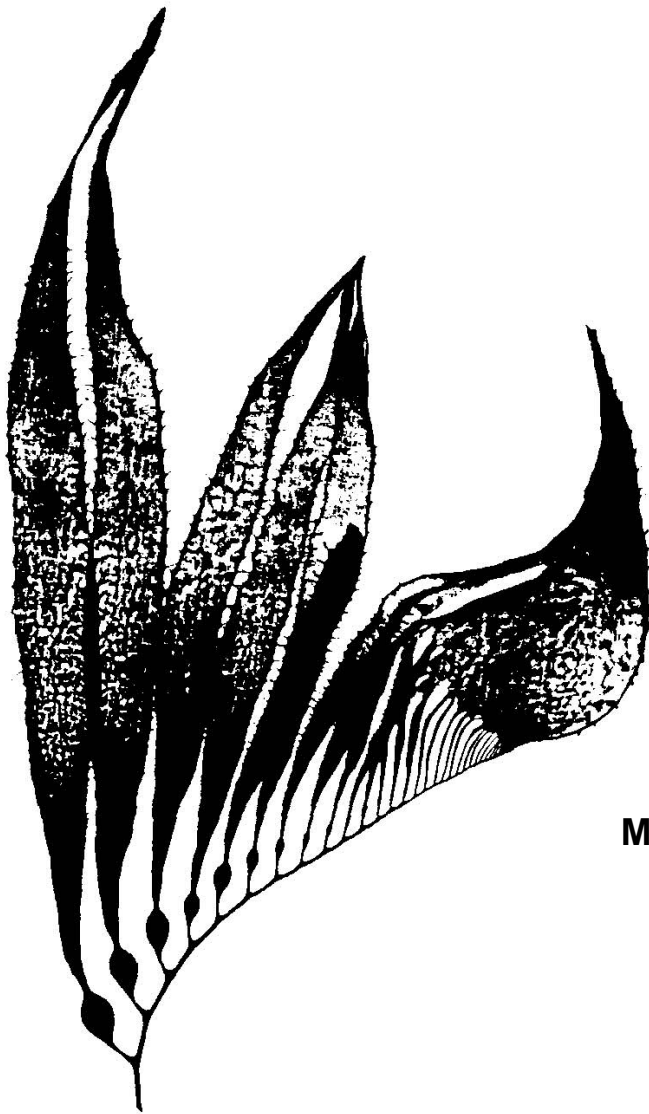


**COASTAL MARINE INSTITUTE
PROGRAM YEAR 10
QUARTERLY REPORT 1**

for the period

July 1, 2003 – September 30, 2003



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

October 15, 2003

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Russell J. Schmitt
Program Manager

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

October 15, 2003

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Program Manager's Report

for the period July 1, 2003 – September 30, 2003

This constitutes the quarterly report for the first quarter for Program Year 10 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, 17 projects currently are being conducted under the aegis of the Coastal Marine Institute.

Actions Pending MMS Approval:

- ◆ Approval of no-cost extension for Task 17601, Contract No. xx, PIs Page, Dugan, Childress, *Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species*, through March 31, 2004.
- ◆ Please note that PI Washburn, require MMS assistance in securing access to a new HF radar site Task 85386, Contract No. 14-35-01-00-CA-31063, *Observing the Surface Circulation...*

Major Programmatic Progress and Actions during the Quarter:

- ◆ Task 12387: *Ecological Consequences of Alternative Abandonment Strategies for POCS Offshore Facilities and Implications for Policy Development*, the revised draft final report will be submitted to MMS next quarter.
- ◆ Task 13093: *A Methodology for Investigation of Natural Hydrocarbon Gas Seepage in the Northern Santa Barbara Channel*; has been completed and the final study report, OCS Study 2003-054, 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 15115: *Effects of Temporal and Spatial Separation of Samples on Estimation of Impacts*; the Draft final report will be submitted in the next quarter.
- ◆ Task 17604: *Shoreline Inventory of Intertidal Resources of San Luis Obispo and Northern Santa Barbara Counties*; the Draft final report will be submitted in the next quarter.
- ◆ 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*; the Draft final report will be submitted in the next quarter.
- ◆ 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, July 1, 2003 – September 30, 2003:

The final report was submitted to MMS. MMS returned the report to the Principal Investigators for revisions.

Future plans:

We will revise and submit our final report by November 1, 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, July 1, 2003 – September 30, 2003

Efforts have been focused on the analysis and writing of the draft final report

Publications and Presentations:

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.

To date we have analyzed 8 separate datasets collected in three different ecological systems; subtidal rocky reef, kelp bed, and open ocean pelagic. Trends in population abundances show consistent declines in all three systems over the last 10-15 years. Most interesting, within each system examined, trends for each component trophic level show approximately the same degree of decline. This pattern holds across spatial scales ranging from a single island within the northern Channel Islands group to the entire Southern California Bight. Also interesting is the fact that data collected using extremely different methodologies, e.g. coastal power plant impingement studies versus diver visual surveys, provide similar estimates of the magnitudes of these declines. Most recently, we conducted time-series analyses on these data sets to describe their temporal trends and explore the timing and magnitude of change. The species examined were classified as to trophic level, mode of reproduction, extent of geographic range, association with benthic or pelagic food webs, and habitat. In general, the magnitude of decline was similar for all species, regardless of classification. Trends were similar at all locations examined within the Bight, suggesting regional declines in abundances rather than redistribution of individuals. These patterns are consistent with the explanation that a regional decline in productivity is responsible for regional decline in fish stocks.

We have now extended our analyses to include almost 30 years of data collected by the National Marine Fisheries Service through their ongoing Resource Assessment and Conservation Engineering (RACE) groundfish monitoring program. These data come from surveys conducted over the outer continental shelf and allow a comparison of the results we found for shallow, reef-associated species with those of deeper, soft-bottom associated species.

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

We are finishing the process of identifying epifaunal invertebrate samples collected during our 2002 surveys. We continue to 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.

List of all personal associated with the project:

Publications and Presentations:

We are currently preparing two papers for publication.

List of all personal associated with the project

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

Graduate students: Sarah Lester

Post-graduate researchers: Keith Seydel

Undergraduate researchers: Corrie Kane

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	100%
Project Year 3:	100%
Project Year 4:	100%
Project Year 5:	91%

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, July 1, 2003 – September 30, 2003

Progress has been made towards the final report, which will be submitted to the Coastal Marine Institute by December 31, 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, July 1, 2003 – September 31, 2003:

During this reporting period, a master's thesis on this project was completed, accepted, and filed. A manuscript on the results to date was completed and submitted for publication in a scientific journal. A draft final report on this study is in preparation.

Analysis of stable isotopic composition of benthic consumers on the shell mounds for use in comparing food webs was completed. Additional samples of consumers from natural reefs were collected and prepared for analysis.

R. Bomkamp and J. Dugan attended the forum on shell mounds presented by State Lands and their consultants in Santa Barbara.

Upcoming work:

A draft final report will be produced. Work will continue on a paper comparing the results of stable isotope analyses of the benthic consumers on the shell mounds to those on natural reefs.

Problems Encountered:

None

MMS Action Required:

A no cost extension was requested for this project through March 31, 2004.

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	85%

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, July 1, 2003 – September 30, 2003:

During this quarter, effort was divided between completing tasks relating to the Spring 2003 sampling, miscellaneous tasks relating to the project as a whole, and the planning of the Fall 2003 sampling. In July, all of the relevant sites were visited during low tide events for the Summer 2003 barnacle data collection (Table 1).

Date	Location	Comments
July 16	Paradise Cove	UCLA Group
July 16	Old Stairs	UCLA
July 17	Alegria	UCLA
July 17	Arroyo Hondo	UCLA
July 17	Carpinteria	UCLA
July 17	Mussel Shoals	UCLA

After the sampling, the retrieved plates and the data sheets were sent to the Raimondi group at UC Santa Cruz for further analysis and data management. Throughout this quarter, much time was spent participating in tasks relating to the near completion of the new database management system that has been developed over the last year. Early prototypes of the database needed to be tested and checked for accuracy. The first release of the database has recently been made available to all MARINE groups for use. While many aspects of this new database are complete, several issues still need to be resolved before it is functioning completely. For example, while most of the photoplot and surfgrass transect data are complete, much of the count data (seastars, motile invertebrates, etc.) have yet to be added to the database. Time was spent this quarter investigating potential avenues for attaining aerial surveys of our intertidal sites. Steven Lee and Maurice Hill have been exploring several options including standard helicopters, remote controlled blimps, and remote controlled helicopters. Several days have been set aside in the upcoming fall sampling season to implement low altitude photo surveys at many of the southern California sites. In early October (Oct. 10-11), a taxonomy workshop will be held at the Cal. State Fullerton campus. A report on the progress of our aerial survey inquiries will be given at this upcoming workshop. Late in this quarter, Steven Lee assisted Jack Engle on the Fall 2003 Channel Islands Research Program trip to Santa Catalina Island for diving surveys and the sampling of the two Catalina rocky intertidal sites (Bird Rock and Little Harbor). The remainder of the proposed Fall 2003 sampling schedule is given in Table 2.

This quarter was marked by several personnel changes. Meera Venkatesan has departed to pursue broader career goals, and the lead technician, Steven Lee, is reducing his involvement with the project to 50% as he resumes graduate school at UCLA. These staff vacancies will be filled to a certain extent by new staff which should be hired in the upcoming quarter. The new MARINE post-doc, Rafe Sagarin, began work September 15 and has been set up with an office here in our lab at UCLA. We will continue to work with Rafe to help orient him with the project and to assist him with his preparations for MARINE related manuscripts.

Date	Location	Comments
September 26	Bird Rock	UCSB with UCLA Help
September 27	Little Harbor	UCSB with UCLA Help
October 24	Old Stairs	UCLA/MMS Help
October 25	Arroyo Hondo	UCLA/MMS Help
October 26	Alegria	UCLA/MMS Help
November 21	White's Point	UCLA/MMS Help
November 22	Mussel Shoals	UCLA/MMS Help
November 23	Carpinteria	UCLA/MMS Help
November 24	Paradise Cove	UCLA/MMS Help
December 6	Coal Oil Point	UCLA Group
December 7	Reserved	Possible Makeup day
December 8	Point Fermin	UCLA/MMS Help
December 9	Reserved	Possible Makeup day
December 10	Reserved	Possible Makeup day
December 20	Reserved	Aerial Photography Work
December 21	Reserved	Aerial Photography Work
December 22	Reserved	Aerial Photography Work

Future Plans:

Throughout the present quarter, we will continue with the preparation and execution of the Fall 2003 sampling. We will also continue our involvement in the finalizing of the new database management system which will involve additional data submissions to the database managers as well as error checking the final product. We will work in coordination with the other MARINE groups to this end. We will continue to plan for the upcoming aerial photographic surveys which will include training for participation in MMS helicopter flights, discussions with vendors that provide remote controlled photographic services, and a feasibility study with a simulator to determine if purchasing a remote controlled helicopter makes sense. We expect to focus on the analyses for the first paper with Rafe.

Problems Encountered:

Computer problems were significant this quarter with the latest rash of computer viruses and worms, plus excessive email spam consuming a tremendous amount of personnel time. In addition our computers were hacked into at least twice during this period, and unrelated, the hard

drive of one of our computers crashed and needed to be replaced. UCLA has implemented new spam-filtering software which should help with spam, plus recently implemented a server-based anti-virus screening, which so far seems to be preventing viruses from being delivered to our computers via email. We have increased our security measures to try to prevent future hacking episodes; time will tell if these are effective.

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, July 1, 2003 – September 30, 2003:

During this quarter we continued to work with Bruce Bealer at SCWRPP on the MMS funded database, which combines intertidal monitoring data for all MMS funded groups, as well as the Channel Islands National Park Service (collectively know as MARINE—Multi-Agency Rocky Intertidal Network). Although construction of the database has taken longer than anticipated, it is now nearing completion, and we expect to be using it for data entry and analyses by October. A good test of how well the database is functioning will be the writing of a final report to be submitted to CMI. We will use the database to construct figures and look for trends in the data, and will thus be able to better direct future modifications of the database structure. This is the reason for the delay in our submission of the final report to CMI. We expect to have a draft of the report completed by the end of November.

Other work done during this quarter included the sampling of barnacle plots and swapping of barnacle recruitment plates at four study sites in San Luis Obispo County (SLO) and four sites in Northern Santa Barbara County (NSB). Sites were visited during July.

Future Plans:

In the next quarter we will enter all spring 2003 data into the database and will use this complete data set to construct figures and detect temporal and spatial trends that will be highlighted in the CMI final report. We will also sample all NSB and SLO sites.

Problems encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

SLO, NSB portions 95%

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, July 1, 2003 – September 30, 2003:

Monitoring of radio-tagged study animals by fieldworkers based at Piedras Blancas field station, San Simeon CA, continues as before. Our total sample for both the central (San Simeon) and southern (Pt. Conception) study areas consists of 72 study animals, 45 of which were also equipped with Time-Depth Recorder (TDR) instruments. On August 25-27 we conducted re-capture operations at Pt. Conception, successfully re-capturing 1 of 3 TDR-deployed study animals in the area at that time. This brings the total number of TDR instruments retrieved and downloaded at this time to 15. More re-captures are planned for October 1-15 at San Simeon, in order to retrieve additional TDR instruments.

In the central study area, 9 of 47 study animals are confirmed dead with carcasses recovered, and an additional 3 are missing and assumed to be dead. The remaining animals fall into two categories: 31 are alive and re-sighted regularly, and another 4 animals survived through the expected lifetime of their transmitter batteries (~2 yrs) but now are rarely seen due to suspected transmitter failure. In the southern study area, 1 of 25 animals has been confirmed dead, and an additional 4 are missing and assumed to be dead. The remaining animals fall into two categories: 16 are alive and re-sighted regularly, and another 4 animals survived through the expected lifetime of their transmitter batteries but now are rarely seen due to suspected transmitter failure. The estimated net annual survival rate of animals in the central study group is 0.80 (N = 47), as compared to 0.89 in the southern study group (N = 25). More than 13,000 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 Monterey. Data collection on sea otter foraging is progressing well, with over 34,000 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	100%

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, July 1, 2003 – September 30, 2003:

Work has progressed as planned. A manuscript is in preparation reporting our findings on sex-specific markers. Analysis of population differentiation using AFLP markers is progressing. In addition, we have made a genomic library enriched for microsatellites, sequenced approximately 20 clones and designed PCR primers for five microsatellite loci.

Problems Encountered:

We have not encountered any problems during this quarter.

MMS Action Required:

None

Future plans:

Work will proceed as planned.

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	95%

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, July 1, 2003 – September 30, 2003:

In May, we delivered a paper, "Trust during an Energy Crisis," at the annual meeting of the American Association for Public Opinion Research (AAPOR) in Nashville, Tennessee. 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 find that people like environmental groups and trusted them more than oil companies or the Minerals Management Service. However, we also find that local Interior Department staff are trusted far more than Washington staff. Fifty-three percent of the respondents said they had a "great deal" or "moderate amount" of confidence in local staff, but only 34 percent said they had a similar amount of confidence in the Interior Department's Washington staff. We are now revising the paper, based on comments we received. We will be submitting the paper to a journal shortly.

Because of the recent interest in the issue of increasing oil and gas development in the national forests in California, we are preparing a short report on public attitudes on the question. The paper, tentatively titled "Public Support for Oil and Gas Drilling in California's Forests and Parks," will be completed shortly and sent to MMS. In general, we find that attitudes toward drilling in parks and public forests are quite similar to attitudes toward drilling for oil along California's coast.

We are also working on a paper investigating the dimensionality of the egalitarianism and individualism measures that we have used in previous publications and reports. We have completed a first draft of the paper, but we need to use more sophisticated missing data imputation methods before sending a copy to MMS. The central finding in this project is that the egalitarianism and individualism measures seem to be independent for people with low levels of political knowledge, but seem to be nearly identical for people with high levels of knowledge.

We previously submitted the paper, "Postmaterialism vs. Cultural Theory as an Explanation of Environmental Opinion," to *Public Opinion Quarterly*, and received a "revise and resubmit" response. We have resubmitted the paper, and we are still waiting for their decision.

Future Plans:

We plan to deliver "Trust during an Energy Crisis" to a journal, and "Public Support for Oil and Gas Drilling in California's Forests and Parks" to MMS in the next quarter.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: 100%

Project Year 2: 100%

Project Year 3: 79%

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, July 1, 2003 – September 30, 2003:

Efforts have been focused on the analysis and writing of the draft final report which will be submitted to MMS in the next quarter.

Action requested from MMS:

None

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	100%

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, July 1, 2003 – September 30, 2003:

ECOLOGY

During this quarter we continued analyses and interpretation of the association of geographic and environmental factors with recruitment patterns observed at offshore oil platforms in the Santa Barbara Channel. The results of these analyses are being incorporated into a draft manuscript for publication. Data analyses and interpretation of invertebrate communities on the platforms from photoquadrat sampling continued. This component of the study will form the basis for a second manuscript.

We also collected specimens for use by the other research groups collaborating on this project. Specifically, we collected encrusting bryozoans (*Watersipora cucullata*) from Platform Gilda for pharmaceutical analysis by Dr. Jacobs' laboratory during this quarter.

In response to an invitation by the organizers, we submitted an abstract for a presented paper on our findings from this study for inclusion in a special session at Aquaculture 2004 (early March 2004) on the culture of pharmaceutically important species.

Future Plans:

Two manuscripts are being prepared for publication, one on the results from recruitment studies and a second on the results from photoquadrat sampling of the platforms. A talk will be prepared for Aquaculture 2004. In addition, we will continue to collect specimens of selected invertebrates for genetic and pharmaceutical analyses, in coordination with the other research groups collaborating on this project.

PHARMACOLOGY

Since the last report we have been able to isolate significant amounts of pure compounds for analysis on proton and ¹³C NMR. Both experiments were successful, but indicated that the compounds may still not be 100% pure. The proton NMR suggested a fatty acid-based compound (the large "methylene envelope" at 1.2ppm) with some unsaturation (signals in the 5.4ppm region). The ¹³C NMR confirms these assumptions and that the compound is much larger than we had originally thought. We are also currently working on maintaining the bryozoan in vivo, so that we may have a continuous supply of compound.

GENETICS

We have made significant progress on determining the genetic variation among samples of *Bugula neritina* during this last quarter. As outlined in our last report we have completed the sequencing of a large number of *B. neritina* samples (>100) for a 1.4 Kb segment of the mitochondrial genome. For each sample, four separate sequencing reactions were necessary to cover this entire region and to provide sequence of both DNA strands. During this last quarter we have focused on aligning these four strands from each sample and checking the forward and reverse sequences to check the identity of each base pair. This is a time consuming process (1,400 bases have to be checked for each sample). Presently we have checked nearly 80 of our samples and prepared a preliminary analysis of about 40 of these samples that are clearly closely related to the cryptic *B. neritina* species that harbors the bacterium that produces Bryostatin-1 (Fig. 1). This analysis has two particularly interesting outcomes. First, it strongly supports that we have identified a new cryptic species of *B. neritina*, found, so far, only from Santa Cruz Island. Second, it suggests that all of the samples from two OCS oil platforms are members of a single clade and thus that colonization of platforms may be a relatively rare event.

Future Plans:

During the next quarter we plan to finish checking the remaining DNA sequences and perform an analysis of the entire data set. In addition, we plan to begin amplifying DNA from the bacterial symbiont from members of each major *B. neritina* mtDNA clade. In addition, we hope to obtain living collections of the rare Santa Cruz Island *B. neritina* species in order to culture large enough colonies to test if it produces different types of Bryostatin compounds than previously found.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	88%

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, July 1, 2003 – September 30, 2003:

A total of four interns worked on MMS and MMS/CMI projects during Summer '03. Kelly Campbell and Jennifer Klaib continued to assist Ms. Dunaway of MMS with the development of marine education curriculum (Tidepool Math), an outreach poster on oil platforms and the MARINE website. Funding from the UCSB Shoreline Preservation Fund was used to support two undergraduate student interns during this period including Tim Malone who assisted with fieldwork in the CMI microdrifter research project mentored by Dr Ohlmann of UCSB, and Sabrina Beyer who was mentored by Dr. Page and Dugan of UCSB in analysing samples of potential fish prey from platforms and natural reefs. We are working with Fred Piltz, other MMS personnel and CMI Investigators to arrange additional internship opportunities for MMS and MMS/CMI projects during Fall 2003.

No Information Transfer Seminars were requested by MMS during this period.

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	100%
Project Year 3:	42%

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, July 1, 2003 – September 30, 2003:

Summary: During the most recent quarter (summer), efforts have focused on improvements in the bubble model a (successful) field trip to image vents at the seabed and analysis of this video. Significant dissemination efforts were also concluded.

Bubble measurements. Further modification to the bubble measurement system, a clear spacer window to ensure a separation between the bubbles in the measurement volume and the illumination screen as well as improved bubble blocking plates has finally allowed the collection of video images of nearly thirty different vents on July 30, 2003 at Shane Seep. About 25% of these videos have been analyzed for bubble size distribution and velocities.

Air Pollution. Measurements were made during an air pollution survey in the air using a total hydrocarbon detector flame ion detector (FID) on loan from The ring approximately 30 transects on a data logger with 0.2 s resolution. Preliminary analysis shows a very strong source of methane to the atmosphere from the dissolved gas plume, trailing off down current. Transects also mapped the plume for a kilometer in the downstream direction almost to the surf zone. This data will be compared with West Campus Station data for the day. Luckily, the wind was towards the station for most of the day, and several transient releases were observed.

Modeling. The bubble model was improved to include the effects of compressibility and pressure induced solubility on methane in bubbles. While not significant at the 22 m deep Shane Seep, it has a non-negligible effect at the deeper La Goleta and Seep Tent Seeps, and is very significant for even deeper seeps.

Dissemination. A manuscript describing the conclusions of the MMS supported workshop held in April on seeps was accepted for publication in EOS and is in Press (Leifer et al., 2003a). A manuscript on the dynamic nature of seeps including the bubble distributions measured under CMX-37 and the survey mappings over the last three years has been written and submitted (Leifer et al., 2003b). A paper investigating the relationship between bacterial community structure in the seep sediment and gas flux has been revised and will be resubmitted in a few weeks (La Montagne et al., 2003). 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 is accepted and was used in the latest BMS redesign (Leifer et al., 2003c). The paper on designing a bubble measurement system has been published (Leifer et al., 2003c). The paper with Ian MacDonald presenting the first ever seep bubble measurements (from the Gulf of Mexico) was published (Leifer and MacDonald, 2003). Results also were presented at the INQUA conference in Reno (Leifer et al., 2003e).

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Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	82%

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, July 1, 2003 – September 30, 2003:

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 personnel, data collection, instrument improvement, and data analysis. Specifically,

- Two undergraduate students were hired and brought up to speed.
- Routine cruises continued to provide data.
- Instruments were returned to the manufacturer for new batteries and firmware.
- Data analysis programs were coded to take a first look at flow statistics.

Two undergraduate students were hired to help carry out routine drifter deployments. The students were trained in maintenance and monitoring of the drifters, and familiarized with experimental design. Drifter deployments have been carried out on schedule and successfully during the months of July and September with the help of the students. A sampling hiatus occurred during August when the drifters were returned for maintenance. New battery packs were installed in some of the units and the firmware was updated. The drifters now store position data internally so that if a single cellular transmission fails (due to the drifter being in a wave trough at the time of transmission for example) the data is subsequently transmitted and not lost. To date near a dozen deployments of drifter sets have been made off Coal Oil Point. The data are sufficient for an initial look a flow statistics and characteristics. Data analysis codes have been written to compute drifter counts, the mean flow field and its associated variance ellipses, and Lagrangian scales.

Also during the quarter collaborative work with Dr. Libe Washburn (UCSB) resulted in a single drifter experiment aimed at quantifying error between drifter and CODAR measurements. Initial results show agreement mostly within 20% for the conditions and CODAR grid square sampled. More of these CODAR validation experiment are planned.

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

Problems Encountered:

None

MMS Action Required:

None

Future Plans:

Work will proceed as proposed.

Estimated Percentage of Budget Expended:

Project Year 1:	100%
Project Year 2:	32%

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, July 1, 2003 – September 30, 2003

California Halibut were obtained from Hubbs Seaworld and treated with a 1:100 dilution of Coal Oil Point sediment which was diluted further 33 and 67% for 28 days.

Samples were stored at 4 °C until analysis. PAHs were analyzed as described in EPA method 8100 [USEPA, 1996]. Sediment samples were extracted with hexane using an ultrasonic disruptor (550 Sonic Dismembrator, Fisher Scientific, Pittsburgh, PA). Cleanup was performed with fully activated silica gel (8 g), conditioned with hexane, and PAHs were collected from the column with 25 ml of methylene chloride/hexane (2:3, v:v). A GC-FID (flame ionization detector) with a capillary column (DB-5) was used for analysis and quantification. The oven temperature was 40 °C, ramped to 160 °C with 40 °C/min, and up to 300 °C with 5 °C/min. The recoveries were 30–111% with a S.D. of 2–15% and MDLs ranging from 11–53 ng/g sediments.

Problems Encountered:

None

MMS Action Required:

None

Future Plans:

Work will proceed as proposed.

Estimated Percentage of Budget Expended:

Project Year 1	100%
Project Year 2	100%

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, July 1, 2003 – September 30, 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) determining the intermediates and end products arising from microbial decomposition of these most persistent and harmful hydrocarbons and (2) the development of techniques utilized to quantify rates for microbial consumption and decomposition of aromatic and polycyclic aromatic compounds in marine environments.

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

We are using two distinct approaches to study the intermediates and end products of hydrocarbon weathering. The first approach is the use of radio-labeled substrates to assess major products of microbial metabolism. We are still developing this approach and have been hampered by problems with our HP 5890 GC. The second technique involves chromatographic technology designed to completely resolve the undefined complex mixture typical of weathered petroleum, so-called two-dimensional gas chromatography. We have begun collaborating with Chris Reddy at Woods Hole Oceanographic Institution, who has helped develop the GC×GC technology. We have run our first experiments and are awaiting results.

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

We have performed our first experiments designed to assess the rates of hydrocarbon weathering. The experiment involved collecting a time series of surface slick samples at Shane Seep, using the slick sampler developed by other MMS-funded scientists (Liefer et al). Samples were collected at the seep and ‘down-slick’ and represent a rough time series. Samples are being run using GC×GC and we hope will provide a rough ‘total weathering’ rate. Depending on the

results of this experiment, future experiments will be designed to key in on just the microbial weathering.

In addition, a second graduate student has begun working peripherally on this project, Frank Kinnaman. Frank recently completed a scientific diving course and is working toward a deeper certification (in order to collect samples at larger seeps).

Future plans:

We are in the process of preparing a long-term incubation study designed to broadly assay hydrocarbon weathering patterns, including aromatics. The duration of the experiment is planned for one year, and will be performed with fresh, sulfidic sediments. Samples will be sacrificed on a monthly basis and assayed new GC×GC techniques at Woods Hole Oceanographic Institution. We plan to acquire fresh petroleum and sediment within the next month.

Problems Encountered:

We have encountered some technical problems with the HP 5890 used for this project, likely related to the gas jets. We are currently working to resolve this issue before we purchase the RAGA radioactivity detector.

MMS Action Required:

None

List of all personal associated with the project:

Principal Investigator: David Valentine

Graduate student researcher: George Wardlaw

Graduate student researcher: Frank Kinnaman

Estimated Percentage of Budget Expended:

Project Year 1: 12%

Project Year 2: 33%

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, July 1, 2003 – September 31, 2003:

This project is investigating the circulation in the eastern Santa Barbara Channel using a combination of drifters and high frequency (HF) radar. The ability of HF radar to predict trajectories is also being evaluated by direct comparison with actual drifters. A new analysis approach is the prediction of dispersal statistics for larval fishes from oil production platforms using HF radar-derived trajectories. The work is a collaborative effort with Dr. Milton Love's research group at UCSB. The recent presentation by Emery et al. (2003, see below) summarized progress so far.

Substantial progress has been made over the reporting period. Currently one HF radar site, located at Reliant Energy's Mandalay Generating Station in Oxnard, CA, is operating in the eastern Santa Barbara Channel. Data coverage from the site has been limited due to problems in obtaining sufficient electrical power. These problems now appear to have been largely overcome through the installation of a new power cable and transformer. What data that has been obtained looks promising since the range is sufficient to overlap with another HF radar site at Coal Oil Point. Three HF radar sites are now operating in the Santa Barbara Channel.

The possibility of installing a new site on Anacapa Island is being investigated. Dr. Ann Bull of MMS arranged a visit to Navy facilities at Port Hueneme and Pt. Mugu for Libe Washburn and Brian Emery to investigate the possibility of installing a site at one of those locations.

A number of experiments were conducted during the reporting period to assess the ability of HF radars to predict near-surface velocities obtained from drifters. The experiments were conducted in collaboration with Dr. Carter Ohlmann in his MMS-sponsored research. Initial results have been promising. Over two days of experiments, hourly time series of surface velocity obtained from the HF radars are similar to those obtained from repeated catch-and-release drifter deployments. These experiments will continue under a variety of wind and ocean conditions.

The following summarizes the status of articles submitted to refereed journals that are based on MMS-funded research:

Beckenbach, E.H., and **L. Washburn**, Low frequency waves in the Santa Barbara Channel observed by high frequency radar, *J. Geophys. Res.* (in press).

DiGiacomo, P.M., **Washburn, L.**, Holt, B., and B.H. Jones, Coastal pollution hazards in Southern California observed by SAR imagery: Stormwater plumes, wastewater plumes, and natural hydrocarbon seep, *Marine Pollution Bulletin* (submitted).

Emery, B.M., **Washburn, L.**, and J.A. Harlan, Evaluating radial current component from CODAR high frequency and moored in situ current meters, *J. Atmos. and Oceanic Tech.* (submitted).

The following presentations related to this MMS-sponsored research were made during the reporting period:

Bassin, C. J., **Washburn, L.**, and E. McPhee-Shaw, "Sub-mesoscale eddies along the northern Santa Barbara Channel: A possible mechanism for nutrient delivery to the inner shelf", Eastern Pacific Ocean Conference, 24-27 September 2003, Wrigley Marine Science Center, Catalina Island, California.

Beckenbach, E.H. and **L. Washburn**, "Vorticity, divergence, and flow states in the western Santa Barbara Channel", Eastern Pacific Ocean Conference, 24-27 September 2003, Wrigley Marine Science Center, Catalina Island, California.

Emery, B.M., Nishimoto, M.M., **Washburn, L.**, and M. Love, "Alternative fate estimation of oil rig bocaccio recruits using HF radar", Eastern Pacific Ocean Conference, 24-27 September 2003, Wrigley Marine Science Center, Catalina Island, California.

McPhee-Shaw, E., **Washburn, L.**, and D. Siegel, "Low-frequency dynamics and nutrient flux to the inner shelf of the Santa Barbara Channel", Eastern Pacific Ocean Conference", Wrigley Marine Science Center, Catalina Island, 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:

A new effort will be pursued to establish a HF radar site on Anacapa Island to improve HF radar coverage in the eastern Santa Barbara Channel. The possibility of installing a site at the Naval facility at Pt. Mugu is also being investigated.

Problems Encountered:

A decision on the application to install an HF radar site on Rincon Island was deferred indefinitely by the new lessee, Greka Energy. In the principal investigator's opinion this amounts to a denial so another site is being pursued.

MMS Action Required:

Any assistance that MMS personnel can provide in gaining access to new HF radar sites would be helpful.

Estimated Percentage of Budget Expended:

Project Year 1: 60 %

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, July 1, 2003 – September 30, 2003:

Site set-up: We have set up and sampled at Pt. Sierra Nevada and Stairs. These sites were chosen in keeping with the original goal of having one site far North of Pt. Conception (Pt. Sierra Nevada), one site near to Pt. Conception (Stairs), and one site South of Pt. Conception (still to be set up). Set up was done in a series of trips to San Louis Obispo and Santa Barbara Counties throughout the summer. We established 8 recovery plots and 3 control plots in the *Chthamalus*, *Endocladia*, *Silvetia* and *Mytilus* assemblages. The recovery plots were set up in 8 sizes, ranging from very small (8 cm x 12 cm) to large (50 cm x 75 cm). A total of approximately 1 square meter will be cleared in each assemblage. To facilitate comparisons between these recovery plots and the existing photoplots being monitored at these sites, the size of the largest recovery plots is the same as the photoplots. Three control plots of the largest size (50 x 75 cm) were established in each species assemblage.

Plot Sampling: We sampled all recovery and control plots using a uniform point contact grid in each plot. 100 points were sampled in all plots except for the three smallest sizes, which were sampled with 30, 40 and 50 points, respectively. Plots were sampled using Handspring handhelds with bar-code scanners. All layers were recorded. Additionally, in each plot, all non-interstitial, non-epibiont mobile invertebrates were identified to the highest resolution possible (or vouchered for later identification) and counted. We took photographs using a photo-framer of all plots to create a visual record of the recovery plots before they are cleared.

Data analysis: We have not performed data analysis yet on these two sites. We plan to conduct the analyses when the third site has been set up.

Future plans:

We will set up a site that is South of Pt. Conception. We have scoped the MMS site Alegria on Hollister ranch, and are waiting for permission to conduct our research there. If permission is not granted, we will select another site that is South of Pt. Conception (possibly Arroyo Hondo). Once the third site is set up and sampled, we will clear all three sites. We will sample these plots in the manner described above once every three months. Additionally, we will put out 5 recruitment surfaces to collect recruits of *Chthamalus*, *Endocladia* and *Silvetia* in the appropriate assemblage. We will use Safety-Walk to collect barnacles, barnacle mimics to collect *Endocladia*, and *Endocladia* mimics to collect *Silvetia*. We will exchange these collectors every month, as well as count the recruits on the natural substrate in 5 plots of the same size as the collectors (approx 10 cm x 10 cm).

List of all personal associated with the project:

Principal Investigators: Richard Ambrose and Peter Raimondi

Technician/Graduate Student: Tish Conway-Cranos

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: ~ 1%

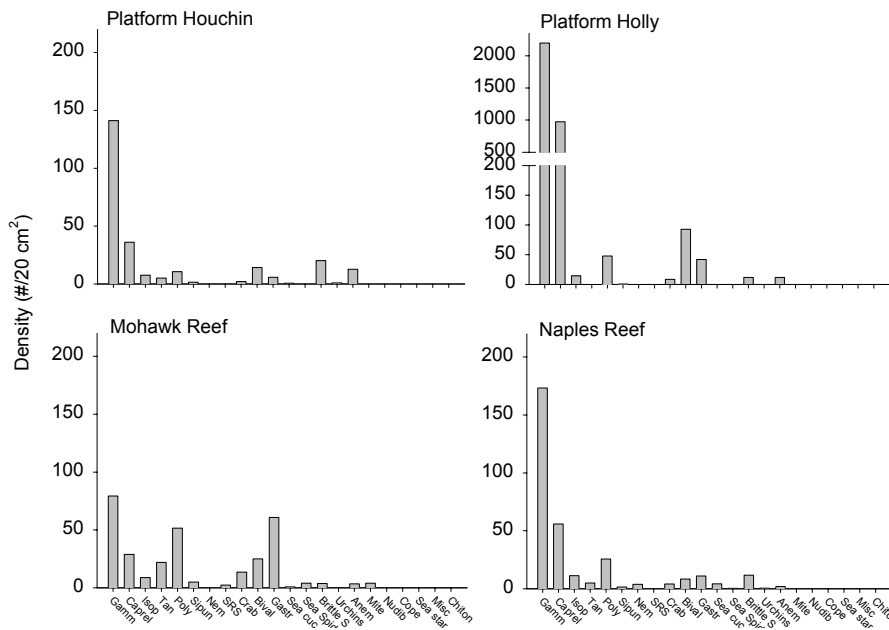
Project Year 2: ~10%

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, July 1, 2003 – September 30, 2003:

During this reporting period, we sampled potential food items of painted greenlings, primarily small amphipod crustaceans monthly, at fixed sampling sites established at Naples and Mohawk reefs and Platforms Holly and Houchin. Samples were collected by scraping and vacuum sampling in randomly placed quadrats and returned to the laboratory for processing. During this period we processed approximately 60 samples to characterize the potential prey for painted greenlings and analyzed these preliminary data. These data show that gammarid amphipods are the most abundant potential prey item at all sites, and that densities of this taxa and caprellid amphipods are much higher at Platform Holly compared with the other sites (Figure 1). We analyzed the stomach contents of 4 painted greenlings collected from Naples Reef in preliminary samples taken in July. Stomach contents consisted primarily of caprellid amphipods ($x=62$ caprellids/fish) followed by gammarid amphipods ($x=8$ gammarids/fish) and small gastropods (one fish had 83 gastropods, the rest none). The difference between the composition of the stomach contents of these fish and the relative availability of



gammarid and caprellid amphipods at Naples Reef suggests the selection of caprellid over gammarid amphipods during feeding. We also developed and tested apparatus for maintaining amphipod crustaceans collected from the study reefs and platforms in the laboratory to estimate

individual growth rates for use in production estimates. In addition, we performed visual surveys to compare painted greenling density and size structure among four sites: Naples and Mohawk reefs and Platforms Holly and Houchin. We then collected fish samples from each of these sites to assess spatial differences in diet and two fish condition indices (condition factor and liver-somatic index). Otoliths (earstones) were also collected from the fish samples.

Finally, we initiated the modeling component of our research in which we plan to use the ecosystem-trophic interaction software ECOPATH/ECOSIM. The general goal of our modeling is to estimate how much fish biomass can be produced on POCS oil platforms versus natural rocky reefs. We down-loaded the model and began researching appropriate trophic parameters (e.g., feeding and growth rates of caprellid amphipods and predatory reef fishes, including olive rockfish and painted greenling). We will eventually use actual feeding and growth rate data from our sampling program and field and laboratory experiments in our models. Our initial focus is to construct trophic transfer models with published information that will best approximate food webs on platform and natural reefs. These simulation, or trial-run, models will provide necessary information concerning the appropriate number of trophic levels, ranges of biomass transfer, levels of environmental stochasticity (e.g., El Nino events, upwelling, and storms) that will influence our models.

Future plans:

We will continue the regular sampling of potential prey and estimation of individual growth rates of amphipods at the study reefs and platforms. Using the fish samples collected during this period, we will compare painted greenling diet with available prey at selected reefs and platforms throughout the Santa Barbara Channel, including Naples and Mohawk Reefs and Platforms Holly and Houchin. We will also construct growth curves from data on the microstructure of extracted fish otoliths. We will continue our ECOPATH/ECOSIM modeling effort.

Problems Encountered:

None

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: 34 %

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, July 1, 2003 – September 30, 2003:

Accomplishments during the summer period 2003 were to complete laboratory and field preparations, and to design and conduct fish population surveys at POCS Platform Gina and six reference sites (3 at Anacapa Island and 3 at Santa Cruz Island). We completed a series of monthly surveys at all sites that provide a time series of population abundance of the five most abundant species, *Coryphopterus nicholsi* (black-eyed gobies), *Scorpaenichthys marmoratus* (cabezon), *Oxylebius pictus* (painted greenling), *Damalichthys vacca* (pile surfperch), and *Rhacochilus toxotes* (rubber lip surfperch), found at our sites. We will repeat the population surveys next spring and summer. In addition to the surveys, we initiated a fish tagging/recapture program in which we are tagging >100 adult black-eyed gobies at each station as well as >60 adults of one large fish species (cabezon, painted greenling, or surfperch).

Future plans:

Plans for fall/winter 2003 include completing the fish-tagging program, continuing repeated surveys to count tagged fish, and devising the most effective method of quantifying per capita birth rates for each species. The specific large species of fish we select for our tagging program depends on which species we can successfully tag. Our overall objective of describing the source-sink population dynamics of POCS and natural reef fishes relies on our ability to measure the movement and per capita survivorship and reproduction of individual fishes. We plan to concentrate much of the tagging effort on pile surfperch because as a live-bearing species they can provide us the most accurate measure of per capita birth rate.

Problems Encountered:

We have not encountered any problems.

MMS Action Required:

None

Estimated Percentage of Budget Expended:

Project Year 1: 52 %