

RPWG
L

RESTORATION FEASIBILITY STUDY NUMBER 1

Study Title: Re-establishment of Fucus in Rocky Intertidal Ecosystems

Lead Agency: EPA

Cooperating Agency: USFS

INTRODUCTION

Qualitative evidence indicates that rockweed, the marine alga, Fucus, was damaged by both the spilled oil and the cleanup effort. Fucus is a critical structural component of the intertidal habitat in the oil-spill area, and it serves as an important spawning substrate for herring. Re-establishment of this species will increase the rate of recovery of other associated biotic communities.

There may be a substantial delay in natural recovery of areas where populations were reduced over large areas (100-1000 m of shoreline), because dispersal of seeds is limited (< 1 m in most circumstances). Drift plants may increase this distance, but the importance of this mode is unknown.

The reproductive and life history of Fucus is well known, and techniques for collection of seed are well established. In southern parts of the range plants are fertile year round, so the timing of the application of seeds may be relatively unimportant in the establishment of the plant. The specific life history cycle of the plant in PWS and the GOA is not known. It is expected, however, that the plants will be fertile for at least most of the spring and summer.

Objectives:

- A. Document the extent and magnitude of recruitment of Fucus in areas subjected to alternative cleaning technologies.
- B. Determine the feasibility of re-establishing Fucus in damaged areas.
- C. Develop and demonstrate potential large scale seeding techniques to re-establish Fucus.
- D. Demonstrate the efficacy of seeding versus transplanting Fucus.
- E. Identify the costs of implementing a full-scale Fucus restoration project.

Relationships with Other Studies:

This study is fundamental to bringing an ecosystem approach to the restoration program. It relates directly to RF 2, re-establishing critical intertidal fauna, and to various NRDA studies, particularly Coastal Habitat Study Number 1.

Methods

The study plan has two parts: (1) laboratory experiments that develop techniques for obtaining large quantities of embryos suitable for use in reseeding, and (2) field experiments to test the effectiveness of embryo reseeding and transplanting in habitats that experienced varying degrees of oiling and cleaning.

Laboratory experiments will be conducted to determine embryo attachment strength over time. Since the seeds must remain in suspension, experiments will also be conducted to assure their viability in culture media for at least two weeks. Although techniques for obtaining Fucus embryos are simple and well known, these techniques will be modified and tested for the production and handling of the large numbers of embryos that would be necessary for a full-scale reseeding project.

Field tests will then be conducted with various "seeding" procedures (e.g., dispersal of embryos, dispersal of embryos, and transplants of fertile adults). All three methods will be tested in one control and one habitat that was disturbed by oil and subsequently cleaned. Dispersal of embryos will then be tested in habitats with different combinations of oil and cleanup techniques (e.g., bioremediated, hot water wash). The experimental design will use three replicates of each habitat type, three replicates of each procedure, and three replicates of controls to measure natural settlement. Variables to be measured include height of Fucus plants, numbers of plants, and percent vegetative cover. Maps prepared by the Damage Assessment Geoprocessing Group will be used to identify potential study sites. In the initial project, primary study sites will be in or near Herring Bay, PWS.

BUDGET: EPA

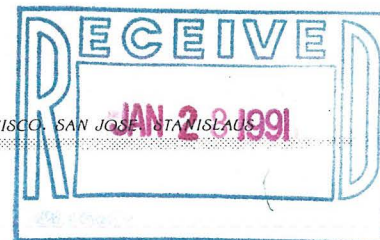
| | |
|----------------------|------------|
| Salaries | \$ 2.0 |
| Travel | 11.0 |
| Contractual Services | 135.0 |
| Supplies | 2.0 |
| Equipment | <u>0.0</u> |
| <u>TOTAL</u> | 150.0 |



MOSS LANDING MARINE LABORATORIES

CALIFORNIA STATE UNIVERSITY FRESNO. HAYWARD. SACRAMENTO. SAN FRANCISCO. SAN JOSE. SANTA BARBARA. SANTA CRUZ. SAN TOME. SAN VICENTE. SAN XELI.

P. O. BOX 450
MOSS LANDING, CA USA
95039-0450
(408) 633-3304



January 24, 1991

Dr. Mike Stekoll
Juneau Center for Fisheries and Ocean Sciences
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

Dear Mike:

Enclosed is a Status Report on our (Foster/De Vogelaere) Fucus Restoration Project contract. We hope to get back to Herring Bay as early in the Spring as possible to set up the experiments, and I will contact you soon about possible logistics.

As you will recall from my letter of November 10, 1990 (Letter to C. Hill, U of A Procurement Officer, with a copy to you and others involved with this contract), there are a number of changes to be made in my contract. These include a change in the scope of work, a change in the ending date of the project, addition of a co-principal investigator, and a request that the missing \$9,333 be added to the contract. Relative to the last point, I enclose an additional memo from Dr. Dave Gibbons of the US Forest Service further indicating that \$60,00 was to be transferred to San Jose State University Foundation, \$9,333 more than actually arrived. It is now nearly the end of January and I have yet to receive a reply to this letter from the University of Alaska. As you are the Contracting Officer's Technical Representative (COTR), I would appreciate your help in resolving these matters. Could you please stimulate the University of Alaska to provide an official response to me and to the San Jose State University Foundation concerning the changes requested in my letter?

It was good to see you and hear your presentation at the Western Society of Naturalists meeting in Monterey, and I look forward to working with you in Alaska this Spring.

Sincerely,

Michael S. Foster
Professor of Marine Science

copies to:

- H. Kibby, EPA, Corvallis
- ✓ B. Ross, EPA, Anchorage
- D. Gibbons, USFS, Juneau
- N. Crane, SJSU Foundation
- C. Hill, U of A Procurement Office

United States
Department of
Agriculture

Forest
Service

Alaska Region

Reply to: University of Alaska

Date: July 3, 1990

Subject: EPA Restoration Funding

To: Catherine Fenton
Ray Highsmith
Mike Stekoll

The enclosed Interagency Agreement transfers \$80,000 from the U.S. Environmental Protection Agency to the U.S.D.A. Forest Service for Fucus restoration work as part of the Exxon Valdez Natural Resource Damage Assessment process. This has been included as a line item in the \$5,726,903 University of Alaska contract presently in preparation for the time period of March 1 to September 30, 1990. I understand that of this \$80,000, \$60,000 will be transferred to San Jose University Foundation without overhead. The remaining \$20,000 will be assessed 20% overhead (\$4,000), leaving \$16,000 to be used by the University of Alaska for services, supplies and personnel in support of the Fucus restoration project being conducted at Herring Bay, Knight Island.

The \$5,726,903 contract should be completed and ready for signature by mid-July. If you have any questions, please call me at 586-8784.



Dave R. Gibbons, Ph.D.
Project Manager
Coastal Habitat Damage Assessment Project

cc: Mike Foster



MOSS LANDING MARINE LABORATORIES

CALIFORNIA STATE UNIVERSITY FRESNO. HAYWARD. SACRAMENTO. SAN FRANCISCO. SAN JOSE. STANISLAUS

P. O. BOX 450
MOSS LANDING, CA USA
95039-0450
(408) 633-3304

November 10, 1990

Mr. Charles Hill
Deputy Chief Procurement Officer
University of Alaska
Procurement Office
3rd Floor Eielson Bldg., Room 302
Fairbanks, Alaska 99775-1440

Dear Mr. Hill:

I am listed as the Co-Principle Investigator (with Dr. Mike Stekoll, University of Alaska, Juneau) on a contract recently negotiated between the University of Alaska and San Jose State University Foundation ("Fucus transplant studies for oil spill restoration project," University of Alaska; Government Contract No. 53-0109-9-00276 Mod #4). I began work on developing a Fucus restoration project with the Environmental Protection Agency in April, 1990. However as a result of a number of delays and changes, the final, fully approved contract did not arrive at the San Jose State University Foundation until mid-September. The contract was not what I understood to have negotiated with the Environmental Protection Agency, United States Forest Service, and the University of Alaska but, because further delays would have prevented all field work in 1990, I signed it and began the project. I would now like to have the contract modified to reflect what the study is, the time period over which it is to be completed, who the principal investigators are, and how much the funding is.

1. What the study is: The attached "Revised research plan for the Fucus restoration project" dated August 8, 1990 describes the study as it will be done. This was agreed to by all the scientists and agencies involved (listed at the end of the revised plan). Please substitute this plan for the scope of work presently in the contract.

2. Time period: As indicated in the revised plan, the study will end December 30, 1991, not May 30, 1991 as currently shown in the contract.

3. Principal Investigators: As indicated in the revised plan, Andrew P. De Vogelaere should be added as a Co-Principal Investigator.

4. Funding: The funding from the University of Alaska to the San Jose State University Foundation was \$50,667.00. As you will see from the copy of the enclosed letter of July 3, 1990 from M. Stekoll to K. Fenton of your office, I understood that I would actually receive \$60,000 of the \$80,000 the Environmental Protection Agency and United States Forest Service allocated for this project. I do not know what happened to the missing \$9,333, but would appreciate it being

~~added to my existing contract with the San Jose State University Foundation.~~ If it was taken out by the University of Alaska as additional overhead, I would point out that the University of Alaska is not actually administering the details of the project, San Jose State University Foundation is (and, moreover, your records will show that their indirect costs are only \$10,991). Because of this uncertainty over my budget, I recently had to decline an invitation by the EPA to participate in a restoration meeting in Anchorage. Although the meeting was quite important to the project, I could not use my existing travel budget for fear of being unable to accomplish some of the field work. The funding shortfall may also result in one less field survey to assess our experimental results and the recovery of tarred substrata.

I appreciate your attention to these matters, and look forward to your reply.

Sincerely,



Michael S. Foster
Professor of Marine Science

copies to:

- H. Kibby, EPA, Corvallis
- ✓ B. Ross, EPA, Anchorage
- D. Gibbons, USFS, Juneau
- M. Stekoll, U of A, Juneau
- R. Highsmith, U of A, Fairbanks
- N. Crane, SJSU Foundation

August 8, 1990

TO: Dr. Hal Kibby
Environmental Research Laboratory
U.S. Environmental Protection Agency
200 SW 35th St.
Corvallis, Oregon 97333

FROM: Dr. Michael S. Foster
Moss Landing Marine Laboratories
P.O. Box 450
Moss Landing, California 95039

REVISED RESEARCH PLAN FOR THE Fucus RESTORATION PROJECT

As you know, there have been considerable delays in processing my contract to do the field work as specified in the "Fucus research plan" dated June 15, 1990, the plan upon which the contract is based. My present understanding is that final paper work is being done by the University of Alaska, Fairbanks, and the contract should arrive soon at the San Jose State University Foundation. Unfortunately, these delays have made it impossible to do all the work as specified in the above plan, and impossible to do it on the schedule originally proposed.

I do feel, however, that a Revised Plan as outlined below will make significant progress towards our general objectives of understanding the causes of variation in Fucus recovery in areas affected by the Exxon Valdez oil spill in Prince William Sound, and of documenting the extent and magnitude of natural recruitment of Fucus in areas subjected to alternative cleaning technologies (particularly areas that were heavily cleaned and those that have residual tar).

In this Revision I propose to:

A. Examine the extent, distribution, and recovery rates of areas coated with tar by:

1) surveying the extent of areas with residual oil (tar), and the distribution of tar within these areas, at sites in Herring Bay and on the more exposed northern end of Knight Island.

2) sampling multiple sites with and without tar to determine present differences in species composition and abundance.

3) permanently marking some of the sites in A.2. so that future surveys of the same areas can be used to determine how fast recovery occurs on tarred substrates.

B. Determine differences in Fucus recovery at sites that were oiled and cleaned vs. areas that were not cleaned by

1) Sampling Fucus abundance and size frequency in oiled/cleaned sites and sites that were not cleaned. Replicate sites will be sampled, and samples will be

stratified by tidal height within the Fucus zone, and by subhabitat (crevice, slope, presence of barnacles) within tidal heights.

2) (based on the results in B.1. and previous observations that Fucus recovery has been relatively slow in the upper part of its range in areas that were heavily oiled and cleaned) experimentally determining what factors affect Fucus recovery in the upper part of its natural range. We anticipate that factorial experiments will be done in at least two sites that involve manipulation of slope, surface roughness, water retention, and grazers.

Our proposed schedule (assuming the contract does arrive by mid August, 1990) is:

I. Sample and mark tar and control areas, and sample Fucus distribution as above in early September, 1990. This would require two people based on the University of Alaska barge in Herring Bay for 5 - 8 days. We will supply all our field equipment except gas for an outboard motor, and charter a float plane to reach sites outside Herring Bay. We would submit a report on this research by December 30, 1990.

II. Resample tarred and control areas, and set up recovery experiments as early as possible in Spring, 1991. We could either use the barge facilities or charter a boat for this work, which will require 4 - 5 field workers for 5 - 8 days.

III. Resample tarred and control areas, and sample recovery experiments in late Summer, 1991. This would require 2 - 3 field workers for 5 - 8 days, with logistics as in I. above. We would submit a report on the entire project by December 31, 1991.

Sampling methods, quality control, and quality assurance will be as stated in the work plan of June 15, 1990. The number of areas sampled and their precise location will depend on discussions with scientists at the University of Alaska, and logistical constraints (primarily weather).

Because of contract delays and prior commitments in August and September, 1991, I would like to add a co-principal investigator to the project. This will be Andrew De Vogelaere, an intertidal ecologist and colleague who has done extensive intertidal field work in central California and Washington, including work on the effects of tar on the rocky intertidal zone. Mr. De Vogelaere, presently a Ph.D. candidate at the University of California, Santa Cruz, will be involved in all aspects of the project, and supervise the intertidal field work in early September, 1990. His phone numbers are: University- (408) 459-4026 Home- (408) 662-3265.

Please notify me of any difficulties with the above proposal before August 11, 1990. Otherwise (in my absence between

August 11 and September 4), Mr. De Vogelaere will proceed with the above plan when the contract is in hand, and coordinate field work with appropriate University of Alaska personnel.

copies to:

J. Armstrong, EPA, Corvallis
B. Ross, EPA, Anchorage
D. Gibbons, USFS, Juneau
M. Stekoll, U of A, Juneau
R. Highsmith, U of A, Fairbanks



Juneau Center for Fisheries and Ocean Sciences

University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

(907) 789-4441 Office
(907) 789-4447 FAX

Da: 03 July 1990
To: K. Fenton
Fr: M. Stekoll *M. Stekoll*
Re: Contract with Mike Foster/EPA

As you are aware, the EPA would like some work done on the restoration of Fucus in the intertidal in Prince William Sound as a result of the Exxon Valdez oil spill. Dave Gibbons of the US Forest Service has arranged with the EPA to transfer the funds to SFOS (IMS?). The total amount is \$80,000. We have arranged for Dr. Mike Foster of San Jose State University (Moss Landing Marine Lab) to perform the bulk of the research in cooperation with myself. After talking with the various people involved, I have devised a tentative budget breakdown.

The \$80,000 will be awarded to the University of Alaska as part of, and in addition to the CHIA budget from the US Forest Service. If possible, we would like to have \$60,000 passed to the San Jose State University Foundation for Dr. Foster's part of the work without overhead being extracted, since the SJSU Foundation will take 35% of that money for its own overhead and will administer that money. The remaining \$20,000 should enter into the CHIA budget and be allocated as follows:

| | | |
|----------|-------|---|
| \$ 4,000 | (20%) | University Overhead |
| \$ 3,000 | | Logistics supply budget for the CHIA |
| | | Herring Bay Studies (Highsmith) |
| \$10,000 | | Salaries for Intertidal Plants Study of |
| | | CHIA (Stekoll: 39641-231610) |
| \$ 3,000 | | Supplies for Intertidal Plants Study of |
| | | CHIA (Stekoll: 39641-231610) |

I assume that Dave Gibbons has or, shortly, will have sent the back-up paper work on this project.

Please let me know whether you need additional information.

c/c Highsmith
Gibbons
Foster

CONFIDENTIAL

RPWG
(2)

November 10, 1990

Draft Preliminary NRDA Status Report

Study Title: Fucus Restoration Project

I.D. No.: University of Alaska, Fairbanks- Govt. Contract
No. 53-0109-9-00276 Mod. #4
San Jose State University Foundation- Project
No. TA201-25

Investigators: Michael S. Foster and Andrew P. De Vogelaere,
Moss Landing Marine Laboratories, P.O. Box 450, Moss
Landing, Ca. 95039 (408) 755-8658

Objectives:

To understand the causes of variation in Fucus recovery in areas in and around Herring Bay affected by the Exxon Valdez oil spill, and to document the extent and magnitude of natural recruitment of Fucus in areas subjected to alternative cleaning methods (particularly areas that were heavily cleaned and those that have residual tar). An understanding of the causes of natural variation in recovery should suggest restoration methods that could be used in this or future oil spills.

Methods:

A. Examine the extent, distribution, and recovery rates of areas coated with tar by:

- 1) surveying the extent of areas with residual oil (tar), and the distribution of tar within these areas, at sites in Herring Bay and on the more exposed northern end of Knight Island.

- 2) sampling multiple sites with and without tar to determine present differences in species composition and abundance.

- 3) permanently marking some of the sites in A.2. so that future surveys of the same areas can be used to determine how fast recovery occurs on tarred substrates.

B. Determine differences in Fucus recovery at sites that were oiled and cleaned vs. areas that were oiled and not cleaned by:

- 1) sampling Fucus abundance and size frequency in oiled/cleaned sites and sites that were not cleaned. Replicate sites are sampled, and samples stratified by tidal height within the Fucus zone, and by subhabitat (crevice, slope, presence of barnacles) within tidal heights.

- 2) (based on the results in B.1. and previous observations that Fucus recovery has been relatively slow in the upper part of its range in areas that were heavily oiled and cleaned) experimentally determining what factors affect Fucus recovery in the upper part of its natural range. We

CONFIDENTIAL

anticipate that factorial experiments will be done in at least two sites that involve manipulation of slope, surface roughness, water retention, and grazers.

Results:

Because of delays in receiving the final contract, we have only been able to complete ten days of field work (September 15 -24, 1990) on this study using two field personnel. During this period, two-replicate sites each of not oiled (controls), intensely cleaned, and less intensely cleaned were sampled. Sampling (cover, density, size, and attachment sites of Fucus, nearest adult Fucus, density of macro-grazers, cover of barnacles, cover of tar, abundance of various substratum relief categories, and slope; quadrats were also photographed) was done using random quadrats in the upper portion of the Fucus zone because this was the region where prior observations indicated that Fucus was recovering slowly (at sites that had been intensely cleaned). In addition, tarred portions of a number of rocky intertidal sites within the vertical limits of the Fucus zone were permanently marked and photographed for long-term recovery assessment. Finally, weather allowed only a half day survey of exposed sites outside Herring Bay, and we did not have enough time to sample the mid-portion of the Fucus zone.

We are currently analysing the results of this work, so the following results should be considered tentative. 1) The most important factors that seem to influence recovery of Fucus are substratum relief, substratum slope, wave exposure, tar, freshwater run-off, and proximity of conspecific adults. 2) There appear to be differences in abundance of some, but not all, species between the two types of oiled sites and the controls. 3) There are trends of slower recovery in the intensely cleaned sites (whether or not the trends are significant is presently being evaluated). 4) Areas still covered by tar have almost no cover of macro-organisms.

The data suggest some promising experimental manipulations to be done in spring, 1991, and sampled in early summer and/or late summer, 1991. The results of these experiments should suggest methods to enhance recovery, as well as allow a determination of the factors that cause variation in recovery among oiled sites.