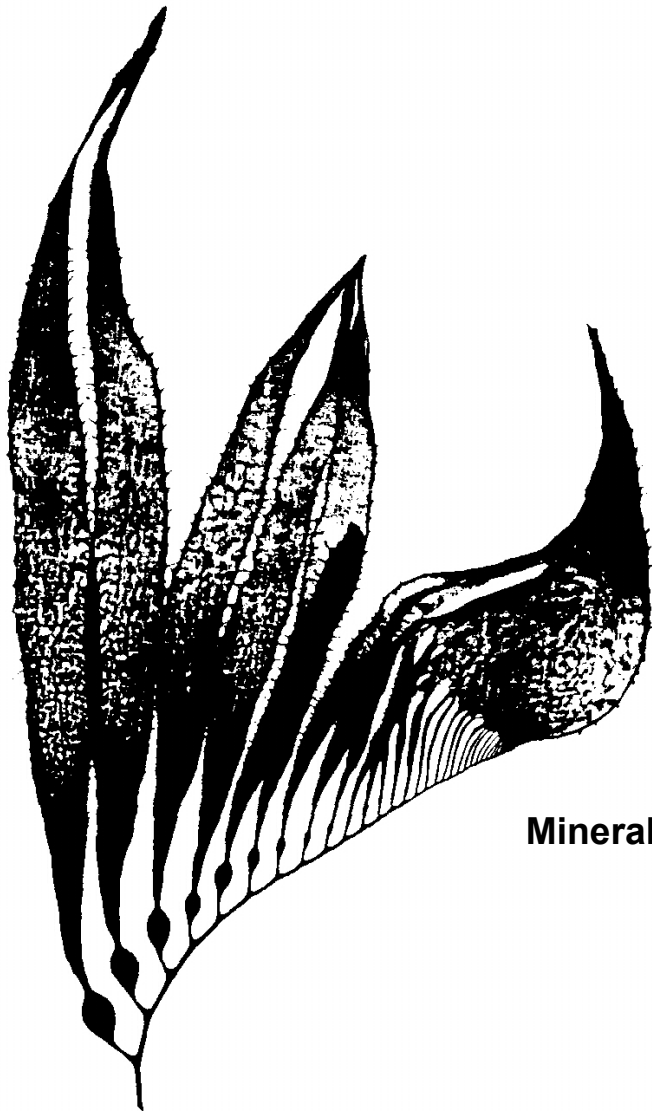


**COASTAL MARINE INSTITUTE  
PROGRAM YEAR 11  
QUARTERLY REPORT 3**

*for the period*

*January 1, 2005 – March 31, 2005*



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

*March 20, 2005*

**COASTAL MARINE INSTITUTE  
PROGRAM YEAR 11**

**QUARTERLY REPORT 3**

*for the period*

*January 1, 2005 - March 31, 2005*

A Cooperative Agreement

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**University of California**

and the

**Minerals Management Service**

**Russell J. Schmitt**  
Program Manager

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

*March 20, 2005*

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## Program Manager's Report

*for the period January 1, 2005 –March 31, 2005*

This constitutes the quarterly report for the second quarter for Program Year 11 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, 18 projects currently are being conducted under the aegis of the Coastal Marine Institute.

### **Actions Pending MMS Approval:**

- ◆ Approval of no-cost extension for **Task 17609**, Contract No. 1435-01-00-30758, PIs Schmitt, Dugan, Hodges, Jacobs, Page, Wilson, Gaines, *Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products*, through May 31, 2005;
- ◆ Approval of no-cost extension for **Task 85339**, Contract No. 1435-01-00-CA-31063, PIs Page, Dugan, Love and Lenihan, *ecological Performance and Trophic Links: Comparison among Platforms and Natural Reefs for Selected Fishes and their Prey*, through September 30, 2005;
- ◆ Approval of no-cost extension for **Task 85340**, Contract No. 1435-01-00-CA-31063, PIs Lenihan and Brooks, *Relative Importance of POCS Oil Platforms on the Population Dynamics of Two Reef Fishes in the Eastern Santa Barbara Channel*, through September 30, 2005, through June 30, 2005;
- ◆ Approval of no-cost extension for **Task 85386**, Contract No. 1435-01-00-CA-31063, PIs Washburn and Gaines, *Observing the Surface Circulation in the Eastern Santa Barbara Channel Using High Frequency Radar and Lagrangian Drifters*, through September 30, 2005;

### **Major Programmatic Progress and Actions during the Quarter:**

- ◆ **Task 12390:** *Testing and Calibrating the Measurement of Nonmarket Values for Oil Spills via the Contingent Valuation Method*, a Draft Final Report was submitted to the Minerals Management Service in the last quarter. We are awaiting comments from 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 during the next quarter;
- ◆ **Task 15115:** *Effects of Temporal and Spatial Separation of Samples on Estimation of Impacts* has been completed. The Draft Final Report has been reviewed by MMS we are awaiting revisions from the PI. The revised Final Report will be submitted to MMS during the next quarter;
- ◆ **Task 17601:** *Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species* has been completed. The Final Study Report has been submitted to MMS;
- ◆ **Task 17605:** *Population Dynamics and Biology of the California Sea Otter at the Southern End of its Range*, a Draft Final Report was submitted to the Minerals Management Service during this quarter. We are awaiting comments from MMS;

- ◆ **Task 17607:** *Public Perceptions of Risk Associated with Offshore Oil Development*, a Final Report is being prepared;
- ◆ **Task 18211:** *Oil Slicks in the Ocean: Predicting their Release Points Using the Natural Laboratory of the Santa Barbara Channel* has been completed. The Draft Final Report will be submitted during the next quarter;
- ◆ **Task 18212:** *Transport over the Inner-Shelf of the Santa Barbara Channel* has been completed. A Draft Final Report was submitted to the Coastal Research Center;
- ◆ **Task 18213:** *Use of Biological Endpoints in Flatfish to Establish Sediment Quality Criteria for Polyaromatic Hydrocarbon Residue and Assess Remediation Strategies*, the Draft Final Report was submitted to the Minerals Management Service during the last quarter. We are awaiting comments from MMS.

**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, 2005 – March 31, 2005:**

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

**Publications and Presentations:**

We are currently preparing two papers for publication as well as a Draft Final Report that will be submitted in the coming months.

**List of all personnel associated with the project:**

Principal Investigators: Dr. Russell J. Schmitt  
Dr. Andrew J. Brooks

Graduate student: Sarah Lester

Staff researcher associate: Keith Seydel

Undergraduate students: Sabrina Beyer  
Lindsey Carr  
Stephen Holloway  
Katy Kunkle  
Chris Martinez  
Christina Tanner

**Future Plans:**

Complete and submit publications and Draft Final Report.

**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:	100%

**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, 2005 – March 31, 2005:**

During this reporting period, a Final Report on this study is being revised. The Draft Final report has been reviewed by MMS and agency comments have been given to the investigators. We are awaiting revisions from the investigators in response to the Minerals Management Service reviews of the report.

**Future plans:**

Complete 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, 2005 – March 31, 2005:**

During this reporting period, a revised Final Report was completed and submitted to MMS.

The citation for this report is:

Page, J.M., J. Dugan., J. Childress. Role of food subsidies and habitat structure in influencing benthic communities of shell mounds at sites of existing and former offshore oil platforms. MMS OCS Study 2005-001. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-31063. 32 pages.

**Future plans:**

None.

**Problems Encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

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

**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, 2005 – March 31, 2005:**

Research for this study continued through this quarter. CMI funds supported Year 1 of this three year study. Years 2 and 3 of the research have been supported by direct funding from the Environmental Studies Program of the Minerals Management Service.

**Future Plans:**

A comprehensive Draft Final Report covering all three years of the project will be submitted at the end of the MMS funding cycle (three years).

**Problems encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

Year 1	100%
Year 2	100%

**Task 17603:** *Following Changes in the Abundance of Rocky Intertidal Populations in Orange County, California: Contributions to a Regional Monitoring Network Agreement*

**Principal Investigator: Stephen L. Murray**, Department of Biological Sciences, California State University, Fullerton, CA 92834-9480

**Major Accomplishments, January 1, 2005 – March 31, 2005:**

Research for this study continued through this quarter. CMI funds supported Year 1 of this three year study. Years 2 and 3 of the research have been supported by direct funding from the Environmental Studies Program of the Minerals Management Service.

**Future Plans:**

A comprehensive Draft Final Report covering all three years of the project will be submitted at the end of the MMS funding cycle (three years).

**Problems encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

Year 1	100%
Year 2	100%

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

**Principal Investigator:** **Pete Raimondi**, Department of Ecology and Evolutionary Biology, Center for Ocean Health, University of California, Santa Cruz, CA 95064

**Major Accomplishments, January 1, 2005 – March 31, 2005:**

Research for this study continued through this quarter. CMI funds supported Year 1 of this three year study. Years 2 and 3 of the research have been supported by direct funding from the Environmental Studies Program of the Minerals Management Service.

**Future Plans:**

A comprehensive Draft Final Report covering all three years of the project will be submitted at the end of the MMS funding cycle (three years).

**Problems encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

Project Year 1	100%
Project Year 2	100%

**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, 2005 – March 31, 2005:**

The Draft Final Report was submitted to the Minerals Management Service for review. We are awaiting MMS comments on this report.

**Future plans:**

Revise, if necessary, the Draft Final Report and submit the Final Report for this project.

**Problems Encountered:**

No problems have been encountered.

**MMS Action Required:**

No MMS action required.

**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, January 1, 2005 – March 31, 2005:**

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

**Future plans:**

We will finalize and submit our Draft Final Report in the next quarter.

**Problems Encountered:**

We have not encountered any problems during this quarter.

**MMS Action Required:**

No MMS action required.

**Estimated Percentage of Budget Expended:**

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

**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, 2005 – March 31, 2005:**

During this reporting period, a Final Report is being formatted for publication and will be submitted to MMS early next quarter.

**Future Plans:**

Revise Draft Final Report, if necessary and submit the Final Report to MMS.

**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 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, 2005 – March 31, 2005:**

**ECOLOGY**

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

An invited article entitled, “Use of OCS oil platforms as sustainable sources of marine natural products” is in review for the international magazine, *Global Aquaculture Advocate*. This article was based on our presentation at a special session at Aquaculture 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. 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**

*Name Change*

The red band (see last quarters section of the quarterly report) previously described has been given the name WC01 and will be cited as such in the future.

*Structural Elucidation*

Currently preparative quantities of purified material are being processed so as to have a large stock available for spectrographic analysis. The process involves acid extraction, separation using column and liquid chromatography, and purification on high performance thin layer chromatography. Purified samples are then tested for bioactivity using the sea urchin assay as



previously described. Samples of WC01 have been processed by NMR with the assistance of the National Cancer Institute (NCI) using a 500mhz NMR with microflow probe. Results are indicating a highly symmetrical structure with at least a single sulfur which may be utilized in the dimerization of the compound. Recent mass spectra of the compound reveal a molecular ion of approx. 350. Assuming a single sulfur, using elemental analysis data the weight calculated would be in the low 700's. This indicates that there may be a dimer of the compound which is broken up in mass spectra. With increased quantities of pure compound continued experimentation will be performed in Dr. Wilson's lab looking at microtubule dynamics.

**Future Plans:**

Currently work is being done to build large stock of red compound in order to perform C13 NMR to further elucidate molecular structure. Further experimentation to corroborate the presence of sulfur in the molecule is also being performed along with stabilization of the previously described protein complex.

**GENETICS**

We continued to make progress on determining the genetic variation among samples of *Bugula neritina* during the quarter. Primarily, we have worked to analyze DNA sequence variation for the mtDNA segment we have PCR amplified. As reported earlier, we have identified one new variant thus far but await the complete analysis of all of our samples. We have also designed a new pair of primers for amplification from the bacterial symbiont in order to assess whether the new *B. neritina* clade also harbors a unique lineage of symbionts (one that may produce a unique Bryostatin compound). Our progress was slowed somewhat by our technician leaving the laboratory.

**Future Plans:**

During the next quarter we plan to fill the open position in the laboratory, re-amplify and sequence the few mtDNA sequences that were difficult to interpret and to begin amplifying and sequencing DNA from the bacterial symbiont from members of each major *B. neritina* mtDNA clade.

**Problems Encountered:**

None

**MMS Action Required:**

Approval of No-Cost Extension is needed.

**Estimated Percentage of Budget Expended:**

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

**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, 2005 – March 31, 2005:**

A total of six interns worked on MMS and MMS/CMI projects during Winter '05. Kristina Estudillo, mentored by Ms. Dunaway of MMS, continued developing educational curricula comparing alternative energy sources with oil and gas for K-12 students. Jennifer Lape, mentored by Drs. Dugan and R. Schmitt of UCSB, collected, scanned and compiled scientific reprints produced by research projects funded by the CMI and SCEI programs for production of CD-ROMs containing all of these documents for MMS and assisted with rocky intertidal monitoring by MARINE. Corinne Kane, mentored by Drs. Schmitt and Dugan, scanned, produced pdf files and compiled all existing final reports from the SCEI and CMI programs for production of additional CD-ROMs containing final reports from each of these programs. Jennifer Klaib, mentored by Dr. Engle of UCSB developed and maintained the web-accessible MARINE database. Funding from the UCSB Shoreline Preservation Fund was used to support two undergraduate student interns who assisted with CMI/MMS research projects during this period. Peter White conducted nearshore studies of surface currents using small drifters under the supervision of Dr. Ohlmann of UCSB. Dana Nakase, mentored by Drs. Page and Dugan of UCSB, analysed population structure and composition of potential fish prey from offshore oil platforms and natural reefs. We are working with Fred Piltz and other MMS personnel to arrange additional internship opportunities for MMS and MMS/CMI projects during Spring and Summer 2005.

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

**Future Plans:**

Work will proceed as proposed.

**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 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, 2005 – March 31, 2005:**

A Draft Final Report on this study is in preparation and will be submitted to MMS during the next quarter.

**Future Plans:**

Efforts will be focused on writing the Draft Final Report.

**Problems Encountered:**

None

**MMS Action Required:**

None

**Estimated Percentage of Budget Expended:**

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

**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, 2005 – March 31, 2005:**

During this reporting period, a Draft Final Report was submitted to the Coastal Marine Institute. The Draft Final Report is being formatted for publication and will be submitted to MMS early next quarter.

**Future Plans:**

Revise the Draft Final report, if necessary and submit Final Report to MMS.

**Problems Encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

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

**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, 2005 – March 31, 2005:**

Analysis and writing culminated in a Draft Final Report, which was submitted to the Minerals Management Service for review during November 2004. We are awaiting MMS comments on the Draft Final Report.

**Future Plans:**

Revise the Draft Final report, if necessary and submit Final Report.

**Problems Encountered:**

None.

**MMS Action Required:**

MMS comments on the Draft Final Report.

**Estimated Percentage of Budget Expended:**

Project Year 1	100%
Project Year 2	100%

**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, 2005 – March 31, 2005:**

*Recruitment*

Safety-walk plates and tuffies were exchanged at Point Sierra Nevada, Stairs and Point Fermin in January, February and March. *Silvetia* collectors were exchanged in February at all three sites. Algae collectors and natural recruitment were sampled monthly. *Silvetia* and *Endocladia* recruits were found in the recruitment plots at all three sites, and on the collectors at Point Sierra Nevada and Stairs.

*Recovery Plot Sampling*

Recovery plots were sampled at all three sites from February 17<sup>th</sup> – February 23<sup>rd</sup>. A Uniform Pt. Contact (UPC) grid was used to quantify percent cover of each recovery plot and three control plots in the *Chthamalus*, *Endocladia*, *Silvetia* and *Mytilus* zones. Mobile invertebrates were counted in each recovery and control plot. Photographs were taken of all plots at all sites using a digital camera and photo-framer.

*Laboratory Work*

Monthly barnacle recruitment plates and mussel recruitment collectors (tuffies) are now being sampled in the lab at UCSC. Two volunteers have been trained to assist with this work. In January 2005, one lab volunteer was trained to sample juvenile mussels from recruitment collectors. To date, barnacle plates have been sampled up until September 2004, and tuffies have been sampled until January 2004.

The following presentation related to this project was presented at the Monterey Bay National Marine Sanctuary Symposium in Seaside, California:

Conway-Cranos, T and P.T. Raimondi. Geographical variation in recovery of rocky intertidal communities following a disturbance. Monterey Bay National Marine Sanctuary Symposium Seaside, California, March 12, 2005.

**Future plans:**

Recruitment collectors will be exchanged and natural recruitment sampled in adjacent plots every month at all three sites. Cleared plots will be sampled every three months.



**List of all personnel associated with the project:**

Principal Investigators: Richard Ambrose and Peter Raimondi

Technician/Graduate Student: Tish Conway-Cranos

Lab Volunteers: Alexandria Leckliter and Libby Porzig

Field Volunteers: Kelley Higgason (UCSC), Ben Perlman (UCSC), Justin Milgrim, Katie Spencer, Morgan Bond (UCSC), Christy Roe (UCSC), Melissa Miner (UCSC), Mary Elaine Dunaway (MMS), Dawn Jech (UCSC), Yuri Springer (UCSC), Hilary Hayford (UCSC), Haven Livingston (UCSC), Mark Readdie (UCSB), Melissa Foley (UCSC), Aimee Bullard (CSU Fullerton), and Nora Grant (UCSC).

**Problems Encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

Project Year 1:	100%
Project Year 2:	100%
Project Year 3:	~ 65%

**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, 2005 – March 31, 2005:**

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 petroleum (including aromatic) compounds released into marine environments. The objectives of this research include: (1) determining the intermediates and end products arising from microbial decomposition of the most persistent and harmful hydrocarbons and (2) the development of techniques to quantify rates for microbial consumption and decomposition of petroleum compounds in marine environments.

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

We have settled on one viable approach to analyze the degradation products of microbial hydrocarbon metabolism. This technique involves chromatographic technology designed to completely resolve the undefined complex mixture typical of weathered petroleum, so-called two-dimensional gas chromatography. We are collaborating with Chris Reddy at Woods Hole Oceanographic Institution (WHOI) to apply this new technique to natural samples and laboratory incubations. We are coupling this approach with measurements of standard metabolites to quantify patterns of hydrocarbon weathering.

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

We are currently conducting four experiments, each designed to assess rates or patterns of petroleum weathering in different environmental conditions. Experiments include i) laboratory incubations of petroleum weathering under sulfidic conditions, ii) determination of spatial petroleum weathering patterns in tar seeps, iii) field experiments to determine the rates and patterns of petroleum weathering during tar transport from the sediment to the sea surface, and iv) determination of the extent of petroleum weathering between the reservoir and sea floor.

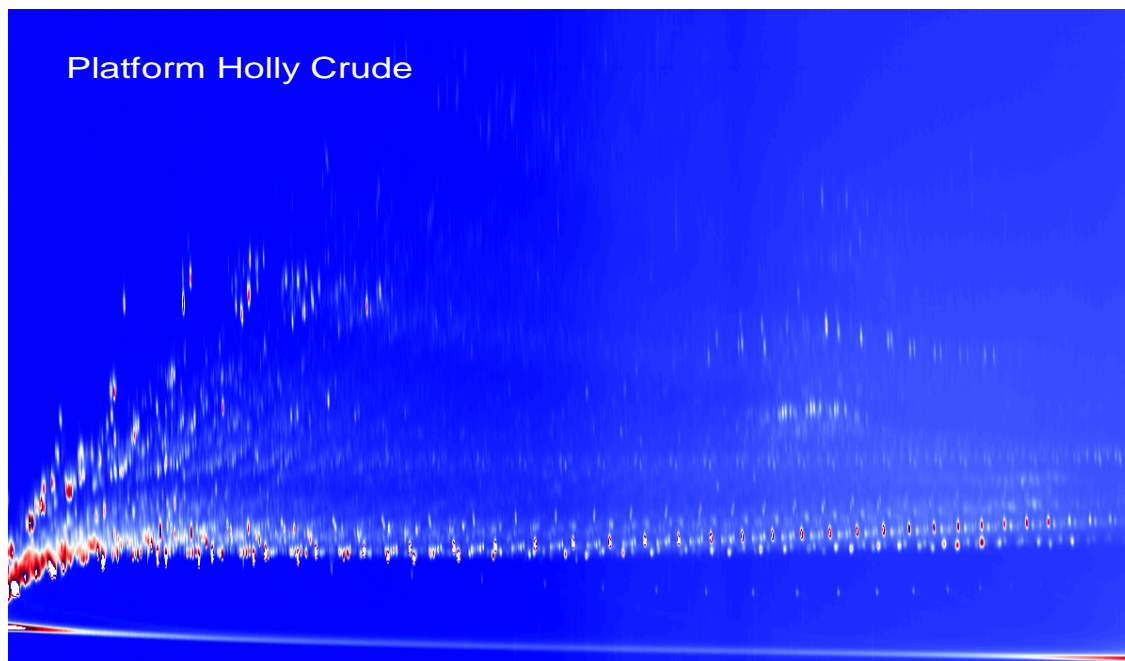
Each of these experiments is ongoing. Selected results from experiments i. included below. Samples for experiments ii., iii. and iv. have been collected, but no results are yet available.

### *Petroleum Weathering under Sulfidic Conditions*

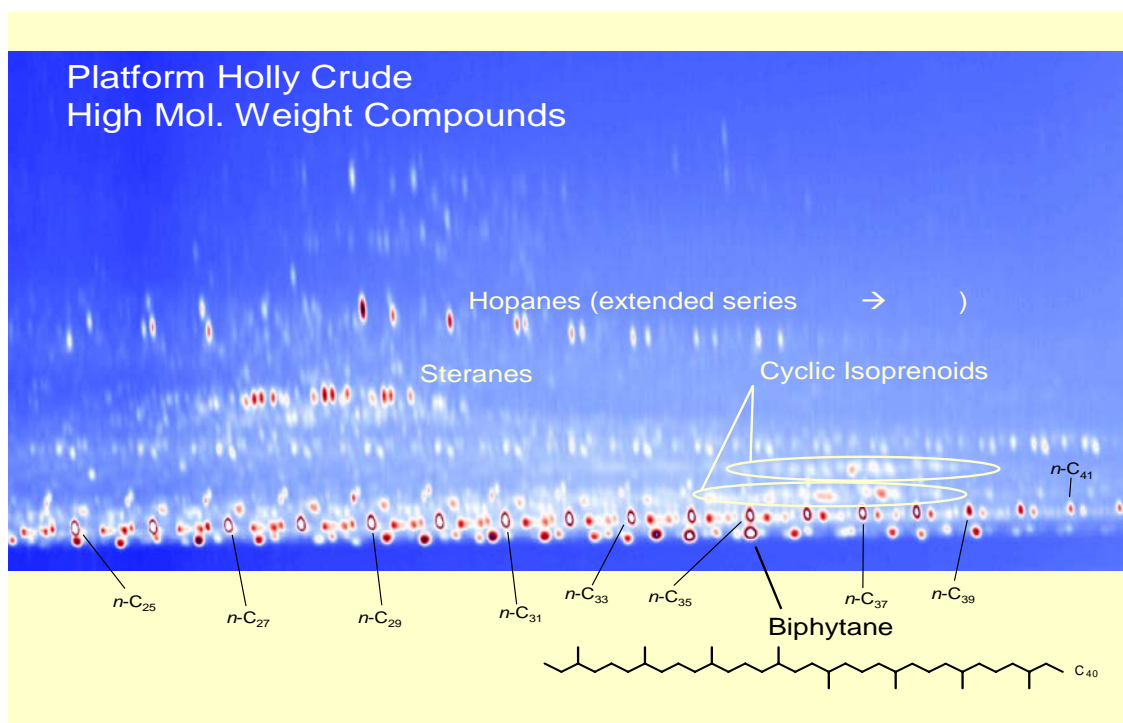
For the previous three quarters we have been performing experiments designed to assess the rates of hydrocarbon weathering in anoxic surficial sediments under sulfate-reducing conditions. These experiments are ongoing and began on October 1, 2004 when we collected 5 L of sediment from anoxic regions of Shane's seep to be used in a long-term incubation experiment. The general approach is to incubate hydrocarbon-contaminated seep sediments under controlled conditions while assaying CO<sub>2</sub>/H<sub>2</sub>S/CH<sub>4</sub> production, sulfate consumption, and changes in petroleum composition. In addition to the assays above we have also begun tracking the production and consumption of organic acids in the incubation bottles. We are using a method for the determination of C1-C5 volatile organic acids in sediments as described by Dan Albert (1998) and further developed in our lab. We plan to use the electrode systems purchased with MMS funds to further characterize the metabolites associated with these incubations. Details of the experimental design have been included in previous MMS-CMI reports.

### *Results*

Figures below show two GC×GC chromatograms of the oil used for incubation, collected from Platform Holly. The upper panel (Figure 1a) shows mainly alkanes ranging in size from 5 to 24 carbon atoms. The lower panel (Figure 1b) shows some of the higher weight compounds which have been labeled for convenience. These chromatograms provide an indication of the resolving power of GC×GC, as each dot represents a discrete compound.



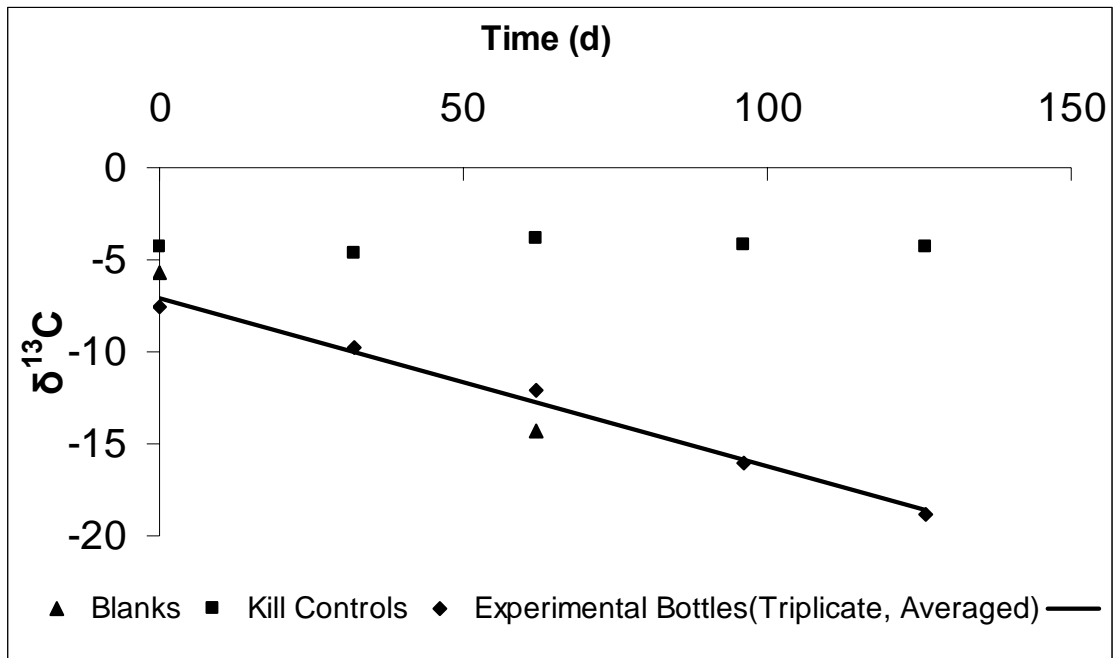
**Figure 1a.** GC×GC chromatogram of petroleum alkanes used for incubation collected from Platform Holly. Samples collected by G. Wardlaw and analyzed by C. Reddy.



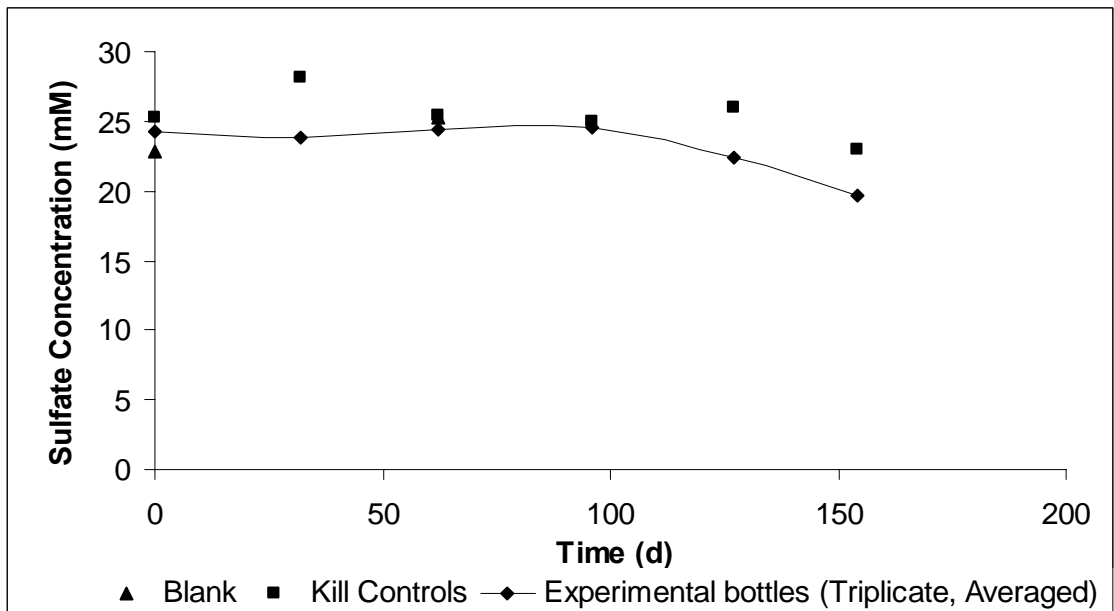
**Figure 1b.** GC×GC chromatogram of petroleum molecular compounds used for incubation collected from Platform Holly. Samples collected by G. Wardlaw and analyzed by C. Reddy.

During the first 160 days of incubation, kill controls (autoclaved petroleum, sediment and seawater), experimental blanks (sediment and seawater w/out petroleum) and experimental bottles (petroleum, sediment and seawater) have been analyzed periodically for various markers/indicators of microbial growth, including the  $\delta^{13}\text{C}$  of the  $\text{CO}_2$  in the head-space, an assay for the depletion of sulfate, measuring organic acid production using HPLC and the GC×GC technique. Our initial results are shown in Figures 2-6. Analyzing the  $\delta^{13}\text{C}$  of the  $\text{CO}_2$  produced during incubation shows the extent of microbial respiration taking place. Depletion of sulfate indicates both that conditions are sufficient for microbial growth and the activity of sulfate reducers. Organic acid production and consumption provides an indication of microbial growth, and the increase in alkalinity shows that sulfate reduction produces sulfide. The GC work will allow us to monitor the consumption of various fractions of petroleum.

Results from isotope ratio mass spectrometric (IR-MS) analyses of the  $\text{CO}_2$  in the head-space show a decrease in the  $\delta^{13}\text{C}$  as can be seen below in Figure 2. Analyses performed on October 1, 2004 show a  $\delta^{13}\text{C}$  value of approximately  $-7\text{‰}$  whereas values from tests performed on experimental bottles on March 4, 2005 showed a decrease in the  $\delta^{13}\text{C}$  to approximately  $-18\text{‰}$ . The  $\delta^{13}\text{C}$  value determined in the kill controls has been static at approximately  $-5\text{‰}$ .

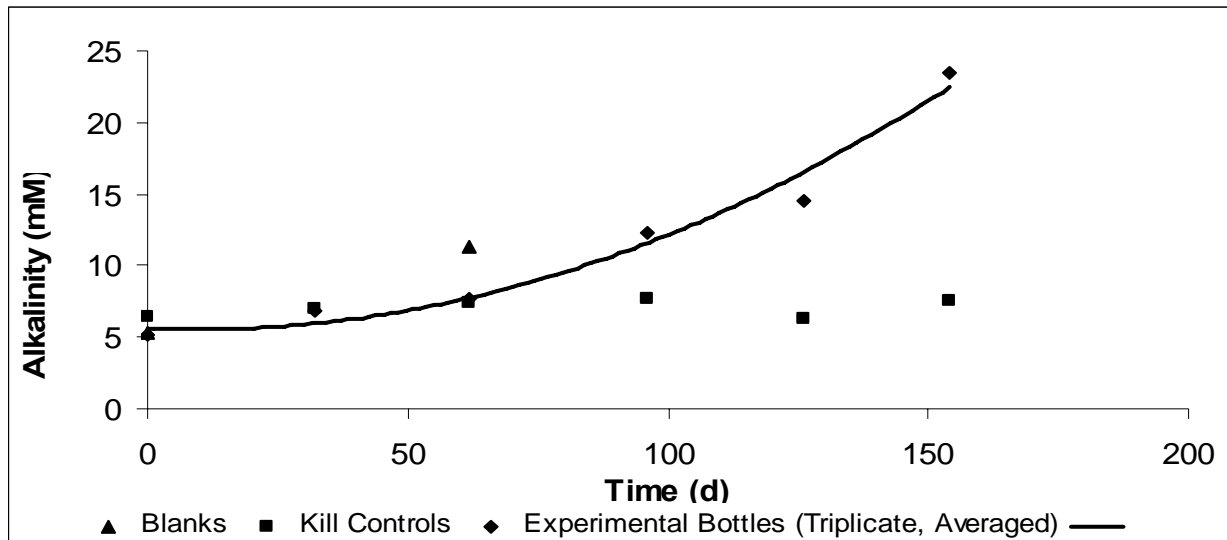


**Figure 2.**  $\delta^{13}\text{C}$  values for the blanks, kill controls and experimental bottles started on October 1, 2004.



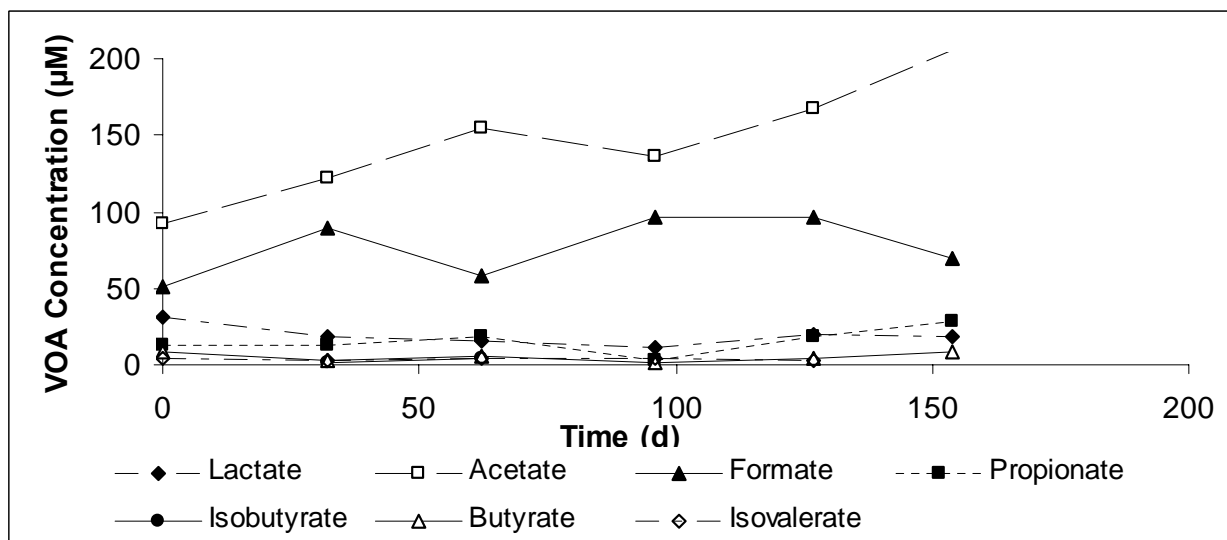
**Figure 3.** Sulfate concentrations for the blanks, kill controls and experimental bottles started on October 1, 2004.

As seen in the most recent analyses (Figure 3) sulfate assays show a decrease in sulfate in the experimental bottles from T = 0 to T = 5. Aqueous sulfate concentrations have decreased from a little over 24 mM to slightly less than 20 mM during the first 160 days of incubation. Sulfate concentrations in the kill controls have remained fairly static at ~ 25 mM throughout the experiment.

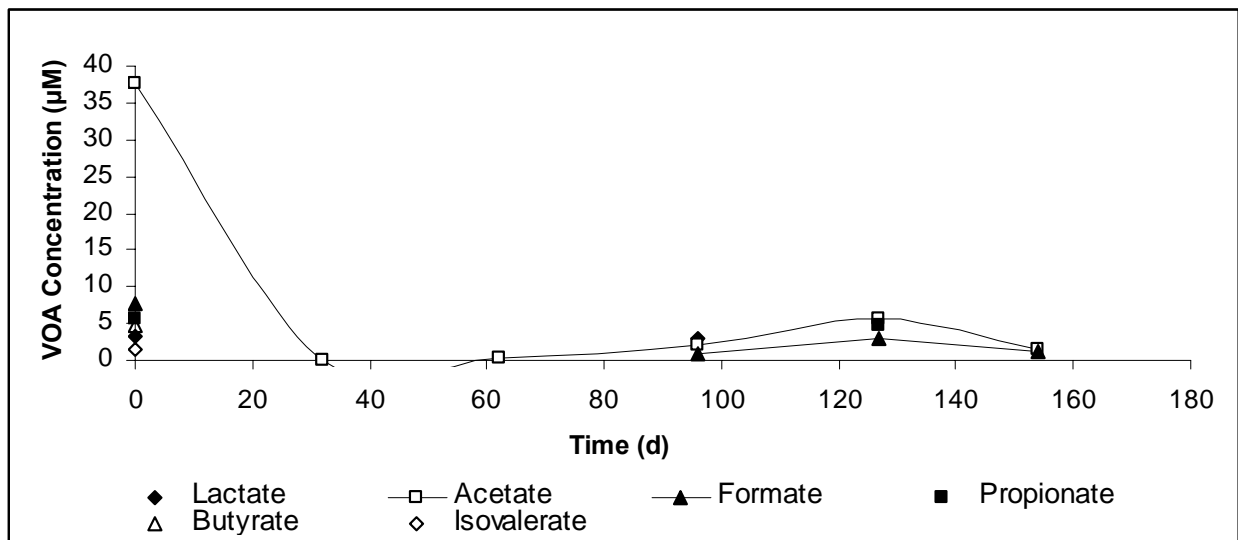


**Figure 4.** Alkalinity values for the blanks, kill controls and experimental bottles started on October 1, 2004.

Figure 4 (above) shows alkalinity increasing in the experimental bottles from ~5mM to over 20 mM while alkalinity in the kill controls has remained constant at ~5mM throughout the experiment. An interesting finding arising from the organic acid analysis is that heat sterilization by autoclave appears to decompose some of the petroleum fractions to organic acids. As can be seen in Figures 5 and 6 below, organic acids concentrations have remained extremely high in the kill controls while a decrease in organic acids concentrations was observed in the experimental bottles.



**Figure 5.** Determined C1-C5 mono-functional organic acid concentrations in the incubation kill controls started on October 1, 2004.



**Figure 6.** Determined C1-C5 mono-functional organic acid concentrations in the incubation experimental bottles begun on October 1, 2004.

Ongoing results from the incubation experiments indicate that sulfate reduction is proceeding at a sustained pace, and is presumably coupled to petroleum components. We anticipate analyzing some of the incubation samples using GCxGC over the next months to confirm this assertion.

### Future plans:

We are in the process of analyzing samples from the long-term incubation experiment, designed to broadly assay hydrocarbon weathering patterns, including aromatics. The duration of the experiment is planned for 12-18 months, but should be extended. Samples are sacrificed on a monthly basis and assayed using the methods described above, including the new GCxGC techniques developed at Woods Hole Oceanographic Institution. We are in the process of acquiring multi-component electrode array systems for analysis of various constituents from the aqueous phase of the experimental bottles including  $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{NH}_4^+$ ,  $\text{O}_2$ , and sulfide. Since microbial activity has been indicated, the first 6 time series will be shipped to WHOI for GCxGC analyses. George Wardlaw will be traveling to WHOI and staying from April 10<sup>th</sup> through April 23<sup>rd</sup> to learn the new GCxGC technique, and to analyze several of these samples.

### Problems Encountered:

We have opted to focus our efforts on the application of GC\*GC to the issue of petroleum weathering. In doing so we have set aside our initial approach of using radiolabeled substrate in favor of the more comprehensive and powerful approach afforded by GC\*GC.

**MMS Action Required:**

None.

**List of all personnel associated with the project:**

Principal Investigator: David Valentine

Graduate student researcher: George Wardlaw

Undergraduate student researchers: Frank Kinniman and Alison Schlosser

**Estimated Percentage of Budget Expended:**

Project Year 1: 100%

Project Year 2: 100%

Project Year 3: 49%



**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, 2005 – March 31, 2005:**

During the first quarter we continued analyzing the large oceanographic and fisheries data sets collected during an MMS-funded experiment running May through August 2004 (MMS program manager: Ann Bull). This research was carried out in collaboration with Dr. Milton Love and Mary M. Nishimoto of the Marine Science Institute at UCSB. A main goal of this research is to understand oceanographic factors controlling settlement of pelagic juvenile rockfishes (e.g. bocaccio) on oil production platforms. We hypothesize that oil production platforms are important artificial habitat for these fishes.

Preliminary results from this work will be presented at the following conference:

Nishimoto, M.M., L. Washburn, M. Love, D. Schroeder and B. Emery. Is the delivery of juvenile fishes settling on offshore platforms linked to transport by ocean currents? 8th International Conference on Artificial Reefs and Related Aquatic Habitats (CARAH), Biloxi, Mississippi, April 10-14, 2005.

In March, 2005 we were granted permission to install a high frequency (HF) radar system on coastal property owned by the Summerland Sanitation District in Summerland, CA. The site was installed about two weeks ago and its coverage and overall performance are currently being assessed. We are optimistic that this site will provide good coverage over the eastern Santa Barbara Channel based on our experience at a nearby site in Summerland that we operated from May through August 2004.

In collaboration with Dr. Carter Ohlmann, who works at the Scripps Institution of Oceanography, a joint study of drifter trajectories and HF radar-derived velocity time series continued over the past quarter. Ohlmann's research group performed several drifter releases within the HF coverage area offshore of Coal Oil Point near Santa Barbara, CA. A main goal of this collaboration is to determine the best method of predicting surface water parcel trajectories based on HF radar observations.

A manuscript describing some results from our MMS-funded research was submitted to *Geophysical Research Letters*, a peer-reviewed journal. The current citation for the manuscript is:

Bassin, C.J., L. Washburn, M. Brzezinski and E. McPhee-Shaw. Sub-mesoscale coastal eddies observed by high frequency radar: A new mechanism for delivering nutrients to kelp forests in the Southern California Bight. *Geophysical Research Letters* (*submitted*).

A principal result of the study described in the manuscript is the discovery of small, near-shore eddies which can transport offshore waters onto the inner shelf (water depths of 10-30 m). An important consequence of these eddies is that they can rapidly transport particles, nutrients, and pollutants such as oil to nearshore waters and possibly to the beach.

**Personnel associated with project:**

Principal Investigator: Libe Washburn  
Programmer Analyst: Brian Emery  
Staff Research Associate: David Salazar  
Graduate Student: Corinne Bassin  
Undergraduate Students: Kathryn Jackson and Justin Pearson

**Future plans:**

The performance of the new HF radar installation at Summerland, CA will be evaluated. Data from the site will be incorporated into the real-time database on the internet. This archive can be accessed at <http://www.icesb.ucsb.edu/iog/codar.htm>.

**Problems Encountered:**

No problems encountered this quarter.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

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

**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, 2005 – March 31, 2005:**

During the reporting period, we continued to process samples of potential food items of painted greenling, primarily small amphipod crustaceans, taken monthly from Naples and Mohawk reefs and Platforms Holly and Houchin. Interestingly, we have discovered that the principal caprellid species on Platforms Holly and Houchin is an exotic species from Japan. This species can occur in densities of 1000's per 400 cm<sup>2</sup>. We also continued to process samples that were taken during experiments to compare the molt rate and molt increment of caprellid amphipods. These data will be used in growth and production estimates of this important prey of painted greenling across sites.

Painted greenling collections were made at the same locations where invertebrate densities were quantified. Using these fish collections, we are estimating mean condition factor (K) for each site to test whether there were differences among regions (east or mid Santa Barbara Channel) and habitat types (reefs and platforms), and to determine if there was a relationship between K and invertebrate prey density. We continue to analyze fish gut content data to determine fish selectivity of prey items in the field.

**Future plans:**

We will finish the processing of invertebrate samples in the coming quarter. An important focus of this work will be the double-checking of species identifications and data entry for errors. In April, Page, Love, Schroeter, and Nishimoto will attend the 8<sup>th</sup> annual Conference on Artificial Reefs and Artificial Habitats (CARAH) in Biloxi, Mississippi and will present a paper on our research. With the collected fish samples, we are estimating stomach "fullness" and determining the number and identity of prey items consumed. We will use these data to compare painted greenling diet with available prey at the study reefs and platforms. We will continue our ECOPATH/ECOSIM modeling effort.

**Problems Encountered:**

None

**MMS Action Required:**

None

**Estimated Percentage of Budget Expended:**

Project Year 1:	100%
Project Year 2:	79%

**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, 2005 – March 31, 2005:**

A Draft Final Report on this study is in preparation and will be submitted to MMS during the next quarter.

**Personnel associated with project:**

Principal Investigators: Hunter Lenihan and Andrew Brooks

Staff Research Associate: Matt Kay

**Future plans:**

Submit Draft Final Report.

**Problems Encountered:**

None.

**MMS Action Required:**

None.

**Estimated Percentage of Budget Expended:**

Project Year 1:	100%
Project Year 2:	99%