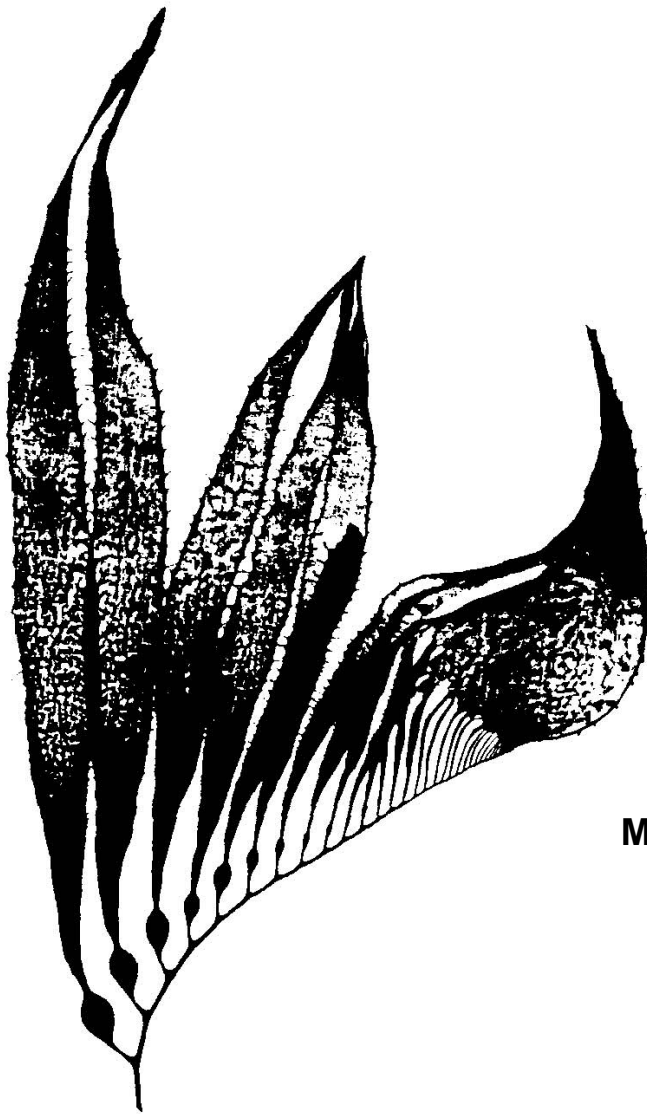


**COASTAL MARINE INSTITUTE
PROGRAM YEAR 9
QUARTERLY REPORT 3**

for the period

January 1, 2003 – March 31, 2003



*A Cooperative Program
between the*
University of California
and the
Minerals Management Service

April 14, 2003

**COASTAL MARINE INSTITUTE
PROGRAM YEAR 9
QUARTERLY REPORT 3**

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University of California

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Minerals Management Service

Russell J. Schmitt
Program Manager

Coastal Research Center
Marine Science Institute
University of California
Santa Barbara, California, 93106-6150

April 14, 2003

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Program Manager's Report

for the period January 1, 2003 – March 31, 2003

This constitutes the quarterly report for the third quarter for Program Year 9 of the Coastal Marine Institute, a cooperative research agreement between the Minerals Management Service, the state of California and the University of California. As of this quarter, 21 projects currently are being conducted under the aegis of the Coastal Marine Institute.

Actions Pending MMS Approval:

- ◆ Approval of no-cost extension for Task 14118, Contract No. 14-35-01-00-CA-30758, PIs Schmitt and Brooks, *Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell Us?*, through June 30, 2004;
- ◆ Please note that PIs Washburn & Gaines, require MMS assistance in securing access to the Rincon Island Site for Task 17608, Contract No. 14-35-01-00-CA-31063, *Observing the surface circulation along the south-central California coast using high frequency radar: consequences for larval and pollutant dispersal*.

Major Programmatic Progress and Actions during the Quarter:

- ◆ Task 12389: *Valuation of Coastal Resources – Understanding Substitution in Time and Space*, has been completed and the final study report, OCS Study 2003-013, was submitted to MMS;
- ◆ Task 13093: *A methodology for investigation of natural hydrocarbon gas seepage in the Northern Santa Barbara Channel*, has been completed. The final study report will be submitted to MMS next quarter;
- ◆ Task 13094: *Application of Coastal Ocean Dynamics Radars for Observation of Near-Surface Currents off the South-Central California Coast* has been completed and the final study report, OCS Study 2001-056, was submitted to MMS;
- ◆ Task 13095: *Effects of Produced Water on Complex Behavioral Traits of Invertebrate Larvae and Algal Zoospores* has been completed and the final study report, OCS Study 2002-050, was submitted to MMS;
- ◆ Task 13096: *Utilization of Sandy Beaches by Shorebirds: Relationships to Population Characteristics of Macrofauna Prey Species and Beach Morphodynamics*, has been completed. The final study report will be submitted to MMS as soon as the manuscript containing the data has been submitted for publication;
- ◆ Task 13293: *Logistical, Training, and Data Collection support for the MMS Marine Bird Monitoring Study in the Santa Barbara Channel and Basin*, has been completed and the final study report, OCS Study 2003-012, was submitted to MMS;
- ◆ Task 15118: *An experimental Evaluation of Methods of Surfgrass (*Phyllospadix torreyi*) Restoration Using Early Life History Stages*, has been completed and the draft final study report was submitted to MMS;

- ◆ The Adamson portion of Task 17610: *Industrial Activity and Its Socioeconomic Impacts: Oil and Three Coastal California Counties*, has been completed and the revised draft final study report was submitted to MMS.

Task 12387: *Ecological Consequences of Alternative Abandonment Strategies for POCS Offshore Facilities and Implications for Policy Development*

Principal Investigators: **Mark H. Carr**, Department of Biology, University of California, Santa Cruz, CA 95064, **Graham E. Forrester**, Dept. of Biology, University of Rhode Island, Providence, RI, and **Michael V. McGinnis**, Coastal Research Center and Ocean and Coastal Policy Center, Marine Science Institute, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

We continued to focus our efforts on writing the final report and associated publications this past quarter.

Future plans:

We will finalize and submit our final report by April 15, 2003.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

| | |
|----------------|------|
| Project Year 1 | 100% |
| Project Year 2 | 100% |
| Project Year 3 | 100% |

Task 14181: *Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell Us?*

Principal Investigators: **Russell J. Schmitt**, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106 and **Andrew J. Brooks**, Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

A number of entities (including MMS) have devoted considerable effort and resources to the long-term monitoring of various components of the coastal marine ecosystems in the Southern California outer-continental shelf (OCS) region. The primary goals of such monitoring are to estimate the current state of the biota and to identify long-term trends in population demographics. Data from such studies are vital to resource and regulatory agencies as they provide critical baseline information needed for accurate assessment of potential effects arising from such particular activities as offshore oil and gas production. The fundamental need for such information is evidenced by the growing number of coastal marine monitoring programs that have been implemented in Southern California.

Our MMS-UC CMI funded research encompasses two separate objectives: (1) the analysis and synthesis of existing long-term monitoring data and (2) the continued annual surveys of subtidal reef communities at Santa Cruz Island.

(1) The analysis and synthesis of existing long-term monitoring data.

We continue to collaborate with John Stephens Jr. and Dan Pondella of the Vantuna Research Group and Kevin Herbinson of SCE to update all of our databases through 2000 and to include data on fish larval abundances from 1977 through 2000. In addition, we have gained access to the National Marine Fisheries RACE database which enumerates catches of fishes from the continental shelf of western North America from 1977 until 2001. We plan to use these data to test hypotheses concerning “top down” versus “bottom up” flow of trophic cascades and to compare the observed responses of fishes inhabiting shallow coastal waters with those inhabiting deeper waters. It is our hope to produce a manuscript in mid-2003 that examines these relationships and that explores the role of secondary productivity in nearshore marine ecosystems.

(2) The continued annual surveys of subtidal reef communities at Santa Cruz Island.

We have continued with our monitoring of the abundances of surfperches, their invertebrate prey, and the algal cover present in benthic microhabitats at 11 permanent study sites on the south coast of Santa Cruz Island. Sampling of fish (via visual counts along permanent band transects) and algal cover (via random point contact methods) were accomplished in the manner described in our proposal. Epifaunal invertebrates collected from three of these sites have been rough sorted and preserved for later taxonomic identification. We were able to complete sampling at all of our study sites in 2002. We are beginning the process of identifying epifaunal invertebrate samples collected during our 2002 surveys.

Publications and Presentations:

We had no presentations associated with this work during this period, but have just finished a manuscript for submission to the journal Ecology Letters and are beginning work on an additional publication for the journal Ecological Applications. Brooks has been invited by the Southern California Academy of Sciences to take part in a symposium on regional trends in southern California fishes to be held at their annual meeting in May, 2003.

List of all personal associated with the project:

PIs: Dr. Russell J. Schmitt
Dr. Andrew J. Brooks

Post-graduate researchers: Keith Seydel

Undergraduate researchers: Jada-Simone White, Corrie Kane, Julie Deter

Problems Encountered:

None

MMS Action Required:

Approval of no-cost extension through June 30, 2004.

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 100% |
| Project Year 3: | 100% |
| Project Year 4: | 100% |
| Project Year 5: | 66% |

Task 15115: *Effects of Temporal and Spatial Separation of Samples on Estimation of Impacts*

Principal Investigator: Peter Raimondi, Department of Biology, University of California, Santa Cruz, CA 95064

Major Accomplishments, January 1, 2003 – March 31, 2003

Progress has been made towards the final report, which will be submitted to the Coastal Marine Institute by April 15, 2003.

Future plans:

Complete and submit the final report.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

| | |
|----------------|------|
| Project Year 1 | 100% |
| Project Year 2 | 100% |

Task 17601: *Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species*

Principal Investigators: **Mark Page**, Marine Science Institute, **Jenifer Dugan**, Marine Science Institute, and **James Childress**, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

Analysis of condition data for the gastropod *Cypraea spadicea* showed that individuals from the mound under platform Gina had greater dry tissue weight per unit of shell length than individuals from mound only habitats, suggesting greater lipid storage and/or gonadal development. Our earlier results found that *Asterina miniata* were significantly larger on the mound under platform Gina relative to shell mounds without overlying platform structure, Hilda and Hazel. We hypothesized that the availability of a food subsidy in the form of faunal litterfall at Platform Gina, but not the shell mounds at the former sites of Platforms Hazel and Hilda, may have comparable effects on the nutritional condition of *A. miniata*. To investigate this hypothesis, additional individuals of *Asterina miniata* were collected from the shell mounds at the former sites of platforms Hazel and Hilda and from the shell mound beneath platform Gina and measured for body size and body dry mass in order to continue development of an index of nutritional condition for use in comparisons across habitats. Animals were collected by divers from the shell mounds with and without platforms, arm radius measured to the nearest mm, oven dried to a constant weight, and weighed. Ordinary least squares regressions of body size and dry mass were calculated for each habitat sampled and compared statistically. For *Asterina miniata*, the slopes of the relationship between arm radius and dry weight did not differ significantly between habitats ($p > 0.05$, test for homogeneity of slopes). This result suggests that *A. miniata* may respond to greater resource availability by increasing linear body size rather than storing lipids.

Progress continued on the preparation of the master's thesis and on a manuscript for publication in a scientific journal based on these results.

Upcoming work:

Preparation of a Masters thesis and a manuscript for publication will continue. Additional animals will be collected and analyzed from benthic habitats under platforms and on shell mounds.

Problems Encountered: None

MMS Action Required: None

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 66% |

Task 17602: *Inventory of Rocky Intertidal Resources in Southern Santa Barbara, Ventura and Los Angeles Counties*

Principal Investigator: **Richard F. Ambrose**, Department of Environmental Health Sciences and Environmental Science and Engineering Program, University of California, Los Angeles, CA 90095-1772

Lead Technician: Steven F. Lee, M.S. (Dept. of Environmental Health Sciences and Environmental Science and Engineering Program, University of California, Los Angeles, CA 90095-1772)

Major Accomplishments, January 1, 2003 – March 31, 2003:

During this quarter, the bulk of our efforts revolved around the planning and executing the Spring 2003 sampling, as well as miscellaneous tasks relating to the project as a whole. Spring sampling occurred throughout the month of March (Table 1). Sampling was completed successfully, but rain, strong storm surge, and large breaking waves hindered sampling at many of the sites. At White's Point, heavy surf delayed the beginning of sampling by 1.5 hours, and then after the plots were set out, a large and unexpected wave swamped and washed away some of our sampling equipment. While much of the work was completed on that day, we had to visit

Table 1. Spring 2003 Sampling Schedule

| Date | Location | Personnel | Comments |
|----------|----------------|--|--|
| March 1 | Paradise Cove | Steven Lee, Meera Venkatesan, Ann Bull, Maurice Hill, Catrina Martin | UCLA personnel with MMS and USFWS help |
| March 2 | Mussel Shoals | S. Lee, M. Venkatesan, A. Bull, Dave Panzer, C. Martin | UCLA personnel with MMS and USFWS help |
| March 3 | White's Point | S. Lee, M. Venkatesan, Fred Piltz | UCLA personnel with MMS help |
| March 13 | Coal Oil Point | S. Lee, Kathy Pfeifer | UCLA personnel with SB County help |
| March 14 | Old Stairs | S. Lee, M. Venkatesan, M. Hill | UCLA personnel with MMS help |
| March 16 | Alegria | S. Lee, M. Venkatesan, K. Pfeifer, Mary Elaine Dunaway | UCLA personnel with MMS and SB County help |
| March 17 | Carpinteria | S. Lee, M. Venkatesan, K. Pfeifer | UCLA personnel with SB County help |
| March 18 | Point Fermin | S. Lee, M. Venkatesan, D. Panzer | UCLA personnel with MMS help |
| March 27 | Arroyo Hondo | S. Lee, M. Venkatesan, K. Pfeifer | UCLA personnel with SB County help |
| March 28 | Coal Oil Point | S. Lee, M. Venkatesan | UCLA personnel only |
| March 28 | Carpinteria | S. Lee, M. Venkatesan | UCLA personnel only |
| March 29 | White's Point | S. Lee, M. Venkatesan | UCLA personnel only |

the site a second time to finish the sampling. Sampling at Arroyo Hondo was cancelled due to heavy rain, and the site was instead sampled later in the month. The seals were absent from the rocks at Carpinteria this season, but heavy surf prevented the offshore mussel bench from being sampled. The mussel and seastar plots had to be sampled on a follow-up visit. Coal Oil Point had to be visited twice as well, but this was not due to the heavy surf (see below). All of the Spring data are now collected and are in the early stages of data management. All of the photographic images have been labeled and are ready to be scored, and the motile invertebrate and *Lottia gigantea* data have been entered into the appropriate Excel files. The rest of the data are awaiting the completion of the new database management system before they can be entered into the computer.

New plots were established this season at two of the sites. At Coal Oil Point, we established a set of five mussel photoplots on an expansive mussel covered bench that occurs just upcoast of the other plots. The plots were setup from downcoast (M1) to upcoast (M5). Mussel cover was dense but not always 100% at the start. Care was taken to avoid other research markers that occurred in the area. An old 8" diameter vertical pipe occurred just inshore of the M1 plot and this was considered a good reference point, so no reference bolt was affixed. Photos (overview and for scoring) were taken on the first day of setup, but motile invertebrates and interbolt measurements were taken on a follow-up visit for logistical reasons. At Point Fermin, a set of five 1m-radius circular *Lottia gigantea* plots were established along with three contiguous seastar irregular plots. All of these plots were located in the general vicinity of the previously established mussel plots. In order to minimize the number of bolts, the new *Lottia* plots were established using the existing bolts of the mussel plots. For four of these plots the main, notched (upper left) bolt of the mussel plots was used, but for one of them (*Lottia* #3), the upper right, un-notched bolt was used. This was to avoid overlap of the circular plots. The numbering of the *Lottia* plots corresponded with that of the mussel plots. The seastar plots were established on the same bench and encompassed the five mussel/*Lottia* plots. The corners of these irregular plots followed terrain features but due to time constraints, no bolts were installed. Instead, a series of photographs was taken to document the position of the plots for future layout and bolt installation. The initial sampling of the *Lottia* and seastar plots was done on the day of their creation. The only other site where additional plots might be established is White's Point. That site could probably support a set of seastar plots and a set of *Lottia gigantea* plots. This season saw the continued sampling of many of the recently established plots such as surfgrass and seastars at Alegria, *Lottia gigantea* at Carpinteria, *Lottia gigantea* at Mussel Shoals, and seastars at Paradise Cove.

The motile invertebrate sampling protocol has remained in the development stage and has still not been implemented by all MARINE groups. In an attempt to solidify the methods, a three person sub-committee (Steven Lee, Dan Richards, and Melissa Wilson) was formed to revisit the issue. During the sampling last fall, the revised methods were tested and our final recommendations were offered to the rest of the MARINE groups prior to the spring sampling. It is unclear if any of the remaining groups implemented the motile invertebrate protocol at their sites, but at our sites, the Spring 2003 sampling marked the second season of the revised methods and we continue to feel that the methods are useful and should be adopted by the rest of MARINE. The methods take some time to get used to, but once in place, can be employed without an unreasonable time commitment. At Carpinteria and Alegria, motile invertebrates were again sampled within *Pollicipes* plots, and within *Balanus* plots at White's Point. Sampling

of littorines is still limited to the *Chthamalus* barnacle plots, and limpets occurring on mussels are not counted (only those found on rock).

The conversion to digital photography has now been fully implemented. This Spring 2003 sampling represents the first season where no emulsion (slide) photographs were taken, even as backup. The ease of obtaining and double checking the quality of images, together with the storage capabilities of the modern computers and storage media, means we no longer have to worry about being conservative with the number of photographs we take. Therefore, we do not hesitate to take a third or fourth photo of a particular plot if we want to adjust lighting or exposure, plus we have added additional photographic reference points. Back in the lab, we simply choose the best two photos for each photoplot and delete the rest. We have instituted a standardized system of nomenclature for all of the digital photographs and file folders and these will be continue to be archived and distributed to the different MARINE groups as appropriate.

Steven Lee continues to be the primary technician on this project, along with another technician, Meera Venkatesan. Sean Bergquist, a UCLA technician who has been involved with the project for the last three years, has left the project. MMS personnel continue to provide sampling assistance. In addition, Santa Barbara County has a new planner (Kathy Pfeifer) who will provide assistance at the southern SB county sites. We have also been getting help from Catrina Martin from USFWS in Ventura.

This season marked the second use of our latest site description page. There have been several modifications of this form over the last several years, and the current version represents a combination of the old narrative approach and a newer approach developed by Steven Lee at UCLA that features abundance class data for species, which could be entered into a computer database and used analytically. This new version is a significant improvement over the previous versions, but there are still some elements that could be improved upon. It remains our belief that a more comprehensive species reconnaissance form could be adopted that provides information on species other than the core taxa.

Many of these protocol standardization issues have been driven by the current contract between MARINE groups and SCCWRP to develop a database management system for this project. This process is nearing completion and an early beta testing version of the database has been released. Steven Lee of UCLA has volunteered to be the beta tester for entering data into the new database, and is currently communicating with Larry Cooper of SCCWRP regarding the bugs that need to be worked out.

Future Plans:

Throughout the present quarter, the remainder of the tasks relating to the Spring 2003 sampling season will be completed. The photoplot slides will be scored. There is still a question as to when the new Microsoft Access database will be ready, but until then we are not able to enter most of the data from the Spring sampling. Hopefully, some of these data can be entered during the beta testing phase of the new database, and that these data won't have to be entered a second time once the bugs in the system are fixed. We also plan to revisit all of the sites during the remainder of this series of springtime low tides to do some general site maintenance, to GPS all of the bolts and plots using our new mapping-grade GPS, and to begin collecting voucher specimens from the sites. The planning and scheduling of these site visits are currently underway. Once all of the high resolution GPS data are collected, a new set of site maps can be

generated. This is an important time to do this because of all the new plots we have been establishing at the sites.

Problems Encountered:

High surf hindered the sampling at many of the sites during the past sampling period. At one of the sites a rogue wave swamped our sampling gear, flooding our metal detector. We immediately disassembled and dried it so it wouldn't be destroyed, but in the process broke the solder connections to the speaker. The metal detector still works, but only by using a set of headphones connected to the audio jack. At White's Point, while retrieving equipment dispersed by a large wave, a second even larger wave swept over the protective offshore rock formation and overwhelmed two of the sampling personnel. While one person (Meera Venkatesan) simply got wet, the other person (Fred Piltz of MMS) lost his footing during an evasive maneuver and was injured (luckily, not critically) as the wave enveloped him.

MMS Action Required:

None

Task 17604: *Shoreline Inventory of Intertidal Resources of San Luis Obispo and Northern Santa Barbara Counties*

Principal Investigator: Pete Raimondi, Department of Biology, University of California, Santa Cruz, CA 95064

Major Accomplishments, January 1, 2003 – March 31, 2003:

During this quarter the six study sites in San Luis Obispo County (SLO) were sampled for the 15th time, and the five sites in Northern Santa Barbara County (NSB) were sampled for the 22nd time. Sites were sampled November 3rd-7th and 19th-21st.

We have made an effort during the past several months to fully standardize our sampling methods with all groups in MARINE (Multi-Agency Rocky Intertidal Network). We have also switched from photographing our target species photoplots using a 35 mm Nikonos and slide film to using a digital camera. This method worked well in the field for the fall sampling and we anticipate having better quality images overall because we can review them in the field. In addition, scoring of the images on a computer monitor in the lab should ultimately be faster than doing it with slides and a projector.

Future Plans:

In the next quarter we will sample the three remaining NSB sites. We will also score our digital photoplot images and enter these percent cover data along with field data into the MARINE database. Analyses of both long-term monitoring and comprehensive sampling data will continue in the next quarter and we will begin to write up some of our findings for publication.

Problems encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

| | |
|-------------------|-----|
| SLO, NSB portions | 85% |
|-------------------|-----|

Task 17605: *Population Dynamics and Biology of the California Sea Otter at the Southern End of its Range*

Principal Investigators: **James Estes**, Supervisory Wildlife Biologist, USGS-BRD; **Terrie Williams**, Professor of Biology, University of California, Santa Cruz; **Daniel Costa**, Professor of Biology, University of California, Santa Cruz; **Katherine Ralls**, Research Zoologist, Smithsonian Institution; **Donald Siniff**, Professor of Ecology, Evolution & Behavior, University of Minnesota.

Major Accomplishments, January 1, 2003 – March 31, 2003:

Monitoring of radio-tagged study animals by fieldworkers based at Piedras Blancas field station, San Simeon CA, continues as before. Our sample now consists of 47 sea otters captured in the northern study area (San Simeon) and 25 sea otters captured in the southern study area (Point Conception), for a total of 72 study animals. Of these, 45 were also equipped with Time-Depth Recorder (TDR) instruments. We have recovered 11 of the deployed TDRs to-date and downloaded the time-depth data from them for analysis. More re-captures are planned for March 17-21 in the northern study area, and for April 1-4 in the southern study area, in order to retrieve additional TDR instruments.

Of the northern study group, 8 of 47 animals (17%) are confirmed dead with carcasses recovered, and an additional 2 (4%) are missing but assumed dead. All other animals (79%) are alive and re-sighted regularly. Of the southern study group, 1 of 25 animals (4%) has been confirmed dead, one other is missing and unaccounted for, while all remaining animals (92%) are alive and re-sighted regularly. More than 10,000 re-sights have been collected on study animals to date, providing data on both fine-scale patterns of habitat use as well as long-distance movement patterns. As reported previously, the male animals captured at the southern study site continue to move throughout the entire sea otter range, with re-sightings as far north as Santa Cruz and Elkhorn Slough. Data collection on sea otter foraging is progressing well, with over 25,000 feeding dives recorded to date.

Problems Encountered:

No problems have been encountered.

MMS Action Required:

No MMS action required.

Future plans:

Work will proceed as proposed.

Estimated Percentage of Budget Expended:

| | |
|----------------|------|
| Project Year 1 | 100% |
| Project Year 2 | 100% |
| Project Year 3 | 90% |

Task 17606: *Population genetics of surfgrass (Phyllospadix torreyi) for use in restoration.*

Principal Investigators: **Scott Hodges**, Department of Ecology, Evolution and Marine Biology, **Douglas Bush**, Marine Science Institute, **Sally J. Holbrook**, Department of Ecology, Evolution and Marine Biology, and **Daniel Reed**, Marine Science Institute, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

We have made significant progress on determining the genetic variation among samples of *Phyllospadix torreyi* during this last quarter. As stated in our last report, we have completed our laboratory work on generating the DNA fingerprints via Amplified Fragment Length Polymorphisms (AFLP). This has generated a great deal of data that we will use to identify population structure of *P. torreyi* along the Central California coast. We have spent most of this quarter confirming our scoring of the data using image analysis software. This has been essential in order to assure accuracy of our results. We have also nearly finished analyzing our data to identify the samples that represent multiple collections of the same clone. This analysis is necessary because for our analysis of population structure, we need to only include one representative sample of each genetic individual.

Problems Encountered:

We have not encountered any problems during this quarter.

MMS Action Required:

None

Future plans:

During the next quarter we plan to finish our identification of clones and to begin the analysis of population structure. We also plan to prepare manuscripts reporting our findings.

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 92% |

Task 17607: *Public Perceptions of Risk Associated with Offshore Oil Development*

Principal Investigator: Eric R.A.N. Smith, Department of Political Science, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

In July, a public opinion survey designed by this research team was conducted by U.C. Santa Barbara's Survey Research Center. This survey was entirely funded by a grant from the University of California's Energy Institute. Because some additional funding remained at the end of the survey period, a follow-up survey was conducted in October. The sample size is 1,285. These data are now being analyzed.

A paper stemming from an earlier part of this project, "Postmaterialism vs. Cultural Theory as an Explanation of Environmental Opinion," was submitted to *Public Opinion Quarterly* for publication. When it is published, the paper will be co-authored by Eric Smith and his graduate research assistant, Juliet Carlisle. The paper was given a "revise and resubmit" by the journal. We have revised and resubmitted it.

A proposal for a paper, "Trust during an Energy Crisis," has been accepted for delivery at the annual meeting of the American Association for Public Opinion Research (AAPOR) in May. In this paper, we investigate public support for oil drilling, public trust in the oil industry, in environmental groups, and in government regulators--including both Interior Department staff in Washington, and local MMS staff in California. We also investigate people's beliefs about whether high gasoline prices are caused by supply shortages or price-fixing by oil companies. We are currently writing this paper, and we expect to send a draft of the paper to MMS in April.

Future Plans:

We plan to deliver "Trust during an Energy Crisis" at the AAPOR meeting in May, and then submit it for publication. We also plan to prepare several other papers and reports based on the survey in the coming months.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: 100%
Project Year 2: 100%
Project Year 3: 59%

Task 17608: *Observing the Surface Circulation along the South-Central California Coast Using High Frequency Radar: Consequences for Larval and Pollutant Dispersal*

Principal Investigators: Libe Washburn, Institute for Computational Earth System Science and Department of Geography, and Stephen Gaines, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

During the quarter 1 January – 31 March 2003 we progressed on several aspects of this project. We are now working with an environmental consultant, Ms. Judy Wood of Wood Environmental Services, to secure a permit for a new HF radar site at the Rincon Island west of Ventura, California. Experience has shown that the permit process to access a new site is long and complicated so we believe a specialist in this area can help expedite the issue. This site has proven particularly difficult to gain access to because the original lessee, Rincon Island Limited Partnership has gone bankrupt and a new lessee has not yet been identified by the California State Lands Commission. We will also work with this consultant in our pursuit of another permit at the Mandalay Generating Station. We are currently working with the owner of the station, Reliant Energy, to conduct tests to see if electronic noise from the plant will be a problem.

We made progress scientifically in a number of aspects of this project. A revised manuscript entitled “Evaluating radial current measurements from CODAR high frequency radars with moored current meters Brian M. Emery, Libe Washburn, and Jack A. Harlan was re-submitted to the Journal of Atmospheric and Oceanic Technology. This manuscript describes our extensive evaluation of HF radar performance based on comparison with current meter time series. Another manuscript entitled “Observations of wavelike circulation using HF radar in the Santa Barbara Channel, California during 1998-2000” by Edwin Beckenbach and Libe Washburn is almost ready for submission to the Journal of Geophysical Research, Oceans. This manuscript describes what we believe are topographic Rossby waves over the Santa Barbara Basin. They are important because they appear to disrupt the more persistent cyclonic circulation in the western Santa Barbara Channel.

Experiments in applying a new technique for extending the range of our HF radars are encouraging. We have been working with personnel at CODAR Ocean Sensors, of Los Altos, California to apply software modifications to extend the range from 42 km to 60 km. The range extension has been achieved, but we will not realize its full benefit until our additional sites are installed.

We are also continuing our analysis of near shore eddies which we discovered near our site at Coal Oil Point. Preliminary analysis indicates that the eddies transport cold nutrient rich water on shore. A new graduate student at UCSB, Ms. Corinne Bassin, is working to characterize the basic parameters of the eddies such as the strength of their currents, their size, and their duration. We are also planning field experiments to learn more about them and their significance for near shore transport.

Action requested from MMS:

Any assistance MMS can give in our dealings with the California State Lands Commission to gain access to the Rincon Island site would be greatly appreciated.

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 96% |

Task 17609: *Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products*

Principal Investigators: **Russell J. Schmitt**, Department of Ecology, Evolution and Marine Biology, **Jenifer Dugan**, Marine Science Institute, **Scott Hodges**, Department of Ecology, Evolution and Marine Biology, **Robert Jacobs**, Department of Ecology, Evolution and Marine Biology, **Mark Page**, Marine Science Institute, **Leslie Wilson**, Department of Molecular, Cellular and Developmental Biology, and **Stephen Gaines**, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

ECOLOGY

During this quarter we began to explore relationships between various geographic factors (water depth, distance from shore, and distance along the coast) and patterns of recruitment of invertebrate taxa onto settlement plates at the seven study platforms. In preliminary analyses, there was a significant correlation between location along the coast and recruitment (abundance) of three of the four taxa (barnacles, hydroids and tubuculous amphipods) on tiles. In contrast, there was no correlation between water depth or distance from shore with recruitment patterns of any of the taxa.

We also began investigating possible relationships between environmental factors (e.g., temperature, chlorophyll *a*) and growth patterns of the model suspension feeding organism, *Mytilus galloprovincialis*, on the platforms. Chlorophyll *a* data for our specific study sites and periods were obtained from the SeaWiFS database (via the Institute for Computational Earth System Science (ICESS), U.C. Santa Barbara). In addition, we obtained sub-surface (15m – our experimental depth) temperature data from temperature loggers deployed during our experiment. Preliminary analyses indicate that water temperature may partially explain differences in mussel growth rates among platforms, whereas chlorophyll *a* concentrations do not.

We completed data collection from our photo-quadrat surveys using point contact analysis of the photographs. These surveys consist of photographic sampling at four depths both up and down current at four randomly chosen conductor pipes and four outside platform legs (64 photo-quadrats per platform, 448 photo-quadrats total). Spatial and temporal patterns in the distribution and abundance of invertebrates at the platforms are now being analyzed.

During this quarter, we also collected specimens of encrusting invertebrates from several offshore platforms for use by the other research groups collaborating on this project. Specifically, we collected anemones (*Diadumene* sp.) and colonies of the introduced encrusting bryozoan (*Watersipora cucullata*) from Platforms Gail and Gilda for pharmaceutical analysis by Dr. Jacobs group. Additional specimens of anemones were collected and sent to taxonomic experts for analysis and identification. In addition, we collected branching bryozoans (*Filicrisia franciscana* and *Crisia occidentalis*) from Gail and Grace for genetic analysis by Dr. Hodges group.

In February, we prepared and presented a poster of our results entitled “Patterns of recruitment, abundance and distribution of invertebrates and fishes on offshore platforms: relationships to gradients in oceanographic conditions.” at the annual ASLO (American Society of Limnologists and Oceanographers) meeting in Utah.

PHARMACOLOGY

Marine organisms that inhabit the subtidal structures of offshore oil production platforms are a potential source of novel compounds for pharmaceutical use. These organisms provide an unparalleled opportunity to study natural product chemistry from populations of organisms living in ecologically unique habitats.

In this report we are describing our data on the effects of coumarin compounds isolated from algae found on oil platforms on the sea urchin cell division assay. In addition, we are also presenting our work on the effects of dicoumarol (the prototype coumarin compound used in the microtubule assays that were previously presented) on mammalian breast cancer cell lines.

We are also presenting our data from the continuing task of detailed bioassay-guided fractionation using Straight and Reverse Phase High Pressure Liquid Chromatography (HPLC) and Preparative Thin layer Chromatography of the three organisms collected from OCS oil platforms in the Santa Barbara Channel. We have also begun derivitizing the extracts to methyl esters to increase stabilization. As well we have been collaborating with Dr. Paul Scott at the Santa Barbara Natural History Museum and Dr. Daphne Fautin at the University of Kansas to carefully identify all the invertebrates collected and under study

Coumarins Isolated from *Batophora oerstedii*

Background and Evolutionary Significance of *Batophora oerstedii*

Batophora oerstedii belongs to the order Dasycladales, a group of primitive unicellular algae members of the kingdom Protocista. Dasycladales represents an order of green algae that existed during the Cambrian era 570 million years ago. Most eukaryotes evolved prior to the Cambrian period 640 mya. However, plants (gymnosperms) arose during the carboniferous period 320 mya. Out of 175 Dasycladales known genera, only 11 extant genera remain today. Because of this low number, scientists have classified them as “living fossils” and have suggested that an extinction of this order is at hand.

While most unicellular organisms are microscopic, *Batophora oerstedii* is a unicellular alga 20-70 mm in length and 3-6mm in diameter. It is a widespread and frequently found species that grows on oil production platforms located in the Gulf of Mexico. Coumarins had not been known as constituents in green algae until in 1983 it was reported for the first time the occurrence of a 3,6,7-trihydroxycoumarin in this order of alga.

We believe that these molecules present in algae are potentially not only able to regulate the growth of epiphytes, but may also function as an internal growth regulator by affecting microtubule polymerization. In the elongated *Dasycladus* cell, organization of the cytoskeleton is involved in its morphogenesis. The oriented transport of materials plays an essential role in morphogeneses. This transport can be visualized as cytoplasmic streaming and is mediated by a concerted action of actin filaments and microtubules. The ability of coumarins to modulate and

function in growth by effecting microtubule dynamics has not been investigated. To define further the mechanism of action of these compounds, the purpose of this work is to examine the growth regulatory effect of 3, 6, 7-trihydroxycoumarin in *Batophora oerstedii* (of the order Dasycladales). Exploration of this coumarin derivative should result in further data concerning the precise mechanism(s) of action of this class of compounds and thus a better understanding of the potential clinical uses.

Results of Coumarins Isolated from *Batophora oerstedii*

As seen in Tables 1 and 2, the midpolar lipid extracts of *Batophora oerstedii* are active in inhibiting the cell division of sea urchin embryos. This is expected, since the coumarins would be localized in either the chloroform or ethyl acetate fractions. An interesting observation is that the ethyl acetate fractions in both collections become more active once they are acid hydrolyzed, indicating that once the glycosides are cleaved off the coumarin molecules they become more active.

Table 1: *Batophora oerstedii* Extracts and their effects on Sea Urchin Cell Division

| Fraction (100 ug/ml) | Non Acid Hydrolyzed % Inhibition of Cell Proliferation | Acid Hydrolyzed % Inhibition of Cell Proliferation |
|----------------------|---|---|
| Crude Extract | 100 | 80 |
| Hexane | 10 | 8 |
| Chloroform | 20 | 10 |
| Ethyl Acetate | 81 | 100 |

Dose Response curves of *Batophora oerstedii* crude extracts (Figure 1) demonstrate an IC_{50} of approximately 44 μ M. Chloroform extracts demonstrate a dose response curve (Figure 2) with an IC_{50} of approximately 52 μ M.

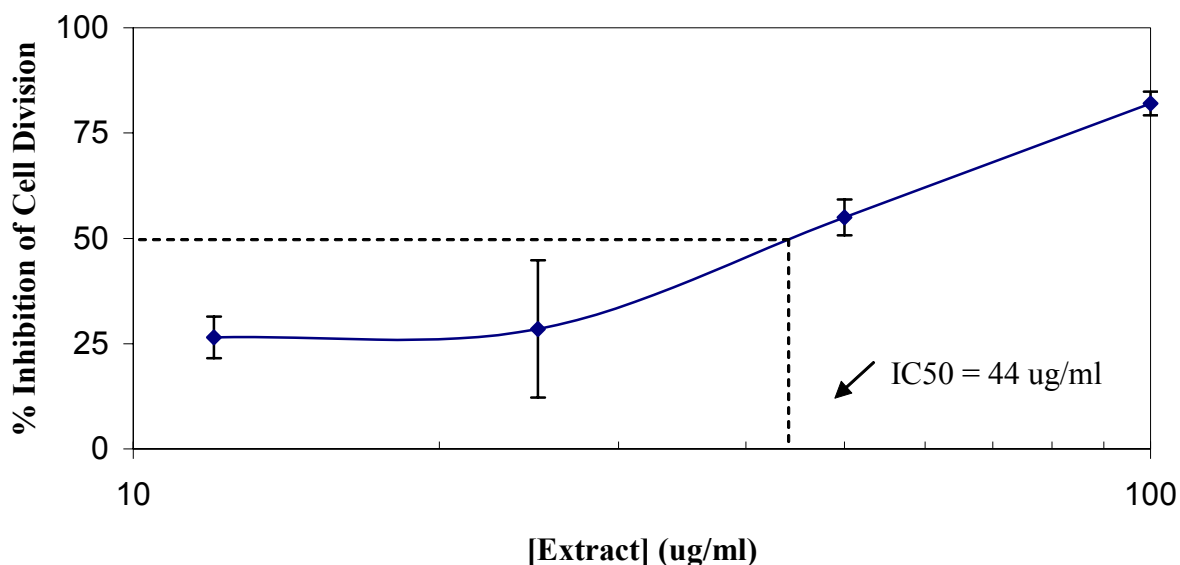


Figure 1: Inhibition of Sea Urchin Cell division by Crude Extracts of *Batophora* sp.

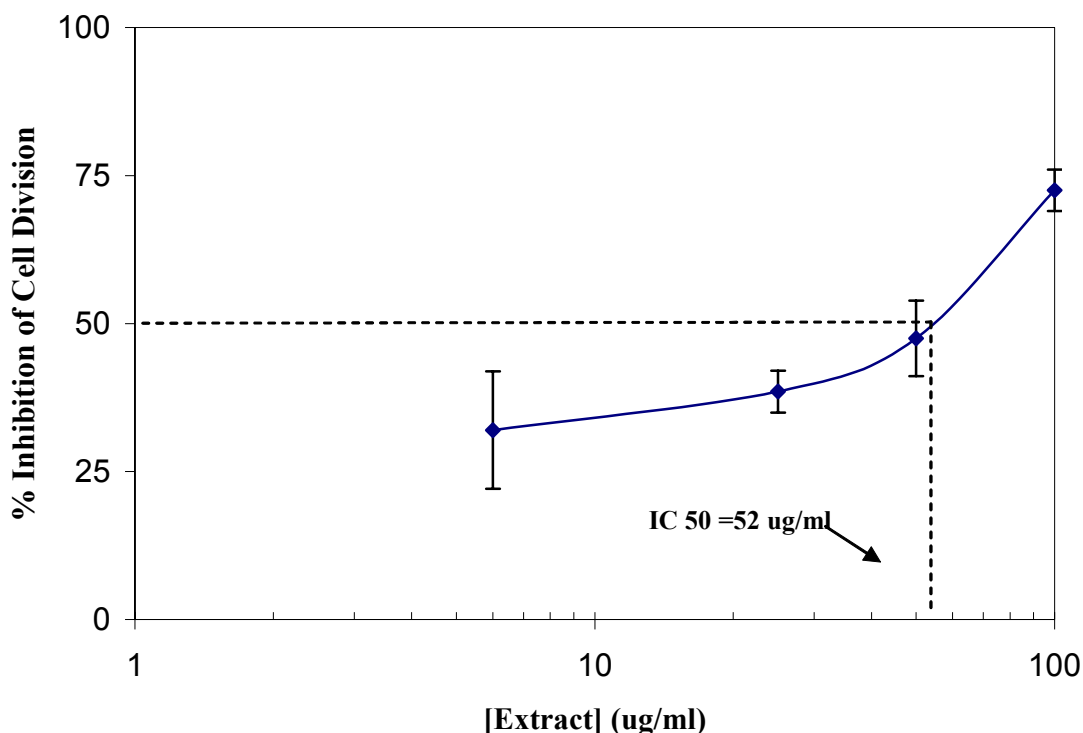


Figure 2: Inhibition of Sea Urchin Cell Division by ethyl acetate extracts of *Batophora* sp.

Effects of Dicoumarol on MCF-7 Breast Cancer Cell Proliferation

Previously we reported dicoumarol (a coumarin anticoagulant; 3, 3'-methylenebis [4-hydroxycoumarin]) inhibits the first cleavage of *S. purpuratus* (sea urchin) embryos in a concentration dependent manner with 50% inhibition occurring at a concentration of 10 μ M. We used dicoumarol as the model compound for the effects of coumarins on cell proliferation because it was the most potent of the coumarin compounds we tested. We found that dicoumarol binds to bovine brain tubulin with a K_d of 22 μ M, and that 0.1 μ M dicoumarol strongly stabilizes the growing and shortening dynamics at the plus ends of the microtubules *in vitro*. The anti-mitotic effects of the widely used cancer chemotherapeutic agent taxol (paclitaxel) are also mediated by suppressing microtubule dynamics. We demonstrated that exposure to combinations of taxol and dicoumarol results in a synergistic inhibition of cell division of sea urchin embryos. In addition, we found that dicoumarol disrupts microtubule formation and the proper alignment of mitotic chromosomes in sea urchin embryos by immunofluorescence microscopy.

The results suggest that the anti-proliferative mechanism of action of dicoumarol and possibly related pharmacophores may be mediated by tubulin binding and the stabilization of spindle microtubule dynamics.

Our previous reports were primarily mechanistic studies using the sea urchin cell division assay as our model system since it is highly selective for microtubule-targeted agents. However, we

were interested in seeing the effects of dicoumarol on a mammalian cancer cells, more specifically MCF-7 breast cancer cells. As seen in Figure 3, dicoumarol is able to inhibit the cell proliferation of MCF-7 breast cancer cells with an IC_{50} of approximately 37 μ M. We are currently working immunofluorescent microscopy studies on these cells to test if dicoumarol disrupts microtubule formation as in the sea urchin embryo.

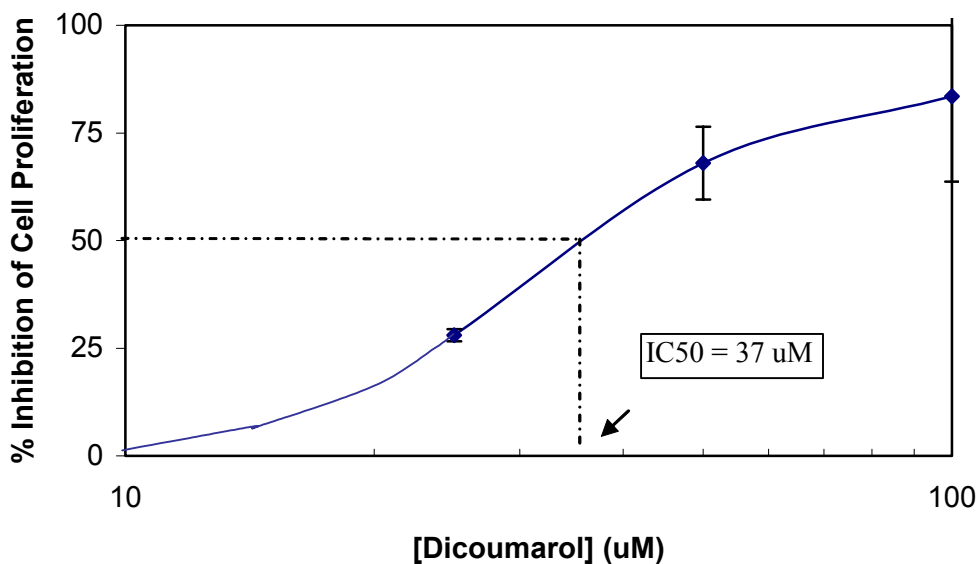


Figure 3: Inhibition of MCF-7 Cell Proliferation by Dicoumarol

Table 2. Comparison of the Effects of Coumarins on Sea Urchin Cell Division and Breast Cancer Cell Division

| Compound | IC ₅₀ in Sea Urchin Cell Division Assay | IC ₅₀ in MCF-7 Breast Cancer Cell Lines |
|---|--|--|
| Dicoumarol | 10 μ M | 37 μ M |
| Coumarins in <i>Batophora oerstedii</i> (Ethyl Acetate Fractions) | 52 μ M | |

Identification of the unidentified Anemone

The laboratory of Dr. Daphne Fautin at the University of Kansas, Lawrence, has been examining both preserved and live specimens of a sea anemone initially identified as *Metridium exiles*. They are finding very interesting and unique structural information such as tiny bodies (about a micron in diameter) in the mesoglea of the body wall. They have not found comparative anatomy in the taxonomic literature or in data bases that is remotely morphologically similar to sections they have taken, leading to the exciting conclusion that this may be a yet unidentified anemone. We have re-supplied them with additional collections and they are currently conducting bacteria-diagnostic stains and vital stains to confirm their results.

Bioassay-Guided fractionation of semi-pure extracts using HPLC for *Corynactus californica* and the unidentified anemone

For HPLC purification, the organisms are extracted using our optimized method designed especially for the organism and fractionated using a flash column to obtain a semi-pure extract.

After activity of the fraction is confirmed using the sea urchin cell division assay, the semi-crude preparation is characterized spectrophotometrically then the extract is purified by HPLC. In the case of the unidentified anemone, 100% bioactivity was retained in the (50/50) chloroform-methanol fraction, which showed a pure UV scan with an intense signal at 243 nm. This fraction was run on HPLC and the major peaks were collected. We are in the process of analyzing each peak for bioactivity. Preparative thin layer chromatography may be employed as well as a tool to further purify the extract.

The active fractions in *Corynactis californica* were lipid soluble in chloroform and markedly inhibited sea urchin embryo division. Based on the polarity of the extract, we have been using straight-phase silica HPLC columns to further fractionate the extract on a gradient of hexane in ethyl acetate. Fractions were collected and evaluated for activity using the sea urchin assay. An active group of peaks have been isolated.

Bioassay-Guided Fractionation of *Watersipora cucullata*

As was mentioned in the last report, the extracts of *Watersipora cucullata* was separated on reverse phase activated C18 silica columns, using an isocratic mobile phase of 94 methanol: 4 Acetonitrile: 2 water, an active peak that was pigmented pink was located. This peak proved very unstable and bioactivity was lost almost immediately. To stabilize the extract, we employed new extraction and storage techniques. The extraction was conducted by lyophilizing the bryozoan and grinding it to a powder and then subjecting the powder to solvents of differing polarities (Hexane, Ethyl Acetate, Methylene Chloride and Methanol), while heating and stirring. The active extract was found in the 100% methylene chloride fraction. To further stabilize the extract we acidified and derivatized the extract with Diazomethane gas to produce methyl esters on terminal carboxylic groups. The extract was stored in 1:1 isooctane/ethanol for stability purposes. This methylene chloride extract with methyl esters was 100% active in the sea urchin cell division assay and separated very well on thin layer chromatography (TLC). Thus we began to use preparative thin layer chromatography to separate the fractions further (Figure 3). Layers corresponding to colored bands on the TLC were scraped off and the compounds were extracted from the silica using ethyl acetate, hexanes and methanol. The semi-pure extracts were then evaporated under nitrogen gas and tested in the sea urchin assay. Two specific bands with differing polarities had 100% activity in the sea urchin cell division assay, indicating that there are at least two if not more active compounds in *Watersipora cucullata*.

Assay of Crude Extracts on Mammalian Cancer Cell Lines

To confirm the biological activities seen in the sea urchin cell division assay, crude extracts of the unidentified anemone and *Corynactis californica* were tested on Hela cells, an ovarian cancer cell line and A549 cells, a lung cancer cell line. The dose-response curves are presented in Figures 5 and 6 and a comparison of the IC₅₀ of all the crude extracts of the organisms in our study is presented in Table 3.

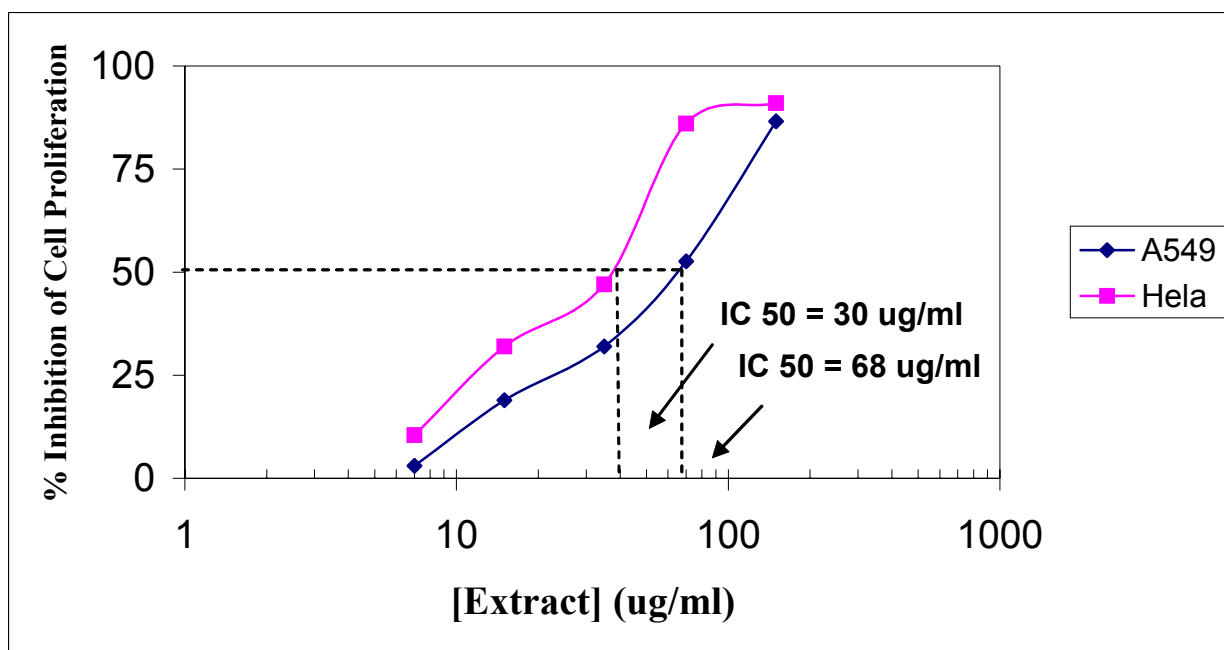


Figure 5: Inhibition of Cell Proliferation by the unidentified Sea Anemone

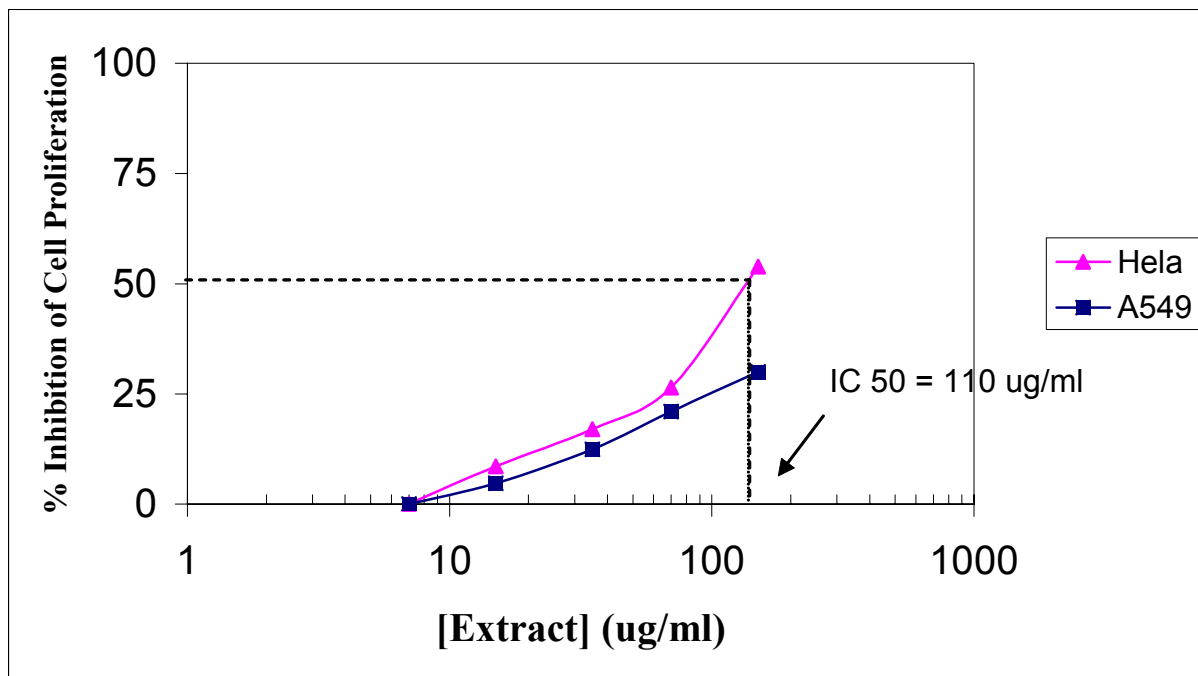


Figure 6: Inhibition of Cell Proliferation by *Corynactis californica*

Table 3: Inhibitory concentration at 50 % of crude extracts.

| Organism | IC ₅₀ in Sea Urchin Cell Division Assay | IC ₅₀ in Hela Ovarian Cancer Cell Lines | IC ₅₀ in A549 Lung Cancer Cell Lines |
|-------------------------------|--|--|---|
| Unidentified Anemone | 250 ug/ml | 30 ug/ml | 68 ug/ml |
| <i>Corynactis californica</i> | 110 ug/ml | 110 ug/ml | 110 ug/ml |
| <i>Watersipora cucullata</i> | 28 ug/ml | Studies not completed | Studies not completed |

Summary points

- We confirmed our original hypothesis that coumarins produced by algal sources growing on oil platforms represent new opportunities to develop a new class of anti-cancer agent.
- We have discovered what appears to be an unidentified sea anemone on platform Gail in the Santa Barbara channel and have found extracts of this anemone to be active in sea urchin cell division assay as well as in ovarian and lung cancer lines.
- We have developed conditions for isolation of a new extract from *Corynactis californica* and discovered activity in a sea urchin cell division assay as well as ovarian and lung cancer lines.
- We have identified at least two active separate compounds in *Watersipora cucullata*

GENETICS

We have made significant progress on determining the genetic variation among samples of *Bugula neritina* during this last quarter. We identified, cleaned, and DNA from an additional 112 samples of *B. neritina* (25 from Catalina Island, 24 from Platform Hogan, 16 from platform Houchin, 2 from Anacapa Island, 4 from Naples reef, and 41 from several sites on Santa Cruz Island). We have nearly finished quantifying the DNA concentrations from all of these samples. Currently we have approximately 16 samples remaining for DNA extraction to complete our sample survey. We have also begun DNA amplification and sequencing of a portion of the mitochondrial genome for the samples where DNA extraction and quantification have been completed.

Future Plans:

The pharmacological aspect of our study will continue isolation of active compounds from organisms collected from the oil platforms including mass spectrometry to retrieve an empirical formula. In addition, the actions of the purified compounds on microtubule polymerization, microtubule dynamics, both in vitro and if appropriate, in living tumor cells will be analyzed.

During the next quarter, the genetic aspect of our study will finish the DNA extractions and quantifications and amplify and sequence the portion of the mitochondrial genome previously identified.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 56% |

Task 17610: *Joint UCSB-MMS Pacific OCS Student Internship Program*

Principal Investigators: **Jenifer Dugan**, Coastal Research Center, Marine Science Institute, University California, California. 93106, and **Edward A. Keller**, Environmental Studies Program, University of California, Santa Barbara, California, 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

A total of seven interns worked on MMS and MMS/CMI projects during Winter '03. Tim Wolff and Rusty Roland continued to work with Ms. Barminsky and Mr. Brickey of MMS on a regional database for use in site-specific geological and engineering evaluation of producing offshore fields in the Santa Maria Basin, Santa Barbara Channel and offshore Long Beach. Kelly Campbell and Jennifer Westerlund filled two new internship positions to assist Ms. Dunaway of MMS with the development of marine education curriculum and classroom kits. Funding from the UCSB Shoreline Preservation Fund was used to support three undergraduate student interns during this period including, Tim Malone who is assisting with fieldwork in the CMI microdrifter research project mentored by Dr Ohlmann of UCSB, Jessica Bean who is assisting with genetic analyses of bryozoans from offshore oil platforms and reefs mentored by Dr. Hodges of UCSB, and Frank Kinnaman who will be mentored by Dr. Valentine of UCSB in assisting with the development of a gas chromatography system for the analysis of aromatic hydrocarbons in natural petroleum samples. We are working with Fred Piltz, other MMS personnel, and CMI Investigators to arrange additional internship opportunities for MMS and MMS/CMI projects during Spring 2003.

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 100% |
| Project Year 3: | 38% |

Task 17611: *Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSOS-HYS)* and
Task 18211: *Oil Slicks in the Ocean: Predicting their Release Points Using the Natural
Laboratory of the Santa Barbara Channel*

Principal Investigators: **Jordan Clark**, Department of Geological Sciences, **Bruce Luyendyk**,
Department of Geological Sciences, and **Ira Leifer**, Institute of Crustal Studies,
University of California, Santa Barbara, California 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

Summary: During the most recent quarter (Winter), efforts have focused on analysis of laboratory preparations for field trips in the spring (and better weather) and data analysis.

Bubble measurements: Analysis of the surface bubble video collected at major seeps in the Santa Barbara Channel continues. The survey unfortunately missed the La Goleta Seeps, with a field trip planned in early April to fill this gap. A publication is anticipated from this data a few months afterwards.

Isotopic Composition: Gas samples were collected at the seabed at an active and relatively quiescent vents at Shane Seep. Surface gas samples were also collected. Samples were analyzed by Rick Coffin of the Naval Research Laboratory for isotopic ratios of n-alkanes. The results showed that main vent gas was heavier (more degraded) than peripheral gas, and that surface gas was consistent with the dominant vents being peripheral, not primary, in agreement with previously reported trace gas measurements, and also surface bubble size distributions.

Air Pollution: Measurements were made in the air using total hydrocarbon detectors (FID) on loan from The Gas Company in conjunction with Leigh Brewer (also The Gas Company). Analysis of the transect data showed a source of methane down current (but upwind) from the seep where there were no bubbles. This can only be explained by the dissolved methane plume separating from the bubble plume (i.e., detraining) due to the currents. Gas samples collected above the seep showed methane concentrations as high as 2% by volume. A future seep air pollution cruise is planned to calibrate the on shore measurements and the Gaussian plume model used to estimate the magnitude of transient releases from Shane Seep based on air pollution measurements at West Campus Station.

Fluid Motions: The nutrient samples collected previously were analyzed and showed a consistent and significant elevation in the seep plume versus outside the plume. A second nutrient sampling mission collected a greater density of samples in co-current and cross current transects at Shane Seep as well as across oil slicks (where no effect is anticipated) and are being analyzed. This will play an important role in the bubble upwelling manuscript currently being written for submission in the next two to three months.

Dissemination: Leifer and MacDonald (2003) was accepted. A paper investigating the relationship between bacterial community structure in the seep sediment and gas flux is being written and should be submitted in a few weeks. A paper on the gas composition of seep gas bubbles was submitted (Clark et al., 2003). The paper on the effect of off-axis rays on measured bubble size was resubmitted after adding a derivation (Leifer et al., 2003). The paper on

designing a bubble measurement system was accepted after adding a section on the effect of bubble blur due to inadequate shutter speed (Leifer et al., 2003b).

References:

- Leifer, I.**, and I. MacDonald, 2003. Dynamics of the gas flux from shallow gas hydrate deposits: Interaction between oily hydrate bubbles and the oceanic environment. *Earth Plan. Sci. Lett.*, *In Press*.
- Clark, J.F., I. **Leifer**, L. Washburn, and B.P. Luyendyk, 2003. Compositional changes in natural gas bubble plumes: Observations from the Coal Oil Point Seep Field. *Geo. Mar Lett.* *Submitted*.
- Leifer, I.**, G. De Leeuw, and L. Cohen, 2003. Calibrating optical bubble size by the displaced mass method. *Chem. Eng. Sci.*, *Submitted*.
- Leifer, I.**, G. De Leeuw, and L.H. Cohen, 2003b. Optical measurement of bubbles: System, design and application. *J. Atm. Ocean. Tech.* *In Press*.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 42% |

Task 18212: *Transport over the Inner-Shelf of the Santa Barbara Channel*

Principal Investigator: **Carter Ohlmann**, Institute of Computational Earth System Science,
University of California, Santa Barbara, California 93106

Major Accomplishments, January 1, 2003 – March 31, 2002:

Introduction: The primary goals of this research are to collect surface current data over the inner-shelf of the Santa Barbara Channel with Pacific Gyre's "Microstar" Lagrangian drifters, and use the data to: identify characteristic features of the flow field such as convergences, divergences and cross shelf transports, determine the surface velocity and velocity variance distributions, examine flow patterns on scales that are too small to be resolved in CODAR current measurements, and investigate how well particle paths determined from Eulerian CODAR fields represent measured Lagrangian flows.

The primary achievements for the quarter relate to data collection and processing. Specifically,

- A routine observational program commenced.
- A first-look data processing software system has been developed.
- Results of the work were presented at the Bight-03 planning meeting.

The first set of routine drifter deployments occurred on 3 March 2003. The improved drifters were used along with the near-realtime data display software and the Mobitex communications pager. Seeding is on our predefined sampling grid off Coal Oil Point. Subsequent drifter deployments are to occur in the same manner with near bi-weekly frequency for the remainder of the year. Development of a software system to process the drifter data is underway. The software removes erroneous position data (if necessary) and computes velocity as a first difference. A combined NOAA-USGS bathymetry product with 60 m resolution for the entire Santa Barbara channel has been obtained and codes have been written to interpolate depth to the drifter position data. The processing codes use the depth information to compute along-shore and across-shore current components and the rate of change in water depth following each drifter.

The work completed to date was presented at the "Bight 03" planning meeting held in January at the SCCWRP office in Los Angeles, CA. Instrumentation and preliminary results of this research were of interest in developing an appropriate observational program for monitoring and understanding the fate of stormwater in the Southern California Bight.

Budgetary Issues: Funds have been used for boat costs (and accompanying personnel) associated with the drifter deployments (and recoveries), and for coding the drifter monitoring and data processing systems.

Estimated Percentage of Budget Expended:

| | |
|-----------------|------|
| Project Year 1: | 100% |
| Project Year 2: | 6% |

Task 18213: *Use of Biological Endpoints in Flatfish to Establish Sediment Quality Criteria for Polyaromatic Hydrocarbon Residues and Assess Remediation Strategies*

Principal Investigator: Daniel Schlenk, Department of Environmental Sciences, University of California, Riverside, Scott Steinert CSC, Marine Sciences Department

Major Accomplishments, January 1, 2003 – March 31, 2003

California Halibut and Speckled Sanddabs from Coal Oil Point which were exposed to the sediment dilutions during the past fall were analyzed for FACs and DNA damage. DNA damage was linear with PAH content in both species. However, FAC concentrations were rather variable and inconsistent with dose. Speckled Sanddabs from an uncontaminated site in Orange County were collected in January and exposed to Coal Oil Point sediments for 7 days. These results indicate that fish residing in Coal Oil Point waters are not resistant to DNA damage following sediment exposures.

Problems Encountered:

We encountered another fish-kill during a repeat of the 28 d exposure periods because of an unexplained water shut-down at the SEA laboratory in Redondo Beach where we are carrying out our exposures.

MMS Action Required:

A no-cost extension for 6 months will be necessary for the graduate student position.

Future Plans:

Work will proceed as proposed. Results will be submitted as an abstract to the 12th International Pollution Responses in Marine Organisms meeting in Tampa, Florida next quarter (May 8-13 2003).

Estimated Percentage of Budget Expended:

| | |
|----------------|------|
| Project Year 1 | 100% |
| Project Year 2 | 50% |

Task 85338: *Weathering of oil and gas in the coastal marine environment: quantifying rates of microbial metabolism*

Principal Investigator: David Valentine, Department of Geology, University of California, Santa Barbara, California 93106

Major Accomplishments, January 1, 2003 – March 31, 2003:

Large quantities of oil and gas are released into the Santa Barbara Channel by way of natural seepage with lesser amounts emitted during petroleum removal and recovery. These emissions greatly affect beach, air and water quality along the Southern California Coast. As a result many studies and a substantial amount of resources have been devoted to developing a better understanding of the weathering processes occurring in hydrocarbon-rich environments. These studies have provided evidence for natural hydrocarbon-consuming communities thriving in heavily contaminated regions. It is assumed that native assemblages of microorganisms having the capability to consume a variety of hydrocarbons emitted from natural oil seeps are present in the Santa Barbara channel. Although microbial oxidation is known to occur, little is known about the distribution of relevant microbial communities, rates of oxidation and the extent to which various hydrocarbons are broken down or consumed.

This MMS-UC CMI funded research focuses on the microbial weathering of aromatic compounds released into marine environments. The objectives of this research include: (1) the development of techniques utilized to quantify rates for microbial consumption and decomposition of aromatic and polycyclic aromatic compounds in marine environments and (2) determining the intermediates and end products arising from microbial decomposition of these most persistent and harmful hydrocarbons.

(1) The development of techniques used to quantify rates of microbial hydrocarbon consumption.

To date we have acquired a HP 5890 series II gas chromatography (GC) system with a flame ionization detector to be used for hydrocarbon identification and subsequent quantification. This system has been equipped with an AT-5 MS 30 m x 0.25 i.d. GC column with a film thickness of 0.25 μ m, purchased using MMS-CMI funds provided. A variety of gases including Helium, Hydrogen, Nitrogen and air have also been purchased and are plumbed to the GC system. A variety of chemicals including methylene chloride, hexanes and methane have also been purchased with MMS funds and will be used for oil fraction separation and extraction. A Beckman Coulter LS 6500 Multipurpose Scintillation Counter has also been purchased and is to be used in coordination with the GC system in order to establish rates for microbial consumption of radio-labeled substrates. The P.I. has received a research scuba diving certification from the University of California, Santa Barbara. A Scuba diving certification has also been received by the graduate student working on the project in order to complete a research diving certification class, which is in progress. These certifications are essential for the collection of samples from oil seeps located in the Santa Barbara channel.

(2) The determination of intermediates and end products arising from microbial weathering processes.

All items mentioned above in the technique development section also apply to this section. The HP 5890 series II gas chromatography (GC) system with a flame ionization detector will also be used for the determination of intermediates and products of microbial weathering and subsequent quantification. The Beckman Coulter LS 6500 Multipurpose Scintillation Counter purchased will be used in coordination with the GC system in order to establish rates for microbial consumption of radio-labeled substrates.

Future plans:

We plan to begin collecting oil, gas and sediment samples from Shane seep located approximately 1-mile offshore of Goleta, CA within the next few months and into the summer. We will also be experimenting with extraction and separation methods required for identification and quantification with the GC system described above. Other plans include establishing fingerprint patterns and standard curves to be used for the quantitation of benzene, benzo(a)pyrene and naphthalene.

Problems Encountered:

None

MMS Action Required:

None

List of all personal associated with the project:

Principal Investigator: David Valentine

Graduate student researcher: George Wardlaw

Estimated Percentage of Budget Expended:

Project Year 1: 8%

Task 85386: *Observations of the surface circulation in the Eastern Santa Barbara Channel using high frequency radar and Lagrangian drifters*

Principal Investigator: Libe Washburn, Institute of Computational Earth System Science, University of California, Santa Barbara, California 93106.

Major Accomplishments, January 1, 2003 – March 31, 2003:

This research focuses on advancing our understanding of circulation processes in the eastern Santa Barbara Channel. The eastern Santa Barbara Channel has many active oil production platforms so knowledge of circulation patterns and likely trajectories of water parcels are important for predicting movements of oil in the event of a spill.

An important operational goal of this work is the establishment of high frequency (HF) radar sites along the mainland coast east of Santa Barbara, California. During this quarter we obtained permission from Reliant Energy, the owner and operator of the Mandalay generating station in Oxnard, California, to install an HF radar system at this facility. We are now preparing the necessary radar equipment and related hardware to accomplish the installation. We are also working with the City of Oxnard to obtain a permit for locating our antennas on sand dunes near the generating station.

Another important goal of the project is to determine if the HF radars can accurately predict the movement of water parcels on the sea surface. The experimental approach is to compare measured trajectories with paths inferred from HF radars. In collaboration with Dr. Carter Ohlmann, we have deployed surface drifters within the existing radar coverage between Coal Oil Point and Refugio. Our analysis of these data will compare actual tracks with HF radar predictions.

One manuscript was re-submitted during this quarter:

Emery, B.M., L. Washburn, and J. Harlan, Evaluating CODAR high frequency radars for measuring surface currents: observations in the Santa Barbara Channel, *Journal of Atmospheric and Oceanic Technology* (submitted), 2003.

One presentation was given during this quarter:

Washburn, L., "Circulation in the Santa Barbara Channel", to volunteer naturalists of the Channel Islands National Marine Sanctuary, 9 January 2003, National Park Service Headquarters, Ventura, California.

Personnel associated with project:

| | |
|----------------------------------|-----------------------------------|
| <u>Programmer Analyst:</u> | Brian Emery |
| <u>Staff Research Associate:</u> | David Salazar |
| <u>Graduate Students:</u> | Edwin Beckenbach & Corinne Bassin |
| <u>Undergraduate Students:</u> | Leah Ow & Gregory Drew |

Future plans:

Two tasks will be pursued in the near future:

1. Install a HF radar site at the Mandalay generating station in Oxnard, California
2. Continue analysis of trajectory data from drifters and HF radars.

Problems Encountered:

The pace of getting a permit from the California State Lands Commission (CSLC) to install an HF radar on the Rincon Island is proceeding extremely slowly.

MMS Action Required:

Any assistance MMS can provide in the permit process with the CSLC would be greatly appreciated.

Estimated Percentage of Budget Expended:

Project Year 1: 0.4 %

Task 18234: *Spatial and temporal variation in recruitment to rocky shores: Relationship to recovery rates of intertidal communities*

Principal Investigators: **Pete Raimondi**, Department of Ecology and Evolution, University of California, Santa Cruz, CA. and **Rich Ambrose**, School of Public Health, Department of Environmental Sciences, University of California, Los Angeles, CA.

Major Accomplishments, January 1, 2003 – March 31, 2003:

Because the funding for this project has only just recently been made available, there has been very little work done on this project to date. We have made one scouting trip to determine where exactly the experimental plots will go. We looked for potential sites at Cayucos, Hazards, Stairs, Lompoc Landing, and Boathouse, and determined there was suitable habitat at all sites visited. We used the criteria of amount of suitable habitat, level of site-specific characteristic recruitment, and proximity to existing monitoring sites to make the following decisions regarding where the experiment will be set up.

Since Stairs is where we have more information from the Shoreline Inventory project, we decided that Stairs would be chosen over Lompoc Landing since the two are so close together. We also decided that Cayucos may be chosen over Hazards since there tends to be higher recruitment at that site based on data collected by the Shoreline Inventory project, and the Stairs area tends to have lower recruitment. It will be an important aspect of the experimental design to set up plots at some sites that have chronically low recruitment and others that have characteristically higher recruitment. Boathouse will potentially be used as well. We have not decided yet whether or not there will be one site South of Point Conception, due to the low abundance of rockweeds in that vicinity.

Future plans:

We will set up experimental disturbance plots at 4 sites. These plots will examine specifically the effect of clearing size on the rate and extent of recovery. As such, we will make clearings of a gradient of sizes ranging from tiny (8 cm x 10 cm) to large (50 cm x 30 cm) in three species assemblages in the upper-middle intertidal; the barnacle assemblage, the *Endocladia* assemblage, and the *Silvetia* assemblage. Each of these target species has a different combination of life history traits that can potentially factor importantly into their extent of recovery. If time and feasibility allow, we will extend the design to include experimental plots in the mussel zone as well.

Additionally, coupled with these cleared plots, we will put out standardized collectors for the recruits of barnacles, *Endocladia* and *Silvetia* at all sites. We will put all three types of collectors in all three zones, with the exception of *Silvetia* collectors in the barnacle zone. This will allow us to examine the role of recruitment between sites as a function of rate of recovery. To quantify site-specific recruitment of all three target species, we will count the number of recruits within a 10 cm x 10 cm area on the natural substrate adjacent to all collectors.

List of all personal associated with the project:

Principal Investigators: Richard Ambrose and Peter Raimondi

Technician: Tish Conway-Cranos

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: ~1%

Task 85339: *Ecological performance and trophic links: comparisons among platforms and natural reefs for selected fishes and their prey*

Principal Investigator: **Mark Page**, Marine Science Institute, University of California, Santa Barbara, California 93106, **Jenifer Dugan**, Marine Science Institute, University of California, Santa Barbara, California 93106, **Milton Love**, Marine Science Institute, University of California, Santa Barbara, California 93106, and **Hunter Lenihan**, Bren School of Environmental Science & Management, University of California, Santa Barbara, California 93106.

Major Accomplishments, January 1, 2003 – March 31, 2003:

An important goal of this project is to explore whether indices of ecological performance (e.g., size, individual growth) of a model fish and its invertebrate prey differ between platforms and natural reefs. During this quarter we evaluated several natural reef and offshore platforms as potential study sites. We were particularly concerned about selecting natural reef and platform sites that have adequate densities of our model fish, the painted greenling (*Oxylebius pictus*). Our goal was to locate sampling sites with painted greenlings at comparable depths. After dive trips to assess the densities of painted greenlings at depths of from 0 to 24 m, we selected Naples and Mohawk Reefs and Platforms Holly and Houchin and a depth of ~ 9 m as study sites for the detailed sampling of the model fish and invertebrate prey. We have assembled the vacuum sampling and other equipment required for the field component of this project and will begin sampling as soon as weather permits.

Future plans:

We will begin the sampling of invertebrate prey and painted greenling at Naples and Mohawk Reefs and Platforms Holly and Houchin.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: 0 %

Task 85340: *Relative importance of POCS oil platforms on the population dynamics of two reef fishes in the Eastern Santa Barbara Channel*

Principal Investigators: **Hunter Lenihan**, Bren School of Environmental Science & Management, University of California, Santa Barbara, California 93106, and **Andy Brooks**, Marine Science Institute, University of California, Santa Barbara, California 93106.

Major Accomplishments, January 1, 2003 – March 31, 2003:

Our accomplishments during the period in question consisted of hiring a fulltime technician, planning our field work for spring 2003, and organizing our laboratory. We conducted a search for a technician/diver through UCSB's Marine Science Institute and the UCSBN Office of Personnel. Our search was successful as we hired an experienced and skilled tech by the name of Matthew Kay, who began work 1 March. Mr. Kay was hired at a level of SRA 1. He has a master's degree in marine biology from the University of Oregon, and is UCSB certified as a scuba diver and boat captain. Matt helped us organize our laboratory space in preparation for our field season which begins 1 April 2003.

In addition to hiring a technician, we assembled literature pertaining to our study organisms, conducted maintenance on field gear, and set-up a computer that will be used for data entry, storage, and analysis. Using non-MMS funds, we also purchased a new truck that will allow us to tow and launch a boat we use for diving activities.

Future plans:

Our future plans consist of finishing preparation of our laboratory and field gear, and initiating our field research activities. We plan to begin sampling population demographics of our study organisms at POCS platforms and natural reefs in April, May, June, and July. Sampling will continue until the fishes have ceased reproducing and we have finished counting and/or tagging all nests, juveniles, and adults.

List of all personal associated with the project:

Principal Investigators: Richard Ambrose and Peter Raimondi

Technician: Tish Conway-Cranos

Problems Encountered: We have not encountered any problems.

MMS Action Required: None

Estimated Percentage of Budget Expended:

Project Year 1: 0 %

