Pacific Coast Oil Spill Project

Second Workshop on Preliminary Experimental Design November 13/14, 1991 Seattle, Washington

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FOREWORD

This summary is the seventh in a set of discussion and planning documents, related to a federal government initiative for experimental oilspill research to improve our understanding of both the effectiveness and impact of different cleanup techniques applied to oiled shorelines.

The November 1991 workshop was the second in a series of workshops planned to fully develop the experimental design of the Pacific Coast Oil Spill Project (refer to Harper 1991 for a summary of the first workshop held in December 1990).

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CONTENTS

1.0 BACKGROUND AND WORKSHOP OBJECTIVES

The participants in this workshop represented a broad range of organizations (including specialist consultants and government agencies in the United States and Canada - see attached listing). In each case, the individual either had a direct stake in the outcome of the project (e.g. Canadian Petroleum Association), a direct involvement in the project design process (contract consultants), or input into the environmental review process affecting program approval through the Canadian Environmental Assessment Review Process (Department of Fisheries and Oceans).

The participants were deliberately selected for their knowledge of a range of technical issues affecting shoreline clean-up and recovery (including geomorphology, hydrocarbon sampling, and biological impacts). A number of the participants have worked extensively in scientific monitoring of the *Exxon Valdez* and other large-scale spills and are able to contribute the benefits of their practical experience (e.g., NOAA, Woodward-Clyde).

The Pacific Coast Oil Spill Project is viewed as a necessary project which will address a critical deficiency in the state of knowledge which exists worldwide concerning the efficacy and impact of cleanup activities directed at oil which strands on coarse sediment shorelines. As such, the findings from this project will have broad applications to similar shorelines, not necessarily on the West Coast of Canada.

The Valdez accident focussed worldwide attention on the potential for catastrophic tanker spills related to the supply of Alaska North Slope Oil, and demonstrated the immense difficulties associated with cleaning oil from coarse (cobble/boulder) types of shorelines. At the same time, the media attention focussed on the clean-up efforts and disagreements between state and federal agencies on the state of clean-up in different areas continues to demonstrate a serious lack of understanding by both the public and informed scientists on the relative benefits of different forms of clean-up in terms of environmental recovery. It is hoped that the PCOS project will go a long way towards clearing-up any misconceptions about the environmental acceptability of different techniques, while at the same time providing practical guidance to response crews.

A considerable body of conceptual project design work has already taken place or is ongoing as of November 1991 (see References). The results from this latest workshop will be fed into the overall project development process over the next six months.

This workshop was conceived with the following basic tasks:

1. To confirm the project rationale and objectives among a broad cross-section of interested scientists and policy-makers;

2. To review and confirm the criteria for site selection;

3. To refine the countermeasures techniques experimental matrix;

4. To discuss options for an oil sampling program and establish a viable approach for future experimental design in this area;

5. To discuss options for biological sampling in a general sense and identify the key issues affecting the project design in this area; and

6. To identify future project milestones and ensure that participants are clear on the sequence of upcoming events affecting the scheduling and funding of the project.

This workshop focussed on issues which directly affect the scientific validity and credibility of the project. A key concern was that the project results have direct application to the oilspill response community.

The following summary of the workshop findings is not a verbatim record of the discussion, but is meant to organize and highlight key points which will affect the future of the project.

2.0 PROJECT RATIONALE AND OBJECTIVES

The rationale behind conducting the Pacific Coast Oil Spill Project has been discussed and rephrased a number of times, and is the subject of an independent document (Dickins, 1990). The importance of revisiting the rationale and making sure that it matches current and valid scientific concerns cannot be stressed enough. In this regard, it is valuable to quote from Houghton et al., 1991, as follows:

> "The effects and extent of shoreline treatment in areas affected by the *Exxon Valdez* spill will greatly complicate assessment of the long-term impacts of treatment and the oil alone. Because much of the heavily oiled shoreline was washed with high pressure hot water at least once, and because so little of the oiled shoreline was left untreated, only a limited number of areas remain where comparisons may be made to distinguish between effects of oiling and effects of oiling plus treatment. Lack of specificity in the available treatment information e.g.,. equipment, temperature, duration, bioremediation application rates, and repetitions) also complicates separation of effects of different clean-up approaches" *(including the effect of doing nothing).*

This quote answers the question which regulators, special interest groups, and the general public would be well within their rights to ask: what can PCOS tell us that the millions spent already on scientific research following the Valdez spill cannot? The answer appears to be, "a great deal".

Location and Transferability

The West Coast is viewed as the primary project location for a number of reasons: the high public profile in this area as the result of both the Valdez and *Nestucca* spills, the potential transfer from and linkage to ongoing scientific programs in the aftermath of the Valdez spill, and the ongoing crude oil spill threat from tankers serving the refineries in the Puget Sound area.

Clean-up effectiveness results are thought to be largely transferable to other coarse sediment coastal areas. Biological recovery results may be more difficult to transfer because of the dependence on local indicator species.

The following objectives were established as a starting point for discussion:

Long Term Objectives: one or more years

Determine the consequences to biota and habitat of specific clean-up techniques (including natural fate and removal processes) applied to coarse/mixed sediment shorelines.

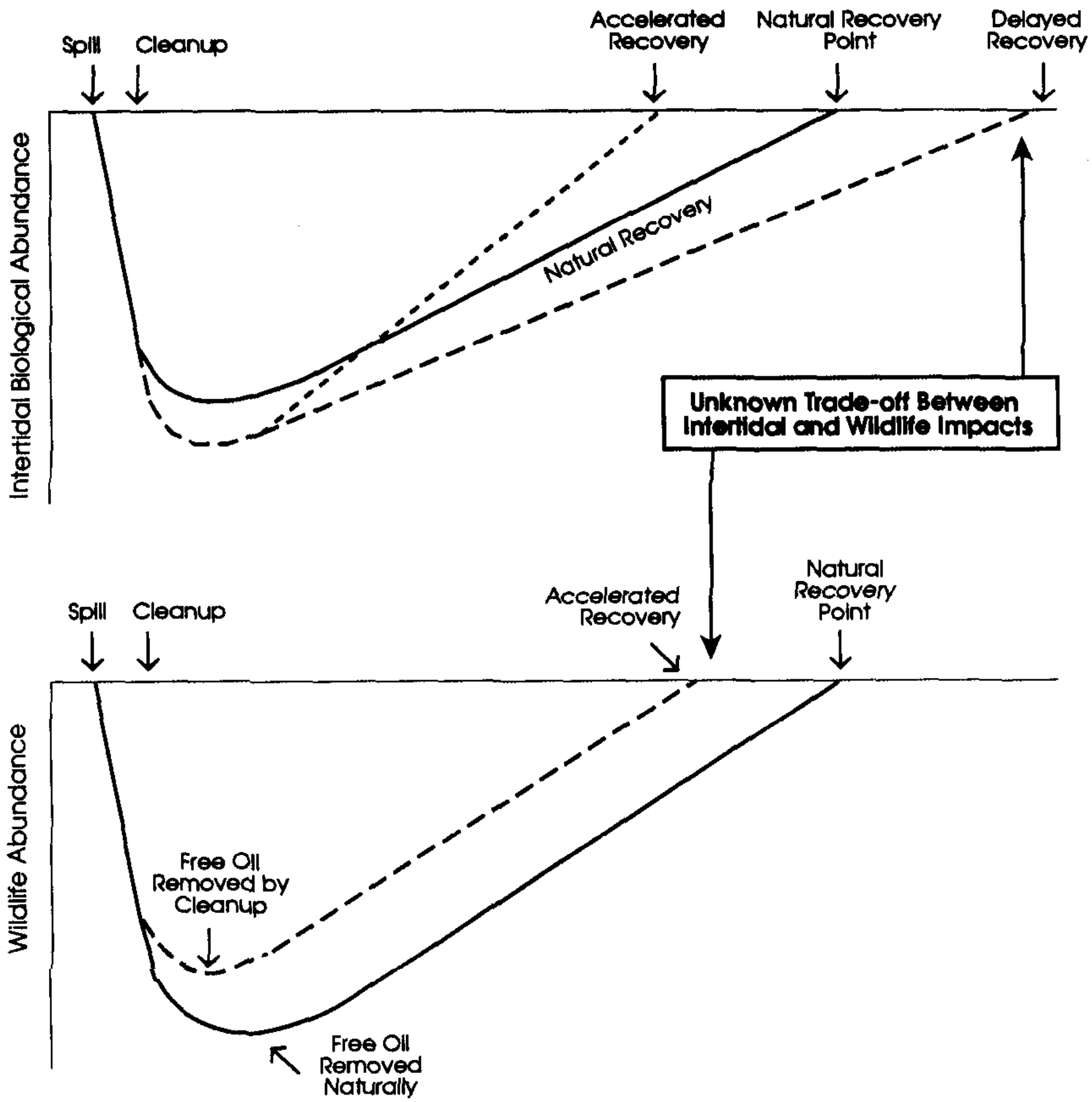
The results could then be used in a number or ways: to compare clean-up in general with natural processes, or to compare the relative consequences of using different clean-up techniques.

Short Term Objectives: days to weeks

1. Determine the variations in cleanup effectiveness;
2. Determine the immediate impact on biota and habitat in the intertidal and shallow subtidal zones; and
3. Determine the effects of different clean-up techniques on oil fate and character (e.g. distribution of oil on the surface of the intertidal/subtidal zones and with depth in the beach).
4. Bioremediation - does it enhance oil degradation.

Laboratory studies could be used as an initial screening mechanism by testing the effects of a particular aspect of a technique on certain biota (e.g., water temperature) and by examining the physical effectiveness of removing oil from a cobble/boulder substrate. The make-up of these studies was not discussed in detail.

Most participants felt that given the environmental tradeoffs between surface oil removal (reducing immediate impacts on higher trophic levels and other more conspicuous species), and the use of intrusive cleanup techniques (leading to immediate mortality and potentially longer term recovery of intertidal and subtidal species), it was essential to view the project in terms of the timescale of impacts and results. The following stylized graph illustrates the problems of comparing these tradeoffs over a time period from days to years (from Harper).



Schematic Representation of Rationale for Shoreline Cleanup
(John Harper)

A number of the key words used in defining the objectives require clarification:

> ***Cleanup Effectiveness:*** *indicates some combination of removal of oil on the surface and at depth (the problems of quantitatively measuring effectiveness are dealt with in a later discussion). In the context of this project, a high level of clean-up effectiveness is directly related to the ability of a technique to remove oil from the beach (not to simply to redistribute the oil to another zone or level).*
>
> ***Consequences:*** *can be viewed in terms of whether a technique enhances or delays biological recovery (long term), or results in significant initial mortality or species removal (short term). One of the objectives of the project is to document both the extent and the mechanism of the biological consequence, ie., how much and how?*

On a practical level, the PCOS results will have major implications for future equipment purchases and training of response crews in shoreline cleanup and restoration procedures.

3.0 SITE SELECTION CRITERIA

The site selection criteria in terms of wave exposure, sediment permeability, particle size, etc., were distributed in advance to the participants.

In view of the difficulties experienced to date by the project team in finding a large number of sites which satisfy the basic constraints of permeability, biological productivity, and uniform wave exposure, the question was raised as to whether the project is being designed around too "tight" a definition of what constitutes an acceptable site.

There was a general feeling that relaxing the issue of permeability was not advisable. A high degree of permeability is often associated with a high level of clean-up difficulty; the project was originally conceived to deal with these "problem" beaches.

In choosing a suitable site from both a scientific and a permitting point of view, the number of individual bays or linear length of shoreline contaminated was thought to be far more important than absolute volume spilled. It is not considered valid to constrain the project at this stage in terms of the volume spilled.

There was overall agreement that the site selection criteria being currently used for site screening and selection continues to provide a useful target as to the "ideal" site (whether or not in practice all of the individual criteria are found in a single location which is acceptable from a permitting point of view).

A somewhat different approach to project planning is taking place in the United States with regard to a proposed experimental shoreline spill sponsored by the American Petroleum Institute (A.P.I.). The emphasis in that study (in its initial stages) is more on securing necessary legal approvals first, and then worrying about the detailed study design.

4.0 EXPERIMENTAL OUTLINE

4.1 Oil Type

The question of oil type relates to a decision to use crude or bunker oil. Within each generic category, there is an almost unlimited range of oil properties. For crude oil on the West Coast, the choice is fairly simple; ANS crude completely dominates all other crude types with respect to both the frequency and volume of shipments.

For bunker oil, the choice is more complicated because a wide range of product viscosities are in common use. It is worth noting that for most B.C. coastal areas (excepting the Strait of Juan de Fuca and Southern Strait of Georgia) the risk of a bunker oil spill in the size range from 1,000 to 5,000 bbl impacting the shoreline is much greater than the risk from a crude oil spill of equivalent volume. For large spill volumes (over 10,000 bbl) the spill risk is dominated by crude oil tankers (Dickins et al., 1990; Cohen & Aylesworth, 1990). The point was made that there may be little to choose between emulsified crude and straight bunker in terms of viscosity.

The final decision on which oil or combination of oils to use is a complex one (affecting the needs of potential project funders, and the direct relevance to local community concerns in the area of the experimental site). Recommendations were made not to define the project in terms of a single oil type at this stage, but to leave the options open.

4.2 Experimental Matrix

The original experimental matrix of cleanup techniques and "bays" or plots (from Harper, 1991) was used as a starting point for the initial discussion of which cleanup techniques would have priority for inclusion in the final project and to determine how many oiled "bays" or areas would be required (oil with treatment, oil without treatment, control, and no oil with treatment).

The group decided that the following techniques should be included as part of the project if possible:

First Priority

Washing	with a combination of temperature and pressure to be determined from a separate screening project (involving a combination of laboratory and possible field tests - see Strange Island site option)
Washing with Chemical Treating Agent	considered to have received inadequate attention previously due to concerns about environmental effects of the chemical agents
Manual Cleanup & Removal	including scrubbing, stripping, raking, vegetation cropping, up to cobble/boulder removal
Bioremediation	as an independent experiment involving its own control and a different degree of oiling than the other techniques (in keeping with the view that bioremediation is most likely to prove effective on light to moderate oiling)

Second Priority

Washing followed by Tilling in 1st or 2nd yr.	still considered essential by some participants if subsurface oil is to continue as a key issue to be addressed by this project
Some "super new" technique	nobody knew what this "magic" technique might be but everybody felt strongly that a slot needed to be kept in the project to accommodate some degree of innovation (as opposed to working only with the status quo represented by the known techniques)

4.3 General Discussion of Experimental Approach

NOAA representatives cautioned about being overly ambitious with the project. They made the point that it is realistic to only consider a few variables at a time in a project like this.

Blair Humphrey made the point that this project is trying to move to the next level of understanding, from " we removed the oil from the surface", to " we removed the oil from the beach surface and this is how much we recovered", and finally to " we removed the oil from the surface and what were the ultimate fate and consequences of oil redistribution?". The issue of how to measure oil removal is extremely difficult as Blair Humphrey points out in a subsequent discussion (5.0).

The current reality is that the very best field sampling techniques available will only conclusively document massive effects and changes (given the natural variability in space and time of both the biological communities and the beach composition). There is no point in looking for subtle changes or effects (e.g. 10 to 15%).
The issue of absolute timelines for recovery as function of test scale was discussed. A number of participants felt that it would be impossible to say that the level of recovery experienced in a small test bay in say one year would be equal to the equivalent level of recovery after the same period of time in a large accidental spill; the project can compare relative recovery rates between individual test bays (and associated cleanup techniques).

The subject of replication was discussed at length with the overall conclusion that in order to have some impact on the scientific community, and to be able to say conclusively that certain consequences are directly attributable to a cleanup technique and not natural variability, there must be provision for site replication or at the very least, assurance that randomized plots within a site are not subject to cross contamination (this further constrains the site selection process).

Based on the selected techniques and the need to have an independent oiled control for bioremediation (different degree of oiling from the other techniques), it was determined that the following number of experimental areas, bays, or beaches would be required for: (1) the optimum experiment with all techniques regardless of priority; (2) the reduced experiment with only the first priority techniques; and (3) the minimum experiment with only one technique (it is important to note that even the minimum experiment would significantly advance our understanding of shoreline cleanup processes and their relative impacts).

Experimental Scope	# Techniques Tested	# Oiled Sites	Total # Sites incl controls*
Optimal	6	8	16
Reduced	4	6	11
Minimum	1	2	4

* Controls include sites which are oiled and not treated, sites which remain completely natural (no oil or treatment) and sites which receive only treatment (in the absence of oil).

Note: the estimated number of sites may increase in order to satisfy the need for sampling replicates.

Given the difficulties in assuring similarity between 10 or more sites, a priority should be given to establishing similarity in substrate and biology for all sites associated with a particular technique (this would mean introducing additional controls if the differences between sites used for individual techniques proved too great).

Consideration should be given to using the oiled controls after several years for additional cleanup evaluations (mimicking the *Exxon Valdez* response where some sites were revisited over three years with different techniques). This approach would also support any commitment to final clean-up during the environmental approvals process.

In terms of which zone within the intertidal should be oiled, the comment was made that there is little point in oiling the lower intertidal because the penetration in most instances would be so low - this question requires further consideration. In terms of the absolute worst case for oil residence and penetration, a case can be made for oiling the supratidal even a few tens of centimetres above the High Water mark at the time of the test (D. Little).

There was general support for the idea of conducting a combination of lab and ideally small scale field studies to optimize the washing techniques to be applied during the main experiment; these studies would confirm the necessary oil loading and predicted oil penetration depths for permit applications.

5.0 HYDROCARBON SAMPLING AND ANALYSIS

The following material was prepared by Blair Humphrey of EnviroEd Consultants, Victoria.

The experimental design discussed in Section 4.2 will require estimates of the quantities of oil on each plot during the experiment. Historically, the determination of petroleum hydrocarbon concentrations in discrete samples by various analytical procedures has been used. At the Baffin Island Oil Spill (BIOS) project and more recently during the *Exxon Valdez* incident in Prince William Sound, visual methods of estimating oil cover were also used.

The experiments as described at the workshop will require two quite different levels of estimation or analysis. In the early phases of the tests, oil will be laid down in high concentrations on plots, then cleaned up; this will be followed by a monitoring program to determine the efficiency of the cleanup method , the longer term fate and persistence of the remaining oil, and (perhaps most importantly in terms of the aims of PCOS) the exposure of biota to known quantities of hydrocarbons of known composition.

The quantification of these phases will be very different:

> The first phase (oiling and cleanup) will be looking at changes from the tens of percent by weight and down. A cleanup method that removes significant proportions of oil will be considered efficient. For illustration purposes, a 90% cleanup of oil which made up 15% of the beach sediment weight would leave 1.5% by weight oil, or 15,000 mg kg^{-1}, still a high concentration from an impact perspective.
>
> The second phase involving long-term monitoring to document the effects of remaining oil may require estimates of oil concentration down to about 100 mg kg^{-1}.
>
> A third phase could also be considered which would involve much lower detectability limits for PAH levels in the ppb range (this phase is

not particularly attractive in terms of cost and the large number of samples which may be necessary - see further discussion below).

The BIOS experiment and the *Exxon Valdez* incident have provided data to evaluate some of the methods used to quantify oil. There is some (not enough available) quality control/quality assurance (QC/QA) information from this data to give estimates of confidence limits and estimates of sampling densities to provide confidence in the detection of changes.

The most commonly used analytical tool has been the determination of Total Petroleum Hydrocarbon (TPH). This was done at BIOS using an IR method, and at the *Exxon Valdez* incident using gravimetric methods (Gravimetric Oil and Grease, GOG). Both methods have weaknesses: THC/IR relies on the presence in the oil of fairly low molecular weight components. The method monitors a $-CH_2-$ frequency; as oil weathers, this signal decreases relative to the bulk quantity of oil.

Neither method distinguishes natural from petroleum hydrocarbon. Both methods are best at determining hydrocarbon concentrations when the concentration is high and the oil is fresh. QC data from BIOS (*Exxon Valdez* QC data not available at this time) indicates that for a carefully oiled plot consisting of fairly even fine grained to pebble substrate, a sampling density of one sample per 4 m^2 is required to have 95% confidence of distinguishing a concentration change of one order of magnitude, and a sample density of one sample per 10 m^2 to distinguish a change of two orders of magnitude.

Gas chromatography (GC) has been used less commonly for determining bulk concentrations. Houghton et al. (1991) used GC/mass spectrometry (MS) to determine polyaromatic hydrocarbon (PAH) concentrations and composition. The few QC/QA data presented indicate that a 95% confidence of distinguishing one order of magnitude difference in PAH concentration would require 47 samples per site (site size not defined) for sediments, but only two samples per site (again, not defined) for the determination of hydrocarbon content of the bivalves, *Macoma balthica*.

The alternative to discrete sampling and analysis for the estimation of surface oil content is the visual method used at BIOS and in Prince William Sound, which used the two-pole method of Emery (1961) to survey the beach morphology, with estimates of percent oil cover at each location. In tests between observers at BIOS, Owens (1984) indicated that reproducibility was about ±5%. This is probably adequate to evaluate cleanup techniques; finer differences could easily be due to variation in the application of each method, and methods with similar clean-up efficiencies should be selected on other grounds.

Determining the biological impact of the treatments will need a different data set. In this instance, collections of animals or plants from different treatment plots should be analyzed for compositional differences or similarities. A number of the participants felt that it would be of considerable interest to know the approximate composition of oil left behind after the treatment, and were of the opinion that the mechanism of biological impact from various treatment options is very important to understanding the additional impacts a particular remedial action. They felt that a thorough understanding of such impacts could play a significant role in the selection of response options in the future.

The relative costs of the analytical methods described above are:

THC/IR (or GOG)	C$80
GC (total)	C$160
GC (compo)	C$360-C$1000.
Visual	field labour

The problem remains of estimating the amount of oil beneath the surface, a measurement which is not possible with current methods. An oil-sensitive probe which can pass through an oiled layer and determine its depth would be a boon, but is difficult to conceive of. A probe which would also estimate amount is even less likely (the protection of the sensor from oil during penetration is one of the problems). All possible techniques for achieving subsurface monitoring should be examined in preparing for the experiment;

the determination of subsurface oil is an extremely important component of the project.

If the design of the experiment permits destruction of the plot at the end of the project, then the plot may be excavated by trenches and test pitting (thereby destroying the experiment at this point), and the remaining oil determined. The oil budget would then be determined by knowing the amount of oil laid down on the plot, determining the amount recovered by the cleanup method, and the amount remaining in the plot at the end of the project. What will not be known with any accuracy is the amount of oil left in the beach and removed between the end of cleanup and the end of the project.

The statistical design of the experiments should include true replication of treatments. In many experiments, only one plot per treatment is used, often for logistical or application reasons. In this project, it should be easy to replicate treatments and controls to avoid any weakness of the analysis. To do this, treatments should be applied in sub-plots within larger plots.

For the cleanup methods discussed, merely alternating treatment with no treatment along a section of beach will not produce valid results; oiled sections of beach should be separated by un-oiled sections, some of which are treated and others not. In one fairly long beach section, all permutations are possible without difficulty. On short beach sections, the distribution of treatments among individual beaches (or bays) will accomplish the same thing. The overriding concern is one of confidence: without true replication, there is no means of quantifying the confidence that observed differences are due to the treatment rather than natural factors. If the confidence can be readily determined by statistical methods, it should be done.

5.1 Discussion and Summary of Sampling Issues

There was general agreement with the realistic approach to sampling presented at the workshop (see above text). One observation was that you can design an *effective sampling program to determine biological recovery and* the levels of hydrocarbons in tissue samples, or you can attempt to measure hydrocarbon content in the sediments; it is probably not possible to do both on a coarse sediment shoreline.

Animals tend to be much more consistent in terms of hydrocarbon content at any given time than any statistically valid collection of sediment samples. It is possible to do GC/MS analysis to look at changes in oil properties with time. The uptake of hydrocarbons by the organisms can then be used as an indirect (but much more stable) measure of the amount of hydrocarbons left in the beach. Given that the goal of cleanup is to minimize the toxicity and availability of oil to different animals, building the analytical parts of the project on bio-assay work is a much more relevant approach than attempting an intrusive and ultimately self-defeating sediment sampling program.

In general, for near-surface oil, the group felt that the issue of rating cleanup effectiveness was best dealt with by a combination of systematic visual *observations (building on the experience from the Valdez spill), and GC/MS* for oil composition.

For subsurface oil, a combination of visual descriptors and pitting was recommended. More work is needed to develop a workable probe or conduit system which would allow some means of monitoring subsurface oil without destroying the beach in the process.

Ideally, the experiment should endeavour to track or monitor as best as possible the redistribution of oil through the following pathways: (1) recovery following the cleanup (e.g., flushing); (2) penetration into the beach; (3) oil in the water column nearshore; (4) oil in subtidal sediments (somewhat easier because of the tendency for finer grained material in this zone).

A monitoring system is needed to provide a semi-quantitative measure of sheening; this can also be viewed as an indicator of clean-up effectiveness.

Houghton et al. (1991) suggest a downslope movement of oil as a result of countermeasures, but the data is very spotty and not conclusive. One way of documenting this problem if it exists is with crab pots planted beforehand in the subtidal areas off the oiled beach.

The design of analytical procedures to monitor the effects of bioremediation is a simpler problem than discussed above for the more aggressive clean-up techniques; researchers in this field are satisfied with the results of CG Mass Spec to follow changes in oil composition with time.

6.0 BIOLOGICAL SAMPLING

6.1 Related to Scientific Program Objectives

The biological sampling program was discussed in terms of the duration, location, and methods used.

Sampling Program Elements

DURATION	• short term • long term
LOCATION	• intertidal • subtidal • epibenthos • infauna • fish
METHODS	• destructive • non-destructive • indigenous • caged in-situ • release/recapture

The duration of the biological monitoring includes the baseline work and long term post-spill monitoring. It was considered satisfactory to conduct baseline sampling one year prior to the spill (same time of year as that planned for the spill), and during the year of the spill immediately prior to release.

There is no advantage to setting strict time limits on when the long term monitoring study might end at this stage in the project. Community "recovery" to = or > baseline may be an infinite process. The health of indicator species will likely provide a better end point for practical purposes.

An important point is to determine when the project has reached the point where oil is either not available for uptake, or is no longer toxic.

The different types of biological effects were defined as:

Structural	• abundance & diversity • community • populations (indicator species, etc.)
Functional	• physiological • morphological • individuals
Hydrocarbon Uptake	

NOAA discussed their success with mark and recapture studies involving oyster drills. This technique would be an effective means of evaluating long term growth rates of control sites vs. experimental sites, as well as immediate post spill survival (collecting and tagging prior to the spill).

An experimental site with eelgrass would afford the opportunity of using seed production as a measure of biological recovery.

The favoured approach is to use a large number of indicator species (more than 10) to monitor biological recovery. Sampling at the community level raises the question of how to agree on an end point for "recovery" of the oiled sites; perfectly healthy, normal communities may establish themselves while never matching the control sites in abundance or diversity. It may be worthwhile going to a community level of sampling with a fine grained subtidal material because successive changes are likely to be more predictable than on the rocky/cobble intertidal zone. At the same time, this is the zone where we would expect the least possibility of impact (D. Little).

The following general sampling approach evolved during discussions for the **intertidal** area:

1. Permanent Quadrats to look at: (a) population abundance for several important species which are both ecologically important and sensitive; and (b) recruitment. Note: photo/video methods are commonly used, but will not document the vertical complexity, especially on *Fucus* dominated plots (D. Little)

2. Mark and release for mortality and growth, focussing on epifaunal/infaunal bivalves (this technique has worked especially well for oyster drills)

3. Health of flora

NOAA mentioned ongoing work to apply satellite image processing technology to 8X10 or video in a effort to gauge the relative "health" of that community through changes in spectral signature.

For the **subtidal** area, a similar strategy would be used with the following changes or provisions:

1. Eelgrass may form a key part of the biological recovery monitoring.

2. The requirement for both infaunal and epifaunal indicator species would continue to be essential.

3. A species would be selected as a marker for the amount of oil getting into the subtidal area, particularly during the spill and during clean-up efforts (e.g., mussels).

4. A sensitive species would be selected as a marker for sub-lethal effects (e.g. red algae as a delicate annual).

6.2 Biological Monitoring to Assess Environmental Impact of the Project

In addition to the scientific monitoring program associated with the intertidal and subtidal species, the project must incorporate a comprehensive monitoring program aimed at the wildlife of particular interest to the public, regulators, and fishermen (including native subsistence harvesting).

Even though it may be impossible to quantitatively measure effects on fish and birds, the potential impact can be gauged by careful documentation of causal factors such as free oil on the beach and sheening offshore.

Important issues which will have to be considered part of the impact assessment (local and regional) include:

- site security and public cautionary warnings
- sheens coming off the beach
- bird scaring
- bird rehabilitation contingencies
- fish tainting (standard oleoleptic tests)

7.0 CLOSING

7.1 Optional Staged Approach Using Known Site

An option was presented at the workshop to proceed with obtaining the necessary approvals for a spill site on Vancouver Island. A number of potential advantages were listed at the workshop to support this approach:

- some initial baseline work has been completed
- sensitivity issues are known and are considered manageable
- local native band is considering supporting the project (not directly opposed)
- logistics by coastal steamer and boat in protected waters
- possibility for a 1992 permit if action is taken by January 1

The chief disadvantage of the Vancouver Island site is that it is far too small in extent to accommodate the full project. Taking up this option now would mean that the project would become two phased with the need for an independent environmental evaluation and approvals process for the main site by mid-1992.

The smaller Vancouver Is. site would provide an opportunity to test bioremediation on a lighter degree of oiling than proposed for the other techniques, and also to carry out a pilot study to optimize the washing techniques by using small plots.

There was general support among the participants for making use of any sites which may become available in 1992, recognizing that they will not be optimal for the full experiment. A note of caution concerned the political realities of gaining two sets of approvals in consecutive years for proposals which in many peoples eyes may look like one and the same. The issue was left with the recommendation that we carefully consider the pros and cons of this phased approach before proceeding any further (this was subsequently done and a decision reached to proceed on December 4, 1991).

7.2 Future Activities

It was emphasized that although considerable background research and planning has taken place, there are a number of critical steps which will need to be completed over the next eight months for the project to proceed towards a target of 1993 for the main suite of experiments. The following list is not complete but illustrates the order of different activities which are planned between December 1991 and the summer of 1992.

- make a decision to proceed with the existing site as an interim step*
- short-list new sites and conduct preliminary environmental screening of sites identified in the aerial reconnaissance of October, 1991
- carry out a detailed survey of the most promising new sites (late March to early April, 1992)
- proceed with approvals and EARP process for selected new sites (est. 8 to 10 months minimum from May 1992)
- carry out an ongoing public information program
- complete a detailed project design including logistics and cost

*Note: the decision was made subsequent to the workshop on December 4 to proceed with seeking approvals for an existing site at Strange Island, Nootka Sound.

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Pacific Coast Oil Spill
2nd Project Design Workshop

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Red Lion Inn Seatac
November 13-14, 1991

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