the State is conducting a contingent valuation study, the rationale for the Federal government to conduct a similar one is not apparent. (NRDC)

Response: The state and federal governments are pursuing separate claims that are likely to be heard in separate courts. The federal government has no control over, or information about, the state economics studies. Therefore, the Federal Trustees are performing their own economic studies.

Comment: The Trustees are using contingent valuation techniques to determine the value of some resources which appear to be non-public. (API)

Response: The Trustees will not use contingent valuation, or any other economic methodology, to measure injury to any purely private resources.

Comment: Contingent valuation's reliability for non-use values, such as intrinsic value, is controversial. Such methods are not supported by the literature. Unless the Trustees exercise care in their design and implementation, the results of these studies may not be reasonable. They are not likely to provide valid or reliable estimates of damages in the circumstances of this case. (API, ESC,) The difficulty of separating the use and non-use components of a contingent valuation response dictate against use of contingent valuation in this study. (ESC)

Response: The Trustees are proceeding very carefully with their contingent valuation study which is being performed by recognized experts in the field and which will be peer reviewed by nationally renowned economists. There is no need to separate the use and non-use components of contingent valuation responses.

Comment: The public is poorly informed as to actual conditions in Prince William Sound. Before contingent valuation questions are asked, it is important to assure that the respondents are given accurate information. (API)

Response: Contingent valuation respondents will be provided the amount and type of information deemed most appropriate for accurately measuring the natural resource damages.

Comment: Economics 7 does not describe: the survey plan; the survey design; the methods by which survey results will be analyzed; the type of research to be conducted to determine the accuracy of survey instruments; the type of preliminary testing that will be done; the basis for conducting a nationwide survey; or the type of econometric analysis that will be used. (APSC, API)

Response: The economic study plans are intended only to provide the public with general information about proposed and ongoing studies. The Trustees believe that the published plans achieve that goal.

Comment: There is no explanation as to how Economics 7 will exclude the lost public land, recreation, subsistence, research, and archaeological values that Economics 4, 5, 6, 8, and 9 purport to measure. (ESC)

Response: The economic study plans are intended only to provide the public with general information about proposed and ongoing studies. The Trustees believe that the published plans achieve that goal.

Comment: The description of Economics 7 implies that that study will duplicate some portion of the state's economic studies. (ESC)

Response: The state economics studies are proceeding separately from the federal studies.

Comment: There is no legal basis for recovery of damages based on "intrinsic values." (ESC)

Response: The Trustees are obligated to study and to recover for all lost value to natural resources caused by the oil spill. Intrinsic values are a well-recognized component of the total value of a good, and the court in Ohio v. Department of the Interior held that use value is not the sole component of natural resource value.

Comment: Bequest values will not be reduced because full restoration of the natural resources will occur within a relatively short period of time. There cannot be losses of existence or bequest values for temporary injuries to natural resources. And option value losses should be small because future use is not expectedly to be adversely affected by the spill. (ESC)

Response: Bequest, option, and existence values may have been reduced by the EVOS because complete restoration of the injured natural resources may not occur and public perception of the value of the injured natural resources may be altered for an extensive time period.

Comment: Non-use value losses have been confined in the relevant literature to permanent, irreversible injury to unique resources. The extension in this study of non-use loss concepts to temporary injury to resources for which there are vast numbers of substitutes is contrary to the basic principles underlying these concepts. (ESC)

Response: There may have been permanent and irreversible injury to natural resources affected by the EVOS. Even if complete recovery does occur, contingent valuation is an appropriate methodology to use to measure decreased value of injured natural resources from the time of injury to the time of recovery.

Comment: Natural resource economists generally no longer consider option value to be a separate source of value. Hence the Trustees should not include option values as a component of value. Nor should the present discounted value of future use be included within the category of use value losses. Otherwise, double-counting will occur. (ESC)

Response: The Federal Trustees believe that all aspects of intrinsic value of the injured natural resources are recoverable. The Trustees do not believe that including present discounted value of any future lost use values will result in double-counting.

Comment: Use of willingness-to-accept measures in this study would contradict the NRDA regulations which provide that the only acceptable contingent valuation methodology requires use of willingness-to-pay measures. (ESC)

Response: Both willingness to pay and willingness to accept will be considered in the contingent valuation study. The Federal Trustees will use the measure that most accurately values the loss.

Comment: There is not an adequate description of the statistical design or quality assurance provisions of this study or any indication of the method for defining the sample population or drawing a representative sample. (ESC)

Response: The economic study plans are intended only to provide the public with general information about proposed and ongoing studies. The Trustees believe that the published plans achieve that goal.

Comment: The budget is inadequately explained. Of note is the $670,000 for supplies and equipment. (ESC)

Response: The economic study plans are not intended to provide detailed information about the budgets for various studies.

Comment: Because the 1989 and 1990 descriptions of this study are so similar, the Trustees should make known the progress and expenditures made to date. (ESC)

Response: The economic study plans are intended only to provide the public with information about proposed and ongoing studies. Detailed information about progress and budgets is litigation sensitive and cannot be provided in this public document.

Economics Study No. 8 - Affected Research

Comment: Loss of information associated with the interruption of scientific studies does not constitute a natural resources injury compensable under relevant statutes or DOI regulations. (API)

Response: The Trustees believe that the relevant statutes and the DOI regulations entitle them to recover for losses to the various services provided by the natural resources. One such service is the provision of scientific information that may be learned through scientific studies.

Comment: This study is to account for the cost of resources expended on research programs affected by the spill, but these expenditures should be the subject of private claims by the research program sponsors, not the Trustees. They are not natural resource injuries for which recovery can be had under the relevant statues or the DoI regulations. And whatever losses in knowledge might have occurred will be offset by the knowledge gained as a result of spill-related research. (API, ESC)

Response: The loss of scientific information provided by public natural resources is a public loss that the Federal Natural Resources Trustees should value. The Trustees do not view the research expenditures necessitated by the EVOS as a public benefit.

Comment: There is no identification of the research activities that were delayed or canceled as a result of the spill. Thus, it is not possible to determine whether the study costs are reasonable. (ESC)

Response: The study of affected research programs will inventory the research activities that were damaged or destroyed by the EVOS. These study plans and their budgets were intended only to provide the public with general information about the studies, not to reveal detailed information about the plans themselves or about the corresponding budgets.

Comment: The Plan does not set forth the criteria that will be applied to assure that assessment is directed to committed uses of the resource. (ESC)

Response: The "committed use" requirement derives from the NRDA regulations which are optional. Thus, the Trustees need not limit their studies to committed uses of the injured natural resources. Nevertheless, the Trustees do not intend to measure losses associated with purely speculative uses.

Comment: The Plan fails to set forth how the "total project costs, extra sums expended amounts spent on each study" will be used to evaluate research losses. (ESC)

Response: The economic study plans are intended only to provide the public with general information about proposed and ongoing studies. The Trustees believe that the published plans achieve that goal.

Comment: Because the 1989 and 1990 descriptions of this study are so similar, the Trustees should make known the progress and expenditures made to date. (ESC)

Response: The economic study plans are intended only to provide the public with information about proposed and ongoing studies. Detailed information about progress and budgets is litigation sensitive and cannot be provided in this public document.

Economics Study No. 9 - Archaeological Damage

Comment: There is no explanation for inclusion of the remains of past human activity within the definition of "natural resources." (ESC)

Response: A valuation of the committed use of the cultural attributes of natural resources, as well as, the natural components of cultural sites is properly within the natural resources damage assessment process.

Comment: The Plan contains no methods for assuring that double-counting will be avoided. This study potentially will double count the following alleged loss of value of archaeological resources as tourist attractions, which is also being studied in Economics 5, and archaeological science value, which is also being assessed in Economics 8. As to the latter, "intrinsic values" held by native groups will be counted three times unless there is some available method for dividing this value into subcomponents for existence values of archaeological resources, existence values for cultural heritage and culturally-derived intrinsic values held by native groups as members of the general population. (ESC)

Response: The Trustees note these concerns and intend to perform their studies so as to avoid double-counting.

Comment: There is no description of the methods for measuring economic damages and no explanation for valuation of allegedly damaged sites. (ESC)

Response: The economic study plans are intended only to provide the public with general information about proposed and ongoing studies. The Trustees believe that the published plans achieve that goal.

Comment: There is no identification of the unique archaeological sites that have value as tourist attractions. (ESC)

Response: All archaeological sites are unique and may have a use value as tourist attractions.

Comment: Because the 1989 and 1990 descriptions of this study are so similar, the Trustees should make known the progress and expenditures made to date. (ESC)

Response: The economic study plans are intended only to provide the public with information about proposed and ongoing studies. Detailed information about progress and budgets is litigation-sensitive and cannot be provided in this public document.

RESTORATION PLANNING

Comments on Restoration Planning - General

Comment: The Restoration Planning Project does not provide enough information on objectives or on field, analytical and statistical methodologies to permit adequate review. (ESC)

Response: The objective of the 1990 plan was to provide summary information on individual studies, adequate for reviewers to understand the scope of the study and the interrelationships between studies, as well as the scope of the overall damage assessment program.

Comment: In order for the public to effectively participate in the restoration process, the results of the feasibility studies are needed. (NRDC)

Response: The information in the 1990 plan was provided to give the public a general understanding of restoration activities to be conducted in 1990. Additional information on the results of the feasibility studies will be published in a Federal Register Notice.

Comment: Many of the components of the restoration program are actually research. The program develops and tests unproven methods, such as the murrelet dawn detection technique, that do not focus on restoring the ecosystem. (ESC)

Response: Identifying and developing technically feasible restoration procedures for natural resources and services affected by the spill is an objective of restoration planning. Restoration will focus broadly on the recovery of ecosystems as well as individual components.

Comment: There is no information in the Restoration Planning Project as to the extent to which results of the technical studies were considered, if at all, in creating its objectives. Without such coordination, the undertaking of restoration studies is premature. (ESC)

Response: The restoration process is a dynamic process that allows for the incorporation of new information as it becomes available. The objectives for restoration include incorporating the results of technical studies in the selection of any restoration measures.

Comment: The Plan inadequately deals with the role to be played by natural recovery in the restoration process. The literature regarding historical spills indicates that natural recovery is a viable restoration option and one to be preferred. And the

extensive natural recovery that has already occurred makes natural recovery the most cost-effective and environmentally sound restoration option. (API; APSC; ESC)

Response: Natural recovery monitoring will help determine the nature and extent of any natural recovery that is occurring. If natural recovery appears to be adequate, and within a reasonable time-frame, no direct restoration projects will be implemented. Information on the adequacy of natural recovery is central to determining whether to implement restoration actions or to allow injured resources to recover on their own.

Comment: The Plan assesses damages regardless of the prospects for natural recovery. Many of the studies are designed to demonstrate only that there are differences between oiled and unoiled areas without any consideration of whether these differences result in lost use or whether it would be desirable to correct these differences with restoration measures. (ESC)

Response: Identifying injured resources is the first step in the restoration process. Additional steps include determining the need for restoration, identifying potential restoration alternatives, evaluating potential restoration alternatives, implementing restoration alternatives on a continuing basis and evaluating the effectiveness of restoration activities. Even if natural recovery is deemed adequate, the Trustees are authorized to recover the lost use value of the resource during the period of recovery.

Comment: There is no connection between the restoration alternatives set forth in the Plan and the economic work evaluating the need for restoration and determining whether any of these projects are supportable in light of natural recovery. (ESC)

Response: An integral component of the restoration planning process is to determine the nature and pace of natural recovery of injured resources, and identify where direct restoration measures may be appropriate. All proposed restoration alternatives will undergo economic and environmental analyses to determine whether these projects are justified in light of natural recovery.

Comment: Restoration studies are only necessary if technical studies show that a resource will be adversely affected for a long period of time. Restoration studies that are being conducted before the results of the assessment studies are available must assume that all resources are injured and will require restoration measures. This approach requires the unnecessary expenditure of monies for feasibility studies and literature searches concerning resources that are later determined not to require active restoration measures. While this approach may shorten

implementation time once the damage assessment process is over, it unwisely expends resources with little, if any, hope of benefit. (ESC)

Response: The Trustees disagree that restoration studies are only necessary if a resource will be adversely affected for a long period of time. Restoration studies may concern any degree of injury to a natural resource in order to determine whether to enhance natural recovery. During the course of the NRDA studies, where the nature of the resource injury is reasonably clear, and where no alternatives would be foreclosed, it may be desirable to begin implementation of certain restoration activities prior to the conclusion of the NRDA studies and a final restoration plan.

Comment: The focus of the Plan should be redirected toward the identification of alternative restoration strategies. The Plan incorrectly assumes that all resources were injured and that additional research is needed. (ESC)

Response: The Trustees have determined that in some instances they can begin identification of restoration strategies, but they have not obtained a full picture of injuries to all resources and for this reason will continue to study certain resources. When appropriate, further study of particular species will be discontinued. The Plan does not assume that all resources were injured; rather the Trustees are obligated to uncover injuries to all natural resources.

Comment: The Plan fails to focus on restoration. The restoration section of the plan is too cursory and the assessment therefore will not be cost-effective or produce a usable result. Cost-effectiveness does not appear to be a criterion of the Plan and does not play a role in the identification and selection of feasible restoration measures. (API, APSC)

Response: Restoration is receiving increased emphasis as the results of the damage assessment studies are analyzed. Cost-effectiveness is one of several criteria used to determine the appropriateness of a restoration option.

Comment: Thus far the Trustees have attempted to identify restoration approaches that have been used in the past, and then have pursued feasibility studies for other methods which may be costly or less proven. (API)

Response: Restoration options that have worked in the past or have known potential are the first options that were evaluated. Feasibility studies focus on identifying methods that are not as well-established in the sub-arctic conditions of the oil spill area.

Comment: Implementation of restoration strategies should only be undertaken at this stage if their funding does not diminish that available for damage assessment and they are limited to funding urgently needed acquisition projects or initiating pilot restoration projects that have a firm foundation in restoration studies that have been completed and analyzed. (NWF, NRDC)

Response: The Trustees and EPA view the entire restoration process as dynamic and evolving. As information about injuries, resource recovery, restoration methods or costs becomes available, certain activities may be recommended and implemented prior to completion of all damage assessment studies.

Comment: Any restoration projects conducted before the assessment is complete should be funded separately. Although the plan refers to pilot restoration projects, many of the experts consulted have stated that only after several years of damage assessment have been completed can a decision be made regarding the restoration measures to be undertaken. (NRDC)

Response: Any restoration projects that may be implemented prior to the completion of the assessment process will not be funded with monies appropriated for damage assessment activities, but will be funded separately. Restoration projects that are urgently needed to protect or restore injured resources may be implemented if they do not disturb ongoing damage assessment studies.

Comment: The types of restoration projects considered in the Plan are limited. More attention should be paid to acquisition of equivalent assets such as reacquiring timber rights in Prince William Sound and buying back the Bristol Bay oil leases. (NWF, NRDC)

Response: Acquisition of equivalent resources is one restoration option being evaluated.

Comment: Although Ohio v. Department of the Interior indicated that restoration or replacement of resources is the object of damage assessment, it also recognized where costs were grossly disproportionate to loss, such restoration should not be undertaken. (API)

Response: The value of the resource being restored, and the cost of restoration options, will be evaluated before any recommendations to conduct restoration projects are made.

Comment: Few restoration projects are scheduled for action. Restoration projects now consist primarily of workshops, public meetings and comment, and additional feasibility studies. Most of the restoration research remains piecemeal. (API)

Response: As more information becomes available on the nature and extent of damaged resources, additional restoration options will be identified. Workshops, public meetings and comments were, and will continue to be, solicited to help identify possible restoration options.

Comment: Feasibility studies are supported in advance of more expensive restoration activities when restoration has been justified and the realistic means for restoration have been found. Feasibility studies should be realistically selected from methods that have been successfully used in the past. (API)

Response: Due to the dearth of restoration information related specifically to the spill area, feasibility studies may be conducted in the oil spill area using methods that previously have not been employed in the sub-arctic environment as well as well-established methods that have been identified through the damage assessment process.

Comment: The 1990 Plan improperly focuses on potential injuries to natural resources without analyzing the need for restoration or the means to restore damaged resources, replace those that cannot be restored or acquire equivalent resources if restoration is required. Thus, the Plan does not provide a reasonable basis for recovering damages under the Clean Water Act or the NRDA regulations. (ESC)

Response: Before appropriate restoration activities can be fully implemented, it is necessary to make a tentative conclusion regarding natural resources injury. Restoration under the DOI regulations is a four step process: (1) The injured resources are identified; (2) The extent of injury is quantified; (3) A restoration methodology plan is developed to the level of detail required to determine the cost of restoration; and (4) After litigation or settlement, a final restoration plan is developed. The Trustees are acting in a manner consistent with these regulations.

Comment: Section 311(f)(4) and (5) of the Clean Water Act clearly makes the cost of restoration, replacement or acquisition of equivalent resources the exclusive measure of damages. There is no authority for recovery of lost use values. Lost use values can be used only to determine whether proposed restoration techniques are grossly disproportionate to the value of the injured resource and/or to determine the cost-effectiveness of various alternatives for achieving restoration. The Plan ignores this concept. (ESC)

Response: While lost use values may be used for the purposes suggested above, Ohio v. Department of the Interior, 880 F.2d 432 (D.C. Cir. 1989), makes it clear that lost use values may also serve as a measure of damages under section 311 of the CWA.

Comment: The Clean Water Act and the NRDA regulations refer only to "acquisition of equivalent resources." There is no authority for the Plan's expansion of this concept to include acquisition of equivalent goods and services. (ESC)

Response: While the use of NRDA regulations is optional, the regulations generally define "acquisition of the equivalent" as the substitution of an injured resource with a resource that provides the same or substantially similar services. 43 C.F.R. § 11.14(a).

Thus, any restoration option that includes the acquisition of equivalent resources therefore, properly may consider the services those resources provide, both to the ecosystem and to humans.

Comment: The Plan contemplates calculation of natural resource damages independent of the cost of reasonable restoration activities for the recovery of natural resources affected by the spill. This contradicts the fundamental purpose of the damage assessment, which is restoration. (ESC)

Response: The Trustees are directing the damage assessment and restoration planning processes with the objective of restoring injured resources. As indicated in Ohio v. Department of the Interior, the cost of restoration is not the sole measure of damages.

Comment: The Plan fails to include cost-effectiveness criteria in its evaluation of restoration alternatives. It refers on page 333 only to the identification of costs of implementation of restoration measures without referring to the benefits associated with those measures. And on page 336, the list of criteria for selecting restoration feasibility projects makes no reference to any requirement that restoration be more cost-effective than natural recovery. (ESC)

Response: The services provided by the resource, as well as the cost of implementing the restoration measure, will be evaluated before any restoration option is selected. The requirements for restoration include cost-effectiveness and the standard that the cost of the restoration measure not be grossly disproportionate to the value of the resources or services restored.

Comment: The Plan seems to assume that the environment must be restored to a pristine state. Support for this is not found in the Clean Water Act, the NRDA regulations or in Puerto Rico v. S.S. Zoe Colocotroni. Restoration measures should simply return or replace resource services to their baseline condition. (ESC)

Response: The intent of the restoration process is to return the injured resources to their baseline condition. This includes not only their biological condition but also their ability to provide the previous level of services.

Comment: The Trustees are responsible for selecting a cost-effective restoration program; the public's participation in this process is unproductive since the public does not have any independent knowledge about injuries or restoration needs. Public meetings held to develop lists of restoration ideas create expectations in the public that are not justifiable given the actual state of the environment. (ESC)

Response: The Trustees believe that public involvement is an important part of the restoration process. The commenter's desire to increase the influence of responsible parties while excluding the public is inconsistent with the goals of the restoration process.

Comment: The Trustees alone are responsible for choosing active restoration measures. The restoration project's emphasis on public involvement is contrary to the regulatory requirements since it is not cost-effective and distracts the Trustees from focusing on the technical information needed to identify whether specific restoration measures are needed. (ESC)

Response: While the decision to plan for implement restoration activities does rest with the Trustees, they have determined that public participation is important to the damage assessment and restoration planning process. To invoke the public in this process is not contrary to the assessment regulations and assists the Trustees in identifying information important to the restoration process.

Comments on Restoration Planning Activities - Specific

Restoration Technical Support Project No. 1

Comment: The Introduction's statement that "an additional more formal round of peer review is not possible" implies that the "comments received at the technical workshop and series of public meetings" were part of a review process. These meetings were part of an informational effort, not a review process. This statement also implies that the projects were conceived and initiated hastily. They should have been conceived during the winter and aired for comment by interested parties before they were undertaken. (ESC)

Response: Comments received during public technical workshops and meetings were considered during the process of proposing feasibility studies for the 1990 field season. In addition, experts were consulted during other non-public technical workshops.

Comment: The peer review process described appears to be flawed and may generate biased comments. Some of the peer reviewers may have a vested interest in the outcome since they are part of the NRDA process. No information about the reviewers is provided to ensure that such bias does not occur and that a thorough technical review will be made. (ESC)

Response: It is not necessary to list the names of individuals providing expertise in order to review the validity of the studies. Every effort has been made to ensure that a balanced, objective review occurs for each study.

Comment: The cost-effectiveness of this project's review of 1990 feasibility study results is questionable given that those projects are not justified. (ESC)

Response: The cost of this study is reasonable. The peer review process ensures that proposed feasibility studies are appropriate for implementation.

Restoration Technical Support Project No. 2

Comment: This project should have as its objective natural recovery. (API)

Response: The goal of this project is to create a database of information that will help identify areas where direct restoration is appropriate.

Comment: Acquisition-based restoration studies, such as Project No. 2, are premature and unwarranted since there has been no showing that impacted resources and their respective services cannot be restored or replaced. (ESC)

Response: This project is designed to provide information necessary to determine appropriate restoration procedures that are not limited to acquisition.

Comment: This project is neither cost-effective nor focused. It obtains, translates and analyzes data for all the major resources instead of concentrating only on those resources that are in need of restoration efforts. This study's support of off-site habitat acquisition is premature since it has not been shown that impacted habitats cannot be restored. (ESC)

Response: It is appropriate to have a database that shows the status of all resources potentially impacted by the oil spill so that all reasonable restoration options can be analyzed. It is intended to provide a base from which candidate sites for restoration or acquisition can be identified.

Comment: No information is given for evaluation of the type, amount or usefulness of the information to be integrated, the procedure to be used or any quality assurance checks to be employed. And it is unclear whether natural recovery processes will be incorporated into the final result. (ESC)

Response: The information is being reviewed to ensure that it is in an appropriate format for use in the overall restoration planning process. The information provided may also prove advantageous for documenting natural recovery processes that may be occurring.

Restoration Technical Support Project No. 3

Comment: There is no basis for this type of study given that there has not been an identification of injuries requiring restoration. This approach to identifying and developing restoration plans is neither focused nor cost-effective. And there is no consideration given to the ability of the natural resources damaged to recover naturally. (ESC)

Response: This project established a process for developing and reviewing feasibility studies to be considered for implementation in 1991. No decisions have been made about which studies to actually carry out, pending further evaluation of damage assessment

study results. The ability of natural resources to recover naturally is being taken into account; one of the feasibility studies considered would explore methods for monitoring of natural recovery rates.

Comment: There is not enough information given to evaluate the nature and content of the meetings or how future project plans will be more fully developed. (ESC)

Response: More information will be provided about feasibility study proposals prior to implementation in the field.

Comment: There is no way to determine whether and how cost-effectiveness criteria will be considered and whether the focus is solely on restoring oil-spill related injury. The artificial reef project is suspect because there are no confirmed fish kills, reefs were not impacted by oil, and water quality is good. (ESC)

Response: Cost-effectiveness criteria will be considered before implementation of any restoration project, and one of the purposes of conducting feasibility studies is to establish the costs associated with implementation. Construction of artificial habitats for fish and shellfish can enhance productivity and may be one means of restoring damaged population. No decisions have been made about the for, or appropriateness of, such measures in the oil-spill environment. It was cited here as an example of the type of restoration project for which a feasibility study might be need.

Feasibility Study No. 1

Comment: This feasibility study is unnecessary since there is evidence that this resource is recovering rapidly. Recruitment has proven to be effective for restoring oiled shoreline areas, so the benefits of natural recovery will far outweigh those of any of these restoration efforts. (ESC)

Response: Based on further surveys conducted prior to actual field work, the study was modified to determine the causes of variation in fucus recovery and document the extent of natural recruitment in areas disturbed by oil and cleanup efforts. Understanding the causes of natural variation in recruitment may suggest restoration measures to enhance the natural process.

Comment: The majority of this study appears to be research and should not be funded under the NRDA program. Objectives B, C, D and E should only be considered if Objective A reveals that there is a definite need. Otherwise, implementing all of these objectives at the same time is not cost-effective. (ESC)

Response: Objective A was the primary focus of the 1990 study. Objectives B, C, D, and E were modified based on the results of natural recovery monitoring.

Comment: Objective A may overlap with, or duplicate, work being performed in Air/Water 2 or Coastal Habitat 1.

Response: Objective A was similar to objectives in Coastal Habitat 1. However the studies looked at different aspects of the environment and close coordination prevented overlap and duplication.

Comment: Considering the potential for natural recovery, the advantages of transplanting *fucus* are not well discussed. The success of this project is questionable. (API)

Response: The project was modified and no transplanting occurred in 1990.

Comment: Objective C is confusing since *fucus* has spores rather than seeds. And the high energy environment of Prince William Sound will create a dispersal of planted spores greater than the 1 meter noted in the study. (API, ESC)

Response: The word seeding was used in a general sense to mean artificial establishment of *fucus* in barren areas. *Fucus* embryos are dispersed from the parent plant.

Comment: The dispersal test for oiled areas treated with differing cleanup methods is basic, general and unnecessary research. (API)

Response: The study was modified to eliminate this part of the project in 1990.

Comment: There is insufficient information given regarding field methodologies. Although three methods are referred to in the field tests, only two are specifically mentioned. The lack of detail on types of habitat, measured parameters and statistical methods will leave the findings of this study open to challenge. (ESC)

Response: The field methodologies and statistical methods were subject to evaluation to ensure they were valid.

Comment: There is insufficient information concerning the laboratory experiments to evaluate them. (ESC)

Response: The study was modified, and laboratory experiments were conducted as part of this study.

Comment: The statement in the introduction to this study regarding the reduction of *fucus* over large areas fails to consider the vertical distribution of *fucus*. Most *fucus* below the lower intertidal would have suffered little impact from oiling or cleanup. It therefore remains a diversified source of spores for recruitment. (ESC)

Response: The upper edge of the *fucus* zone is in a highly hostile environment where it is difficult for plants to become established. *Fucus* living below the intertidal zone were taken into account in the design and execution of the study.

Feasibility Study No. 2

Comment: The reestablishment of grazers and predators will not restore the ecosystem if primary producers on which the grazers feed are not present. (API)

Response: The study also examines the recolonization of primary producers.

Comment: As the larvae of rocky intertidal species are pelagic, it is likely that the community will recover naturally within a few years, without planting species. (API)

Response: The study examines the rate of natural recovery to determine if it is sufficient or can be enhanced by artificial means.

Comment: The term "enhancement plots" mentioned in the study description is unclear. (API)

Response: Enhancement plots are experimental sites that were established.

Comment: Predator exclusion studies may be basic scientific research beyond the scope of the DoI regulations. (API)

Response: Predators are a variable in the ecosystem that need to be experimentally controlled to identify the potential impacts of EVOS.

Comment: This feasibility study is unnecessary since this resource is recovering rapidly. And cleanup techniques were designed to minimize further injury, thereby leaving a good source of fauna available for recruitment. It is more in the nature of research than damage assessment. (ESC)

Response: The study was conducted to determine if it was reasonable to continue exploring restoration of an intertidal ecosystem heavily impacted by the EVOS. The Trustees disagree with the general assertions of the review that the resource is recovering rapidly and cleanup techniques minimized injuries.

Comment: There is insufficient information given to evaluate how the feasibility of enhancing colonization of key species and recovery rates will be determined and statistically verified. (ESC)

Response: The study was technically and statistically reviewed to ensure its design is valid.

Comment: There is no information on the source or selection of limpets as grazers and *Nucella* and *Leptasterius* as predators to be the key intertidal species as a baseline for measuring recovery. (ESC)

Response: *Nucella* and *Leptasterius* are important predators in the intertidal community and are likely to have an impact on the community structure. They both have limited dispersal capability and are likely to have been impacted by the oil spill. There is ample literature that identifies limpets as critical grazing components in the community structure.

Feasibility Study No. 3

Comment: This feasibility study is unnecessary since this resource is recovering rapidly. And cleanup techniques were designed to minimize further injury, thereby leaving plenty of growth available for recruitment. (ESC)

Response: Beach wild rye appears to be recovering at most locations. At some sites recovery is slow or non-existent. These sites are subject to erosion and will require intervention to mitigate otherwise deleterious effects. The actual number of sites and the type of intervention necessary will be determined after the 1991 spring shoreline assessment. Although cleanup techniques may have been designed to minimize injury, the actual conduct of the cleanup did result in injury to beach wild rye at some locations.

Comment: Restoration methods cannot be evaluated because there is no information given on the "well-established techniques for restoring rye grasses." (ESC)

Response: Only limited information was given on restoring rye grasses since the methods are simple, have been used successfully for years, and are commonly known.

Comment: There is not enough information available to judge the cost-effectiveness of this study. The objectives, even if necessary, should be phased so that B and C are only carried out if it is determined from Objective A that restoration will be necessary. (ESC)

Response: This study determined that there are sites that need restoration and that given the injury observed to date, a pilot project is not necessary before restoration is implemented. Sites to be restored will be determined after the 1991 spring shoreline assessment.

Comment: The information to be gained from this study is not worth a full-scale beach wildrye restoration project. It is not appropriate to identify and prevent erosion which may occur for reasons unrelated to the oil spill. (ESC)

Response: Beach wildrye sites will be restored where there is a danger of further injury if the sites are not restored. There has never been the intent of the Trustees to restore beach wildrye just to study restoration methods. The intent is to identify and prevent erosion for reasons related to the EVOS.

Comment: Too little information is provided to evaluate the criteria used to establish the site potential for wildrye restoration. The mere presence of oil during a site visit does not necessarily mean that there is injured beach wildrye in need of restoration. This grass can grow well even in the presence of oil. (ESC)

Response: The need for wildrye restoration is based primarily on the potential for natural recovery or the lack thereof and the likelihood of continuing erosion if restoration measures are not implemented. The Trustees are aware that beach wildrye can survive in the presence of oil.

Feasibility Study No. 4

Comment: Acquisition-based restoration studies, such as this one, are premature and unwarranted since there has been no showing that impacted resources and their respective services cannot be restored or replaced. (ESC)

Response: Marbled murrelets and harlequin ducks were killed by oil from the spill. Such injury warrants small scale feasibility studies to help determine the need and practicality of possible restoration activities that may be necessary in the future.

Comment: This study is poorly defined. Identification of upland habitats used by murrelets and harlequin ducks is not instructive of habitats used by other species. This study should identify instead scarce habitat types or habitat types used by the greatest number of species (or the species most vulnerable to disturbance or disruption) or those habitats most threatened by human activities. (NWF)

Response: Injury to these species necessitates an understanding of their critical upland and marine habitat.

Comment: Objective E of this study is ambiguous and cannot be evaluated without a definition of the scope of the term "full-scale restoration project concerning upland habitats." If these habitats have not been injured, there is no need for restoration. (API, NWF)

Response: Objective E of restoration feasibility project #4 was not carried out in 1990.

Comment: The budget for Restoration Feasibility Study No. 4 is disproportionately small, especially when compared to that for Restoration Feasibility Study No. 5. (NWF)

Response: The goal of each restoration feasibility project is to accomplish its goals in a cost-effective manner. People and equipment were jointly shared by projects, thus enabling a very modest budget to accomplish the primary tasks.

Comment: Evaluating new research methods such as the dawn detection technique for marbled murrelets is inappropriate. This work is research. (ESC)

Response: The dawn detection technique for marbled murrelets has been used in other west coast areas with some success. Thus, testing its applicability in Alaska was within the scope of

feasibility project guidelines. Because it is not known where marbled murrelets nest in PWS, this must be determined before other more specific restoration projects can be developed.

Comment: Insufficient information is provided to evaluate whether the monitoring of two species of birds can provide sufficient data to develop a feasibility study or full-scale restoration project. (ESC)

Response: The type of data provided in the project descriptions is limited due to the need to keep specific information confidential pending potential litigation.

Feasibility Study No. 5

Comment: Acquisition-based restoration studies, such as this one, are premature and unwarranted since there has been no showing that impacted resources and their respective services cannot be restored or replaced. (ESC)

Response: This study will provide background information on the oil-spill area and adjacent lands and will also serve to identify potential sites for restoration projects.

Comment: The description of Restoration Feasibility Study No. 5 is too vague. It is not possible to ascertain whether it will review an appropriate number of potential equivalent assets. (NWF)

Response: The focus of the study is on the entire area influenced by the EVOS.

Comment: The study indicates that equivalent resources will be acquired. There is no connection between timber land or land proposed for development and lands affected by the spill. (API)

Response: This study is looking at the status of upland resources and the relationship of that land with resources impacted by the EVOS. No decision has been made to acquire upland resources.

Comment: The assessment of alternative cultural sites is not appropriate as they are not natural resources. (API)

Response: Acquisition of cultural sites is one option mentioned by the public as a possible restoration measure. A valuation of the committed use of the cultural attributes of natural resources, as well as the natural components of cultural sites, is properly within the NRDA process.

Comment: Much of this study does not appear to be related to areas affected by the spill; rather, it appears to be data-gathering. Considering the large amount of information that has been gathered, additional mapping is neither warranted nor cost-effective, without knowing which, if any, natural resources should be considered for off-site habitat acquisition. (API, ESC)

Response: The Trustees disagree. The results of this study will help identify the upland resources that may assist in the recovery of injured resources if acquired.