University of California

Coastal Marine Institute

Annual Report

2004 - 2005

University of California

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Annual Report
2004 - 2005

Russell J. Schmitt
Program Manager, CMI
and
Director, Coastal Research Center

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

Mission of the Coastal Research Center

The Coastal Research Center of the Marine Science Institute, UC Santa Barbara, facilitates research and research training that fosters a greater understanding of the causes and consequences of dynamics within and among coastal marine ecosystems. An explicit focus involves the application of innovative but basic research to help resolve coastal environmental issues.

Disclaimer

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THE COASTAL MARINE INSTITUTE

A Cooperative Program involving the

University of California, the State of California

and the

Minerals Management Service US Department of Interior

ANNUAL REPORT

PROGRAM YEAR 11

September 14, 2005

PROGRAM MANAGER'S REPORT

The Coastal Marine Institute (CMI) was initiated in July 1994 as a cooperative research and research training program involving the Minerals Management Service, the State of California and the University of California. The focus is on long-term environmental, social and economic consequences of oil and gas production activities in the Pacific Outer Continental Shelf region. This Annual Report summarizes activities and research progress during Program Year 11 (July 1, 2004 - June 30, 2005).

Major programmatic progress achieved during Program Year 11 of the CMI:

- During 2004 – 2005, 30 regular and research faculty, 131 trainees (2 postdoctoral students, 27 graduate students, 67 undergraduate students, 1 high school student, and 29 staff) from 6 campuses and laboratories participated in CMI research projects;

- This Program year, CMI-sponsored studies produced 37 peer-reviewed papers, 10 publications in press, 11 submitted publications, and 7 publications in preparation, with an additional 31 research presentations. In addition, three CMI-MMS final reports and one SCEI-MMS final report were completed. Five CMI draft final reports are currently in review.

SUMMARY OF RESEARCH PROGRESS

Task No. 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 and Management, University of California, Santa Barbara, California 93106-5131 and **Andy Brooks,** Marine Science Institute, University of California, Santa Barbara, California 93106-6150

Summary of Research:

Overview

In FY 2004-2005, we completed all of our laboratory and field work except for the fish otolith analysis. The data collected this year and last year provides the information necessary to model population source-sink dynamics of our model species *Coryphopterus nicholsii* (blackeye goby) at POCS oil platform Gina and three natural rocky reefs in the Santa Barbara Channel. We are in the process of analyzing our data and erecting the population models we will publish in the mainstream ecological literature. We are still in the processes of developing the techniques to determine site-fish relationships with our fish otolith analysis, which we think will provide the basis for an additional publication.

Population abundance

We completed population surveys at all sites to provide a time series of population abundance of the blackeye goby. Our surveys were conducted in 2003 (June, July, August, and December) and 2004 (January and June). Data from surveys conducted in June and July 2003 indicate that population abundance varied among sites (Figure 1). Coupled with our tagging studies, our population censuses of gobies provide information on immigration, emigration, and mortality rates.

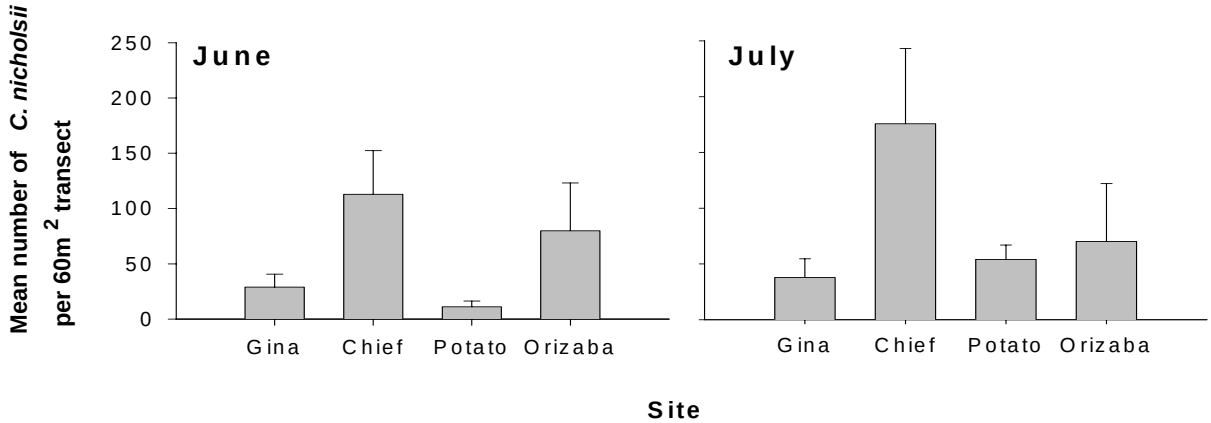

Figure 1. Results of population censuses of C. nicholsii at POCS Gina and three reference sites on Santa Cruz (Chief Reef, Potato Rock, Orizaba). Error bars are 95% confidence intervals.

Per capita growth and survival

We decided to focus our tagging/recapturing effort on *C. nicholsii*, the blackeye goby, due to its high abundance across all sites and the feasability of sampling. Fish were tagged, released and re-censused to estimate per capita survival and growth. We completed four months of tagging (September, October, November, and January) in which 1656 *C. nicholsii* were tagged (Figure 2A) and 673 were subsequently recaptured (Figure 2B). This 40.6% recovery rate is extremely high and will allow for an accurate and precise estimate of population source-sink dynamics.

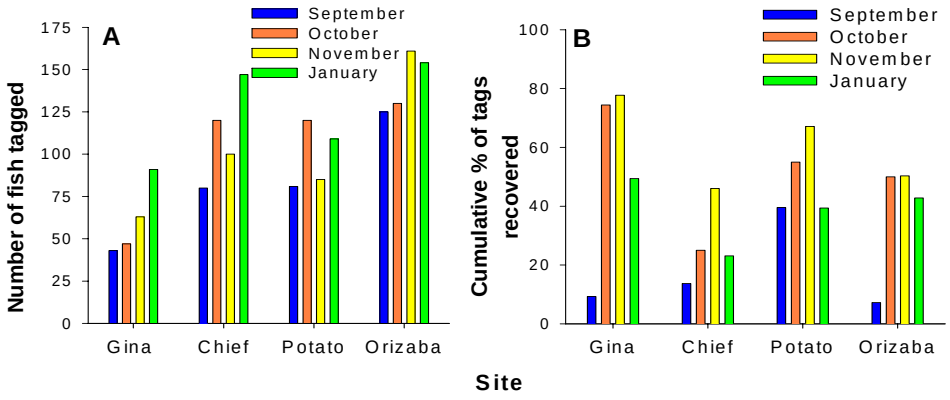

Figure 2. A) The total number of fish tagged at each site during all tagging events; B) The cumulative percent recovery of tags from each tagging event.

Reproductive Output

To estimate reproductive output, we collected and enumerated egg masses from POCS Gina (n = 15 egg masses) and the three Santa Cruz Island sites (n = 11 egg masses at each site) in late Winter-Spring 2004 (Figure 3). Eggs were first noticed in April and some males were still guarding nests in June. We found eggs to be very difficult to maintain alive in the laboratory, probably because males were not present to keep water circulating over the eggs and/or provide them with some developmentally essential chemical signal/cue.

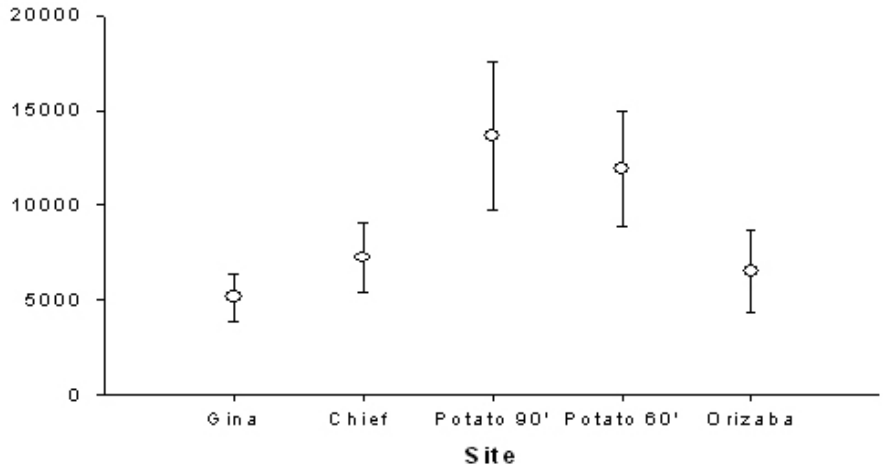

Figure 3: Mean number of eggs per clutch for egg masses of *C. nicholsii*, which were collected from POCS Gina and the three reference sites on Santa Cruz Island. Error Bars are 95% confidence intervals. Note that the Potato Rock site was divided into a deep and midwater sampling scheme. For all Santa Cruz Island sites n = 11, including both depths at Potato Rock (total n at Potato Rock = 22). At Gina, n = 15.

Recruitment

The recruitment of blackeye gobies was estimated at POCS Gina, and our three reference sites in March-July 2004. Recruits were quantified by divers who counted the total number of YOY recruits (fishes <1 cm in length) over four replicate 20 m x 2 m transects (40 m^2) at each site. We found very few recruits in March – May, but we found an increasing trend in recruitment in June (Figure 4). We also quantified recruitment in July and August because recruitment appears, at least this year, to be protracted over a substantially long period.

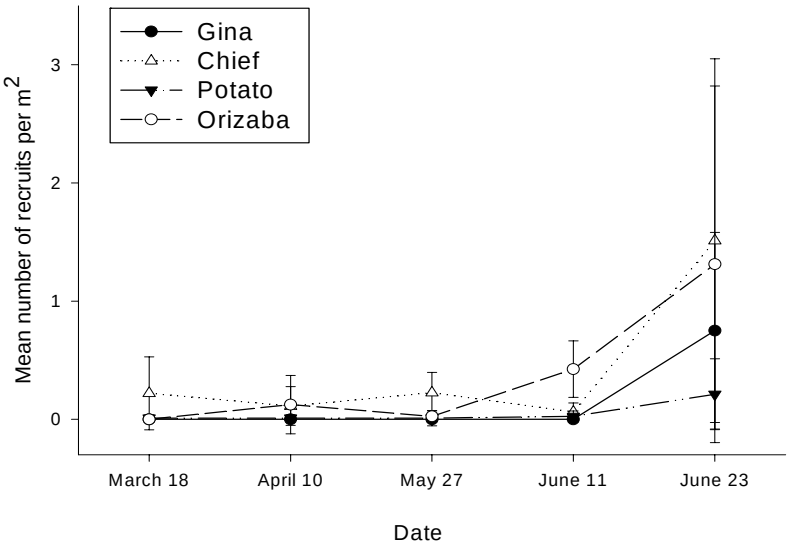

Figure 4. Recruitment at POCS Gina and three reference sites on Santa Cruz Island. Error bars at 95% confidence intervals.

Biotic interactions

The rate of predation on *Coryphoterus* by other fishes was estimated in July and August 2004 by tethering gobies at each site and examining their survival over 24 hr periods. Gobies were tethered at different depths and in different microhabitats, features that distinguish POCS platforms and natural reefs in our study, to determine how these factors influence their survival.

Age and Growth, Connectivity

We collected otoliths from fishes at each site and are completing the process of determining ages for fishes across a varied size range (Figure 5).

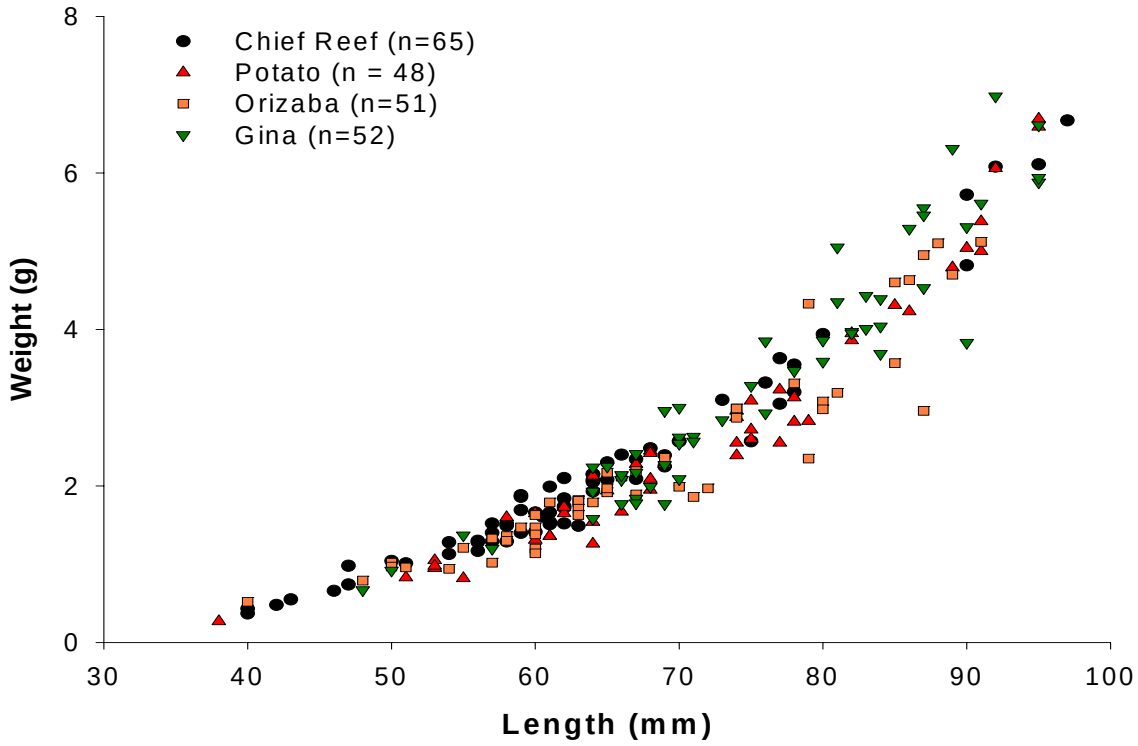

Figure 5: Length – Weight relationship for all specimens collected for otolith removal.

These data provided the first age and growth characterization for this species. In addition, we worked with the Gaines and Warner laboratories and the PISCO program at UCSB to identify micro-chemistry signatures from platform Gina and our natural reefs. These data provided information regarding the origin of individuals within populations at each site. This study examined whether goby populations are well-mixed within the Santa Barbara Channel, or, in contrast, whether there is a degree of self-seeding on these spatially separated locations.

Education Opportunities:

We involved six graduate and nine undergraduate students in our research during the fiscal year. We also had six staff personnel volunteer their time on our project. Our study overlapped with dissertation research being conducted by graduate student Stu Levenbach of the Department of Ecology, Evolution, and Marine Biology at UCSB. He was able to access his sampling sites and was provided a buddy diver to conduct his sampling and experiments in exchange for help with our sampling and tagging studies.

Future plans:

We are identifying and counting annual growth rings in otoliths, as well as preparing samples for our microchemistry-connectivity study. We have organized our data so that they are ready to be integrated into the population dynamics models. We are in the process of compiling our data and information into a Draft Final Study Report and Draft Final Technical Summary.

Problems encountered:

None, expect for the occasional inaccessibility of our sites due to terrorist related security issues.

MMS Action Required:

None

Task No. 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 93106-6150 **Jenifer Dugan,** Marine Science Institute, University of California, Santa Barbara, California 93106-6150 **Milton Love,** Marine Science Institute, University of California, Santa Barbara, California 93106-6150 and **Hunter Lenihan,** Bren School of Environmental Science & Management, University of California, Santa Barbara, California 93106-5131

Summary of Research

One of the major issues in the disposition of decommissioned oil platforms is the need for research that assesses the quality of platforms as habitat for ecologically and commercially important invertebrates and fishes. There are 27 oil and gas platforms off the coast of California. These platforms provide habitat and food for a variety of small invertebrates that are potentially important prey of fish. However, platforms differ from natural reefs in substrate, habitat complexity, and surrounding oceanographic conditions, attributes that could affect the composition and density of invertebrate prey. Differences in the availability of prey resources among platform and natural reef habitats might be reflected in indices of ecological performance of fishes that feed on these invertebrates. In this study, we are considering three questions that relate to how platforms and natural rocky reefs compare in trophic support provided to resident fish populations. First, does the composition and density of potential invertebrate prey of fish differ between platform and reef sites? Second, does the diet of resident benthic microcarnivorous fish differ between platform and reef sites? And third, is fish condition associated with the abundance and composition of available prey resources among sites?

To explore these questions, we sampled small invertebrates at two offshore platform sites, Holly, located ~3 km offshore, and Houchin, and located ~ 7 km offshore. We also sampled natural rock outcrops located inshore of each platform: Naples Reef, located inshore of Holly and Mohawk Reef, located inshore of Houchin. Potential invertebrate prey of reef fish were sampled approximately monthly by scraping and vacuuming 20 x 20 cm quadrats at comparable depths (~9-10 m) at each location. Prior to scraping, we estimated the percent cover of the major space holding taxa. On return to the laboratory, prey items were separated from non-prey material that commonly includes turf forming algae and, from the platforms, mussels and other large macroinvertebrates. The major non-prey components of the benthic habitat in each sample, such as the benthic algae, were also quantified in terms of weight or volume. Following this preliminary processing, potential invertebrate prey were identified, counted and weighed, and the lengths of some taxa were measured. These data will allow us to compare the standing crop, composition, and perhaps production of potential prey among locations on natural reefs and offshore oil platforms. We have collected and processed approximately 650 samples of invertebrates from the four locations in Figure 1.

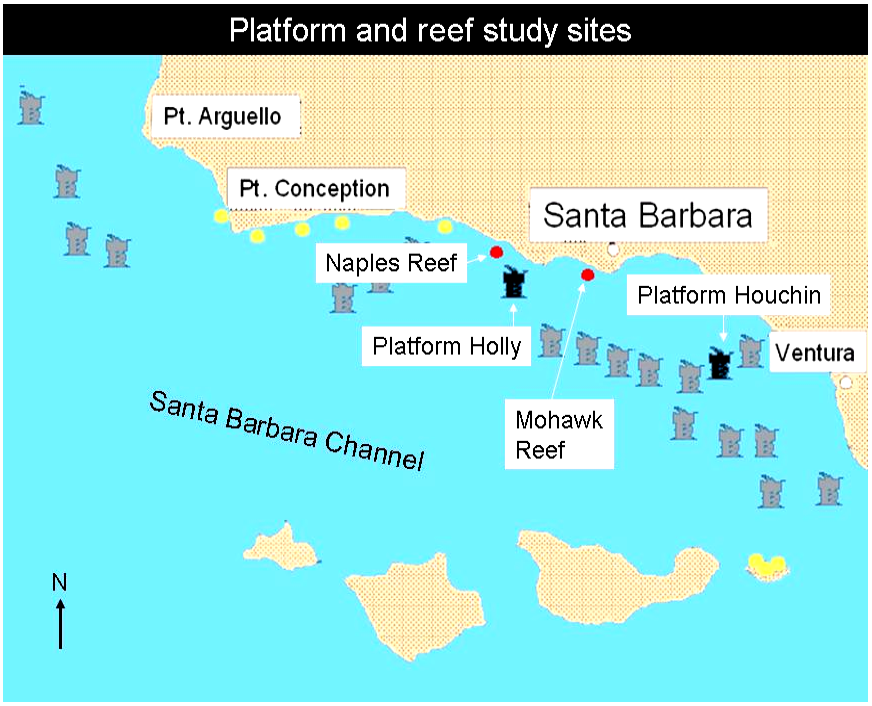

Figure 1. Map showing the location of oil and gas platforms in the Santa Barbara Channel. The study platforms Holly and Houchin are shown in bold, and Naples and Mohawk natural rocky reefs are shown as red dots. The yellow dots show the location of some other rocky reefs in the channel.

In addition to the field sampling of potential invertebrate prey, we compared the "instantaneous" molt rate and increment of caprellid amphipods, important prey items of reef fish, among locations. Caprellid amphipods were maintained individually in the laboratory following sampling, and the number of individuals that molted from each location was recorded over three consecutive days. The molted exuvia and newly molted animal were measured to determine molt increment. These data may permit a comparison of individual growth of these amphipods, one component of production, among locations. We compared the diet and condition of a resident benthic microcarnivorous fish, the painted greenling (*Oxylebius pictus*), among locations in August-September 2003 and April - March 2004. Painted greenling is one of the few fish species found on every surveyed oil platform and natural reef in the Santa Barbara Channel region. They are territorial with a limited home range. Painted greenling were collected by hand in the same area that invertebrates were sampled. Once collected, stomach contents were immediately preserved with formalin injections, and brought to the laboratory for processing. In the laboratory we recorded standard length and wet weight for each fish. Then the stomach from each fish was removed and the contents weighed, identified, and counted.

We also estimated density of painted greenling at each location 3 times during each season. Visual sampling was conducted along 8 transects (30 x 2 x 2 m, 920m^3) at Naples and Mohawk Reefs and within a 528 m^3 area at Platform Holly and 672 m^3 area at Platform Houchin. Depth of surveys was approximately 10 m for all locations except Mohawk Reef, which was surveyed at a depth of approximately 8 m.

The invertebrate assemblages at the platforms and Naples Reef were dominated numerically by amphipod crustaceans. At the two platforms and Naples Reef, gammarid amphipods comprised the greatest proportion of the vacuum samples (50-65%) (Figure 2). At Mohawk Reef, a greater proportion of the samples were made up of other taxa, including tanadiceans, small bivalves, and gastropods. At the platforms, caprellid amphipods were also of importance.

Densities of gammarid amphipods were highest at the platform locations; densities were often an order of magnitude higher at Holly than the other locations (Figure 3). Densities of caprellid amphipods were similarly highest at Holly (Figure 4). Caprellid densities at the other locations were more variable over time and generally lower.

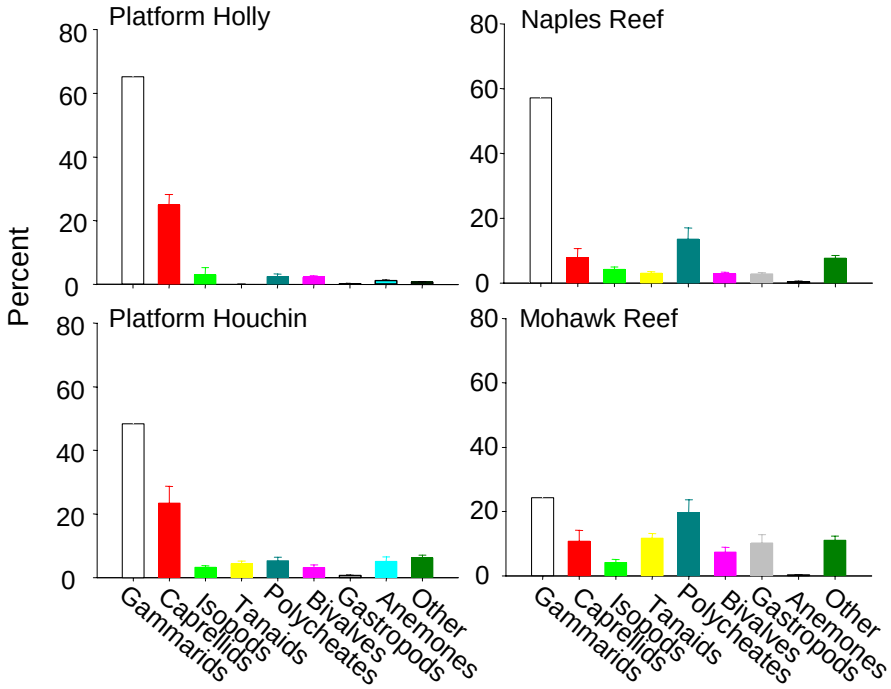

Figure 2. Taxonomic composition of small invertebrates, potential prey of painted greenling, in vacuum samples. Data averaged across 12 months.

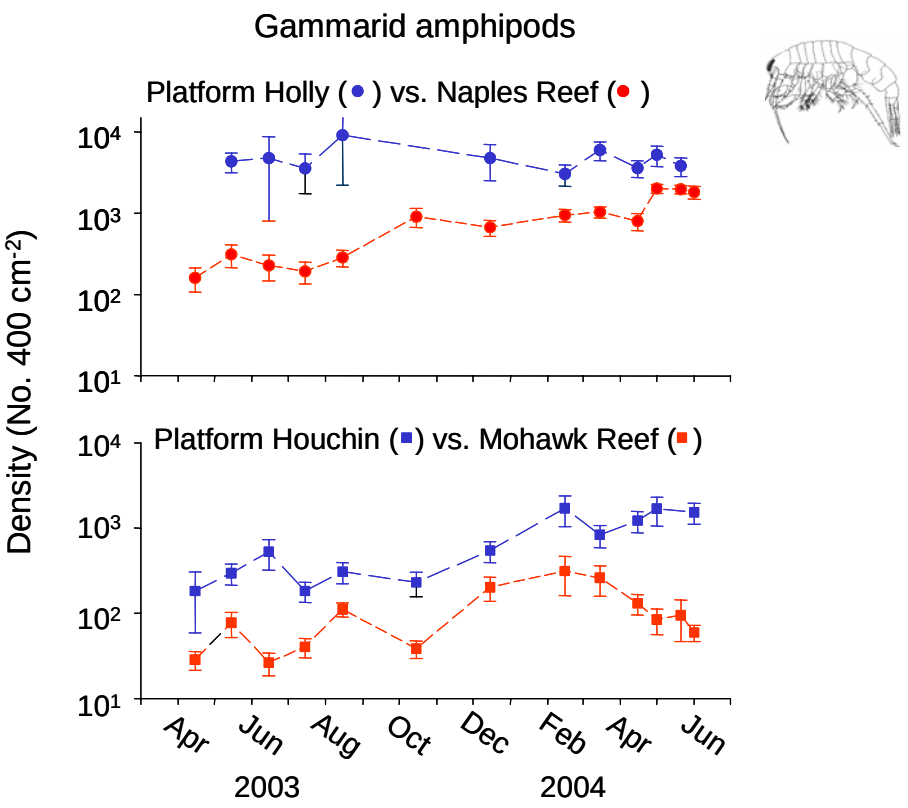

Figure 3. Mean density (±1SE) of gammarid amphipods over time at platform and natural reef study locations. n=8 to 12 quadrats/location in each month. Note log scales on y-axis.

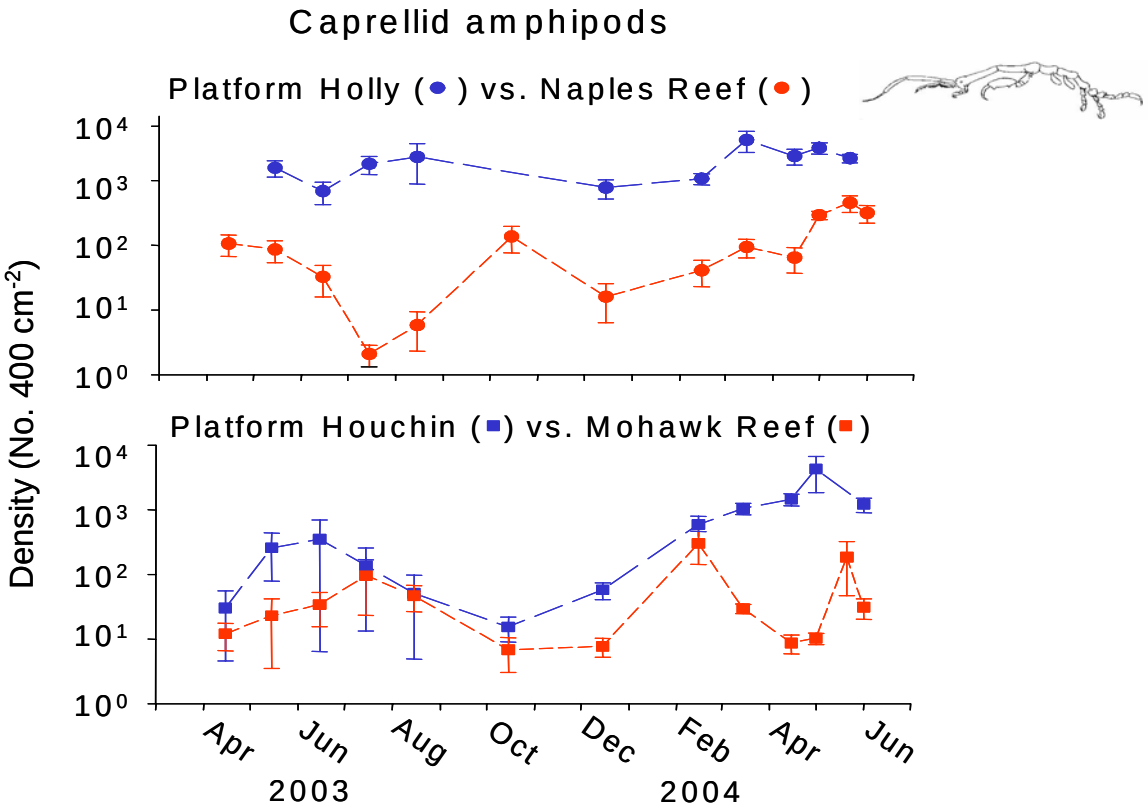

Figure 4. Mean density (±1SE) of caprellid amphipods over time at platform and natural reef study locations. n=8 to 12 quadrats/location in each month. Note log scales on y-axis.

Preliminary data from fish sampled during August-September 2003 show that painted greenling at all locations were feeding primarily (80-95%) on amphipods (Figure 5). At Platform Holly and Mohawk Reef, caprellid amphipods comprised 40-50% of prey items in the stomachs. In contrast, at Platform Houchin and Naples Reef, gammarid amphipods comprised the greatest proportion of prey items. Other prey items in the stomachs included isopods, tanaidaceans, and polychaetes. A platform or reef effect on diet was not evident - gammarids and caprellids were of about equal importance to the diet of painted greenling at Holly, whereas gammarids predominated in fish stomachs from Naples Reef. However, the opposite pattern existed for Houchin and Mohawk. The most abundant caprellid amphipod on both platforms Holly and Houchin is an alien species, *Caprella mutica*, the Japanese giant caprellid (Figure 6). This caprellid occurs in very high densities on the platforms, but is negligible in occurrence on the natural reefs. Densities of native caprellid species are much lower than the alien species at all locations.

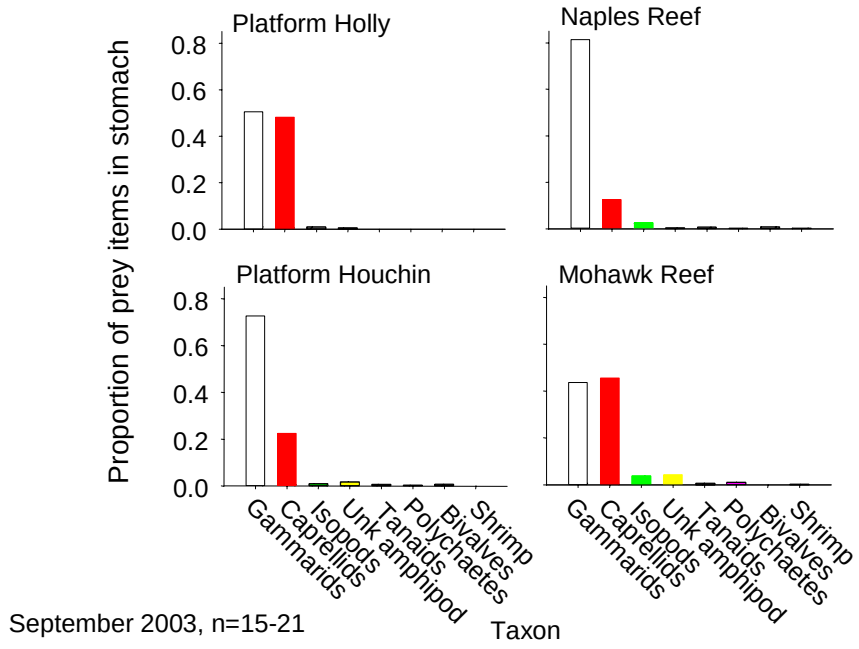

Figure 5. Proportion of prey items by taxon in the stomachs of painted greenling.

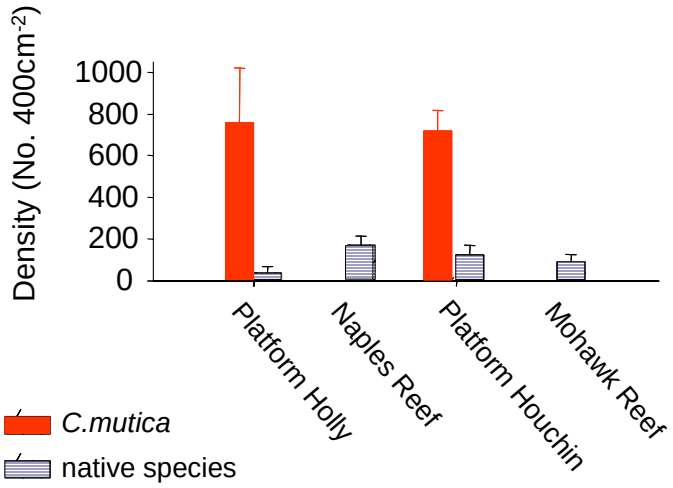

Figure 6. Density (x±1SE) of native caprellid amphipods and the alien species, *Caprella mutica*, in quadrat samples averaged over 12 months.

Differences we found in the proportion of caprellids in fish stomachs as compared to quadrat samples taken about the same time as the fish samples suggested that painted greenling selected caprellid amphipods over other types of prey at 3 of the 4 locations (Figure 7). At Naples Reef, Platform Houchin, and Mohawk Reef, the fish stomachs contained a much higher proportion of caprellids than found in our quadrat samples. The exception occurred at Platform Holly, where caprellid density was very high. At this location, caprellids were slightly more abundant in the samples than in the stomachs.

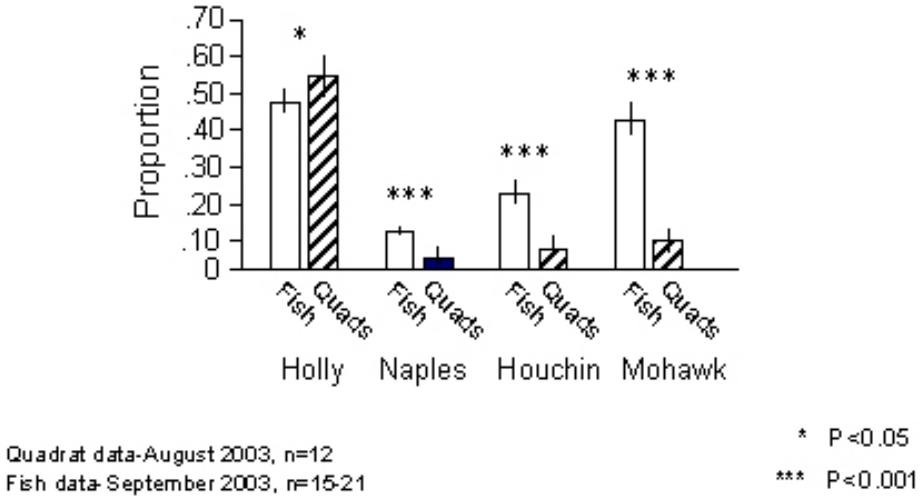

Figure 7. Mean proportion (±1SE) of caprellid amphipods in fish stomachs and quadrat samples.

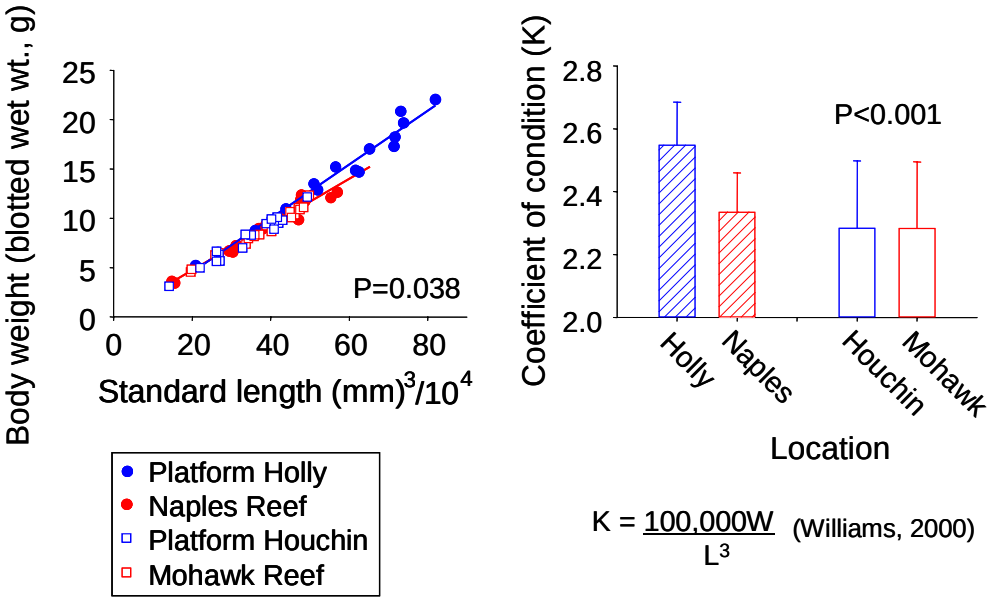

Figure 8. Body weight versus standard length, and condition factor of painted greenling at Platforms Houchin and Holly, and Mohawk and Naples Reefs.

The condition of painted greenling varied among locations and appeared related, at least in part, to the availability of amphipod prey. There was a small, but significant difference in the relationship between blotted fish wet weight and standard length cubed for fish from Platform Holly compared to the other locations (Figure 8). Condition factor K was significantly higher at Platform Holly compared with the other locations. This difference in fish condition does not appear related to fish density since painted greenling densities were intermediate at Holly compared with the other locations (Figure 9).

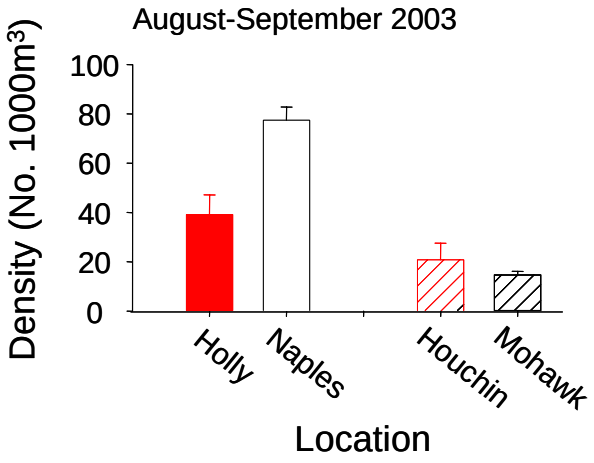

Figure 9. Density of painted greenling (August-September 2003) at Platforms Houchin and Holly, and Mohawk and Naples Reefs.

In summary, our preliminary data indicate that potential invertebrate prey available to benthic microcarnivorous fish were primarily gammarid and caprellid amphipods (70-85%) at the platforms and Naples Reef; however, a greater variety of taxa was available at Mohawk Reef. The alien caprellid amphipod, *Caprella mutica*, occurs in very high densities on the platforms, but is essentially absent from natural reefs. There were large differences in the density of potential prey among locations; densities of prey were typically higher on the platforms than on paired reefs, and overall 1-2 orders of magnitude higher at Holly than the other locations. Amphipods were the most important prey items found in the stomachs of painted greenling and there appears to be selection for caprellid amphipods over other types of potential prey at all the sites, except Holly where caprellid densities are very high. Fish condition was much higher at Platform Holly compared to the other locations and appears to reflect the availability of potential prey. Finally, platforms do provide a forage base for fish comparable to natural reefs. However, alien caprellid amphipods appear to be important contributors to this forage base.

During the upcoming three months we will complete the processing of invertebrate samples from all locations, develop estimates of standing crop (biomass) and production of selected prey taxa at each location, process samples of painted greenling taken in April 2004 for stomach contents and condition factor, and conduct experiments on fish feeding behavior to link prey and predator performance.

Future Plans:

Complete and submit a Draft Final Study report.

MMS Action Required:

None

Task No. 85338: *Weathering of Oil and Gas in the Coastal Marine Environment*

Principal Investigator: David Valentine, Department of Geology, University of California, Santa Barbara, California 93106-9630

Summary of Research

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 of hydrocarbons 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) determing the intermediates and end products arising from microbial decomposition of the most persistant 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. The gas chromatograph used for this analysis, pictured in Figure 1, is located at Woods Hole Oceanographic Institution (WHOI). We are collaborating with Dr. Chris Reddy at 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 three 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 and oil fields, and iii) field experiments to determine the rates and patterns of petroleum weathering during petroleum transport from the reservoir to

the sea floor, to the sea surface, to the beach. Each of these experiments is ongoing. Selected results from these experiments are included below.

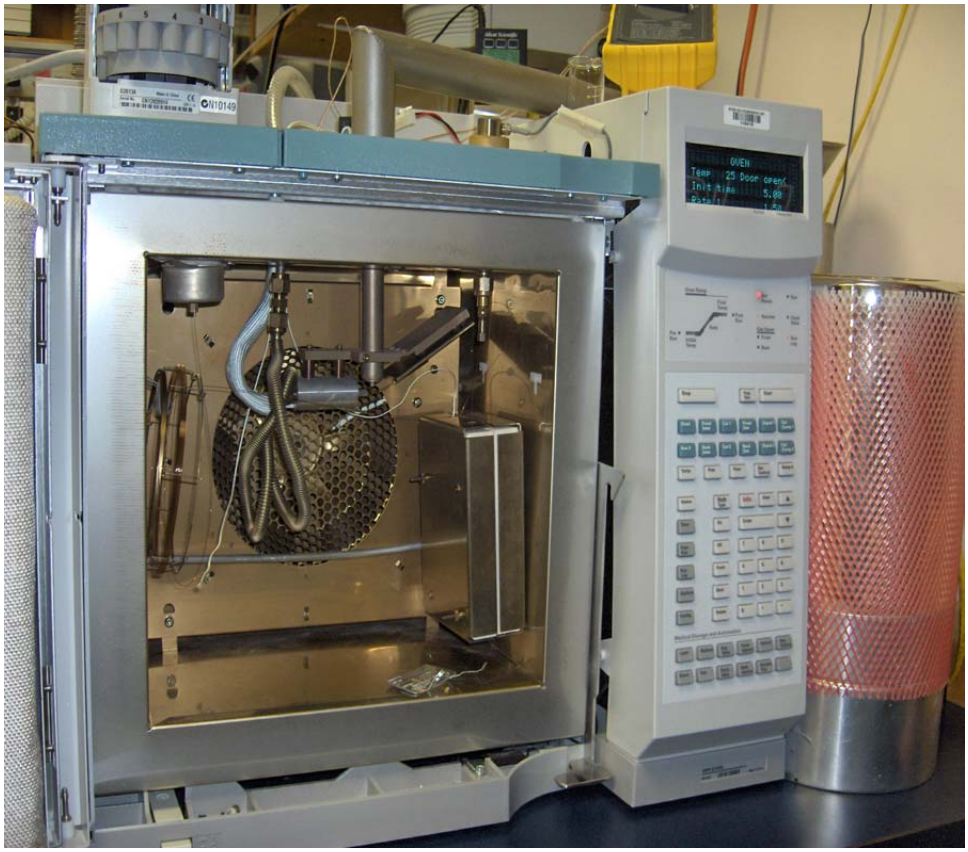

Figure 1. A picture of the HP 6890 gas chromatograph located at WHOI. This instrument contains two separate ovens and columns used to generate the GC×GC images shown in figures 2-4.

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 Seep and combined the sediment with oil collected from platform Holly. The general approach is to incubate hydrocarbon-contaminated seep sediments under controlled conditions while assaying CO_2/CH_4 production, sulfate consumption, and changes in petroleum composition. In addition to the assays above we are also 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 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 a previous MMS-CMI annual report.

Figure 2 shows 2 GC×GC chromatograms of the oil used for incubation, collected from Platform Holly well # 2342-15. The upper panel shows the complete GC chromatogram while the lower panel is a magnified portion of the chromatogram shown in the upper panel. The chromatogram in the lower panel is focused on the high molecular weight compounds found in platform Holly oil. These chromatograms provide an indication of the resolving power of GC×GC, as each dot represents a discrete compound. Complete compound identifications and concentrations are currently being determined; some compound classes have been identified and are labeled in both chromatograms for convenience.

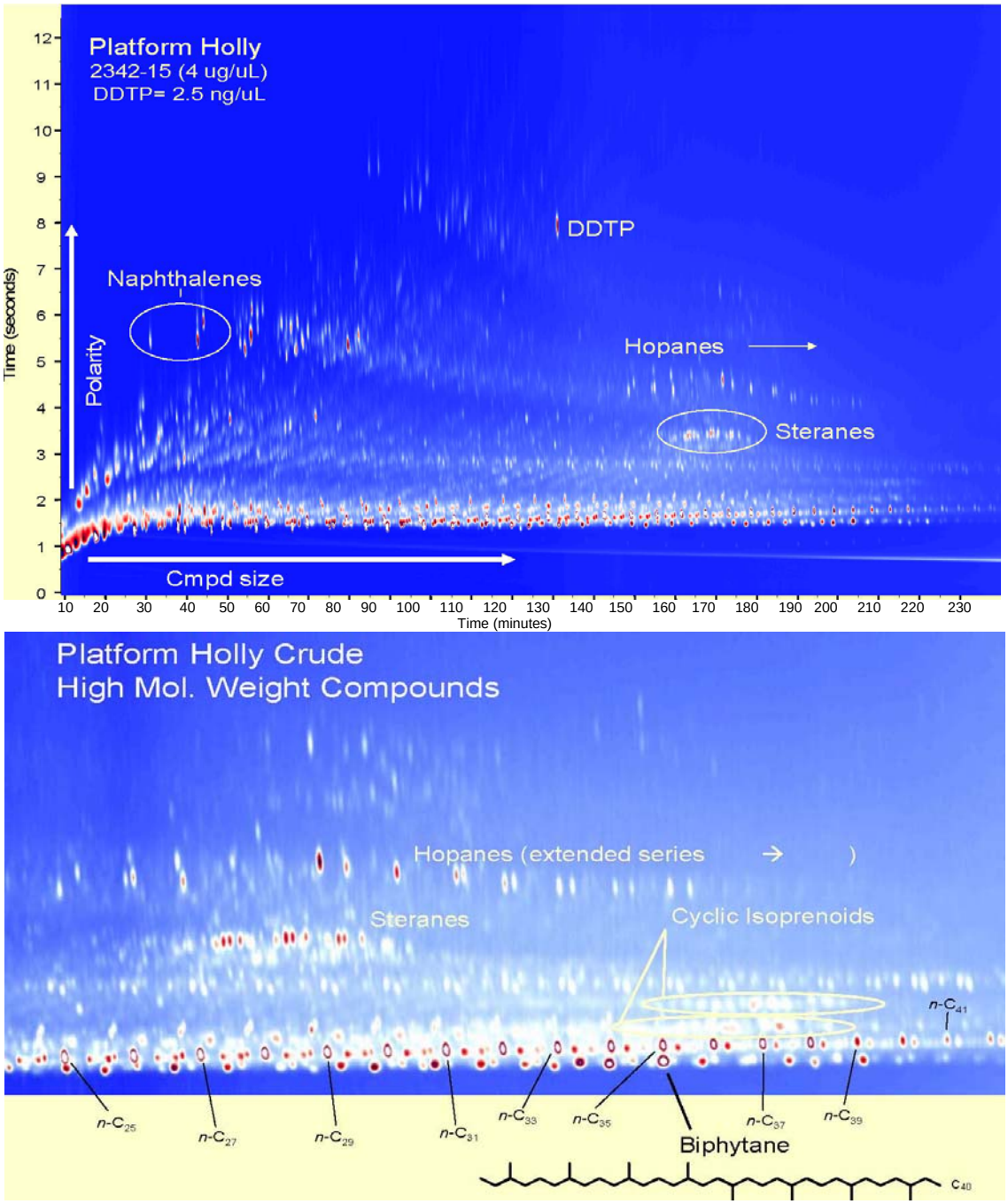

Figure 2. GCxGC chromatograms of petroleum collected from Platform Holly used for incubations.

During the first 230 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 $\delta^{13}C$ of the CO_2 in the head-space, an assay for the depletion of sulfate, measuring organic acid production using HPLC, and hydrocarbon analysis using the GC×GC technique. Our initial results are shown in Figures 3-7. Analyzing the $\delta^{13}C$ of the 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 and bicarbonate. The GC×GC analyses have allowed us to monitor the consumption of all major petroleum fractions.

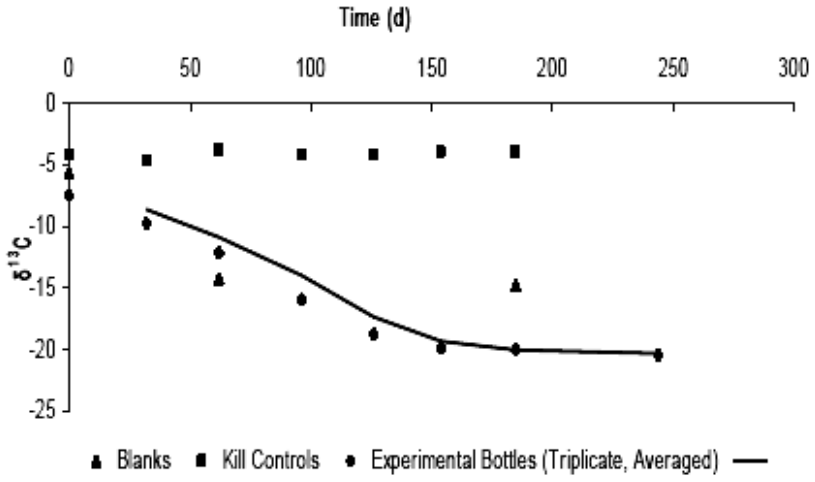

Figure 3. $\delta^{13}C$ values for the blanks, killed controls and experimental treatments initiated on October 1, 2004.

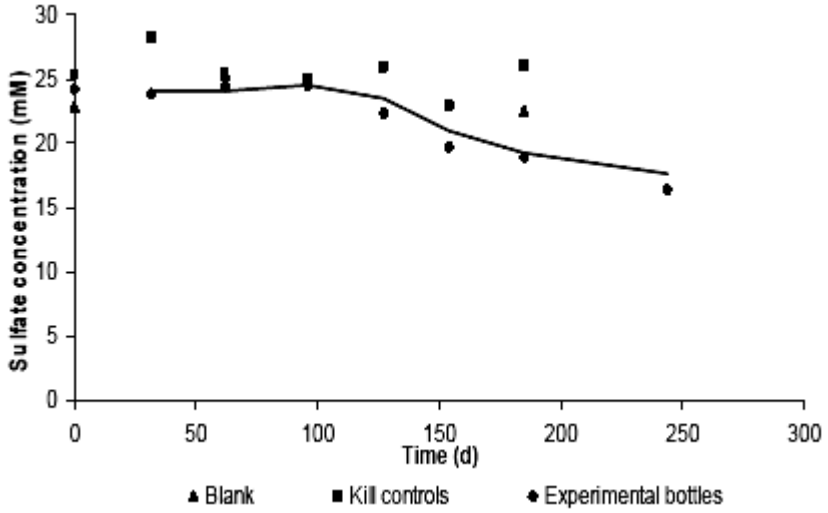

Figure 4. Sulfate concentrations for the blanks, kill controls and experimental treatments initiated on October 1, 2004.

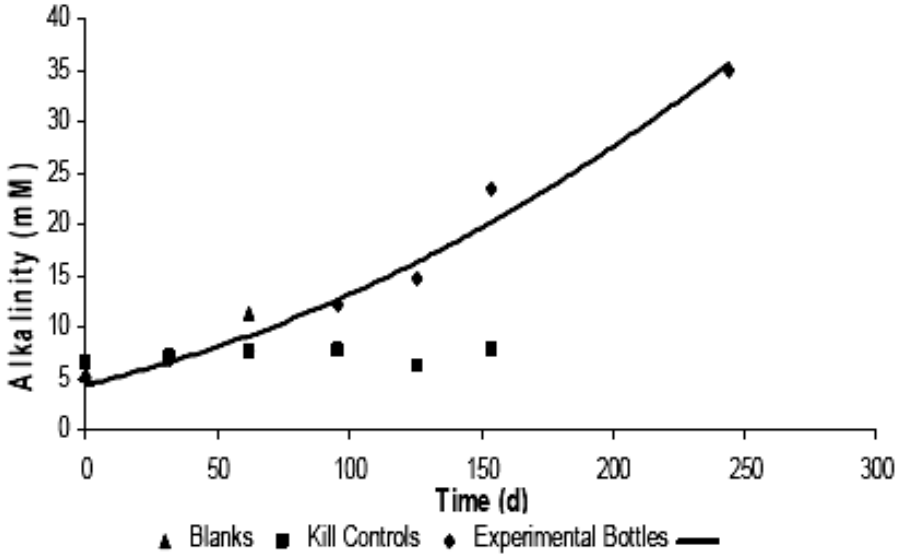

Figure 5. Alkalinity values for blanks, kill controls and experimental treatments initiated on October 1, 2004.

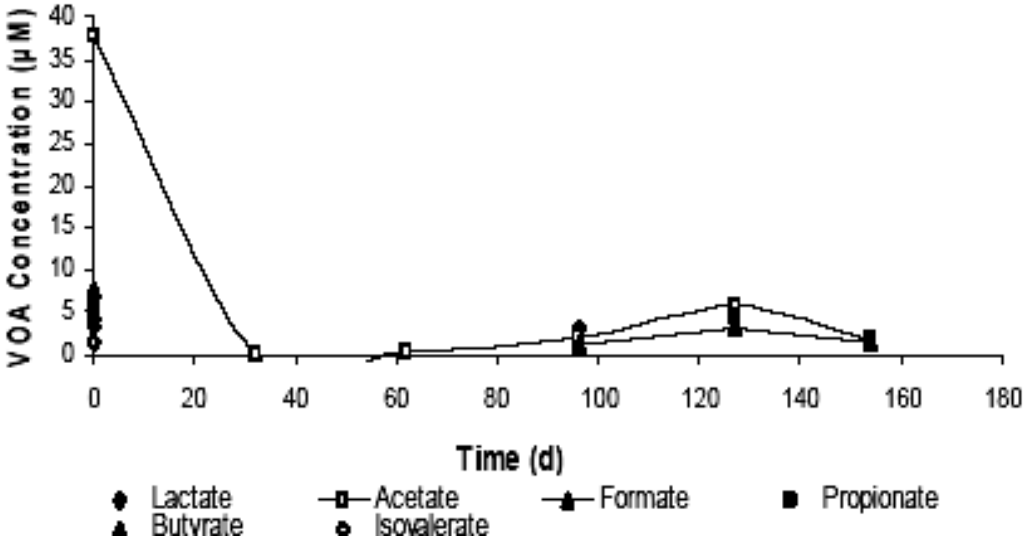

Figure 6. Determined C1-C5 mono-functional organic acid concentrations in the incubation experimental bottles initiated on October 1, 2004.

Results from isotope ratio mass spectrometric (IR-MS) analyses of the CO_2 in the headspace show a decrease in the $\delta^{13}C$ as can be seen in Figure 3. Analyses performed in October of 2004 show a $\delta^{13}C$ value of approximately -7 ‰ whereas values from tests performed on experimental bottles in June of 2005 showed a decrease in the $\delta^{13}C$ to approximately – 20 ‰. The $\delta^{13}C$ value determined in the kill controls have been static at approximately – 5 ‰. As seen in Figure 4 sulfate assays show a decrease in sulfate in the experimental bottles from T=0 to T=8, the most recent analyses.

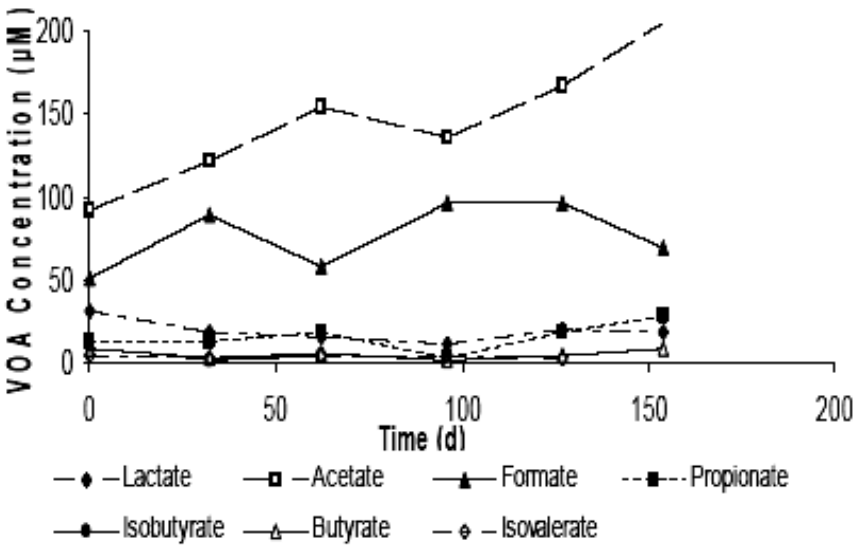

Figure 7. Determined C1-C2 mono-functional organic acid concentrations in the incubation kill controls initiated on December 1, 2004.

Aqueous sulfate concentrations have decreased from approximately 24 mM to approximately 15 mM during the first 230 days of incubation. Sulfate concentrations in the kill controls have remained fairly static at ~ 25 mM throughout the experiment. Figure 5 shows alkalinity increasing in the experimental bottles from ~ 5 mM to over 20 mM while alkalinity in the kill controls has remained constant at ~ 5 mM 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 6 and 7, organic acid concentrations have remained extremely high in the kill controls while a decrease in organic acids concentrations was observed in the experimental bottles. GC×GC chromatograms for the first 6 months of incubation, displayed in the form of mountain plots, are shown in Figure 8.

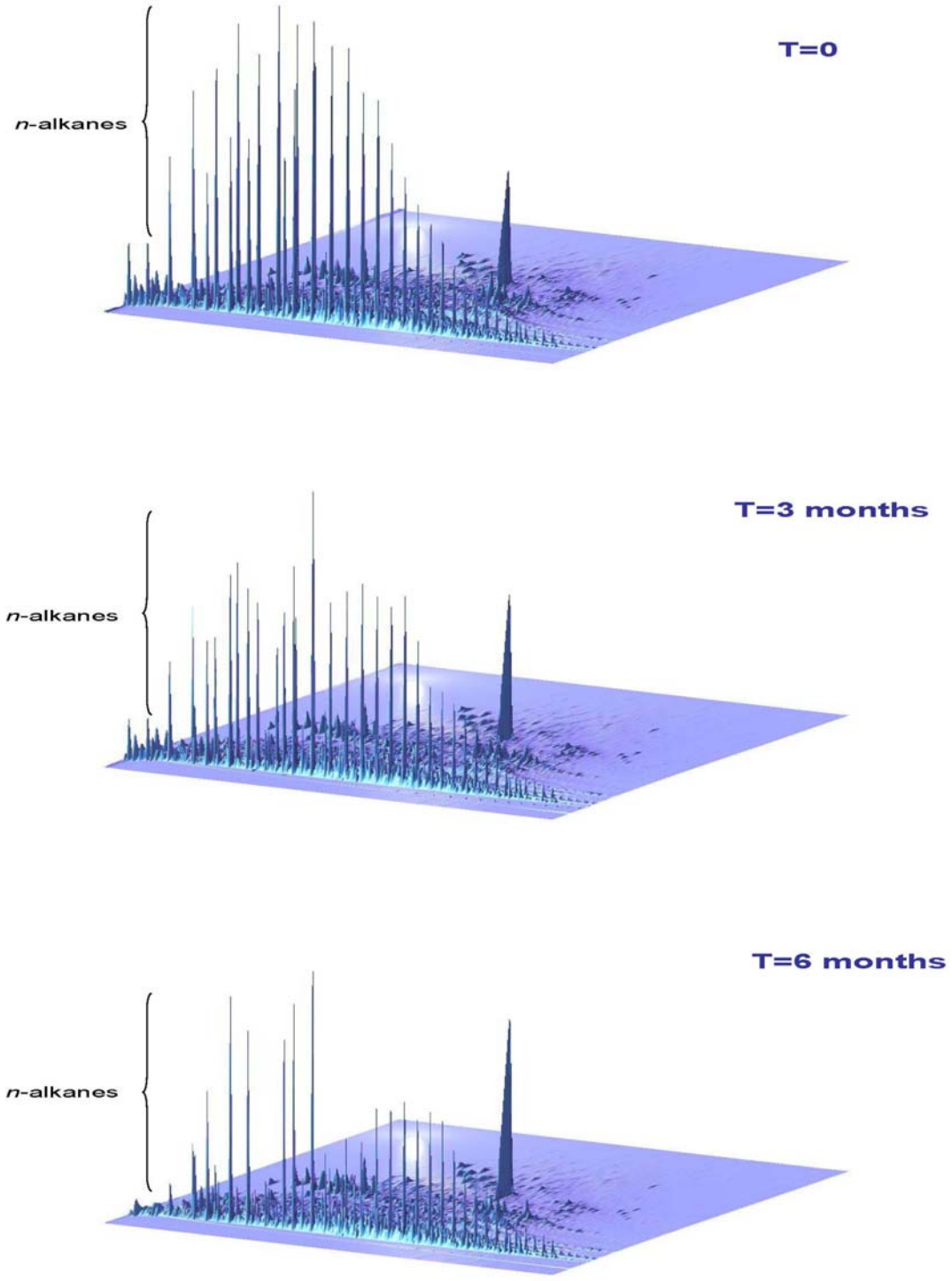

Figure 8. Mountain plot images (GC×GC chromatograms) of petroleum extracted from experimental treatments during the first 6 months of the incubation experiment.

Determination of Spatial Petroleum Weathering Patterns in Oil Field Reservoirs

Samples were also collected from other Platform Holly wells as well as from oil wells on Platform Gail. They were analyzed in order to look at the variations in petroleum contained within various coastal petroleum reservoirs. GC×GC chromatograms for 2 wells accessed by platform Holly (#3242-9 and #3242-18) are preliminarily labeled and displayed in Figure 9. Figure 10 shows GC×GC chromatograms for 4 wells accessed by platform Gail #E9-S, #E15-S, #E-10 and #E-16L. Depths for the platform Gail reservoirs range from about 4500 ft to slightly under 6000 ft. E9-S is the top most reservoir sampled and the deepest reservoir is E-16L located between 5511 ft and 5930 ft. One noticeable feature found on these chromatograms is the increase in n-alkanes with depth as can be measured using a difference chromatogram as shown in Figure 11. The concentration of naphthalene also appears to be considerably elevated in the deep reservoir (E-16L) when compared to the shallow one (E-9S).

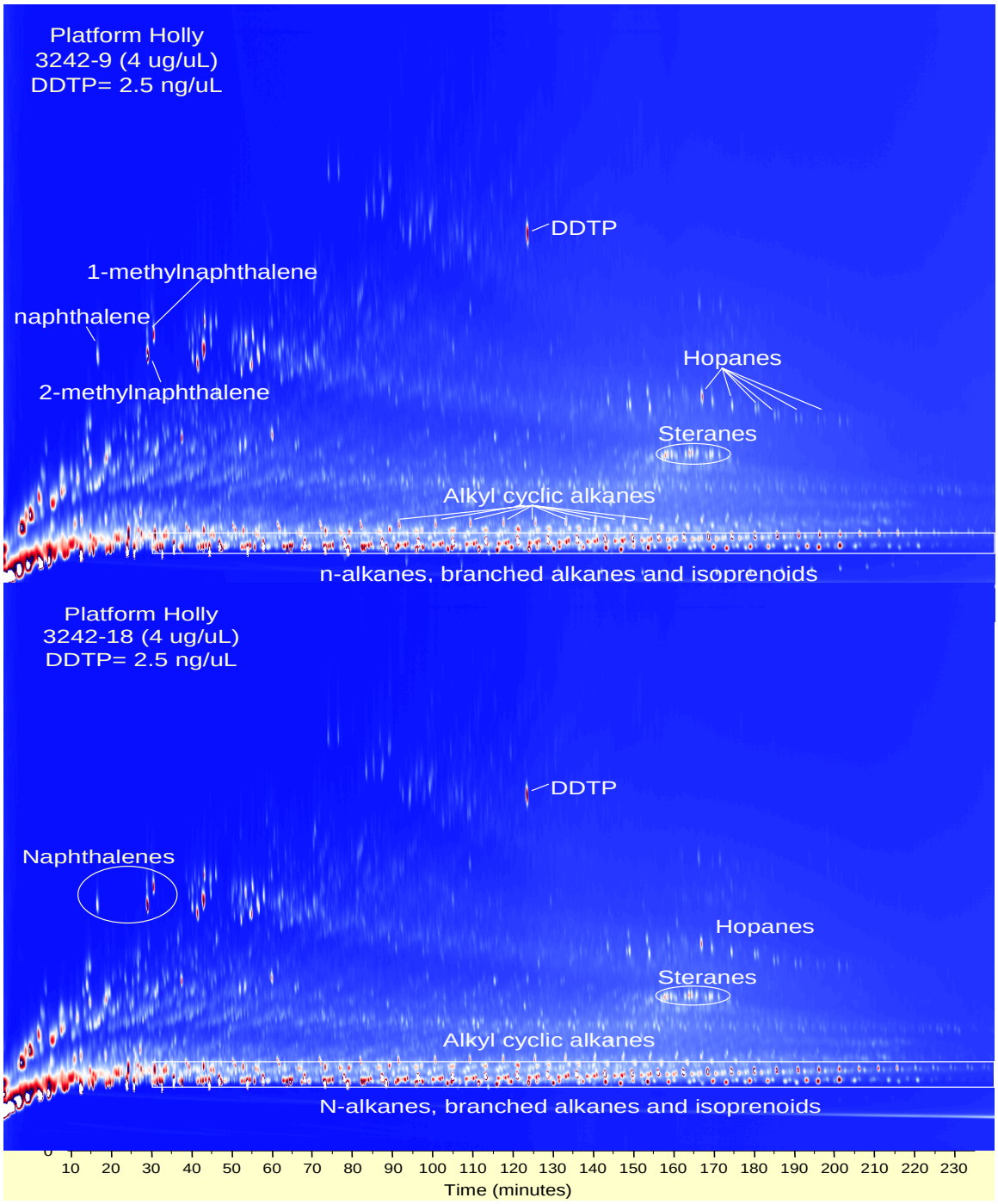

Figure 9. GC×GC chromatograms of petroleum collected from two wells at Platform Holly.

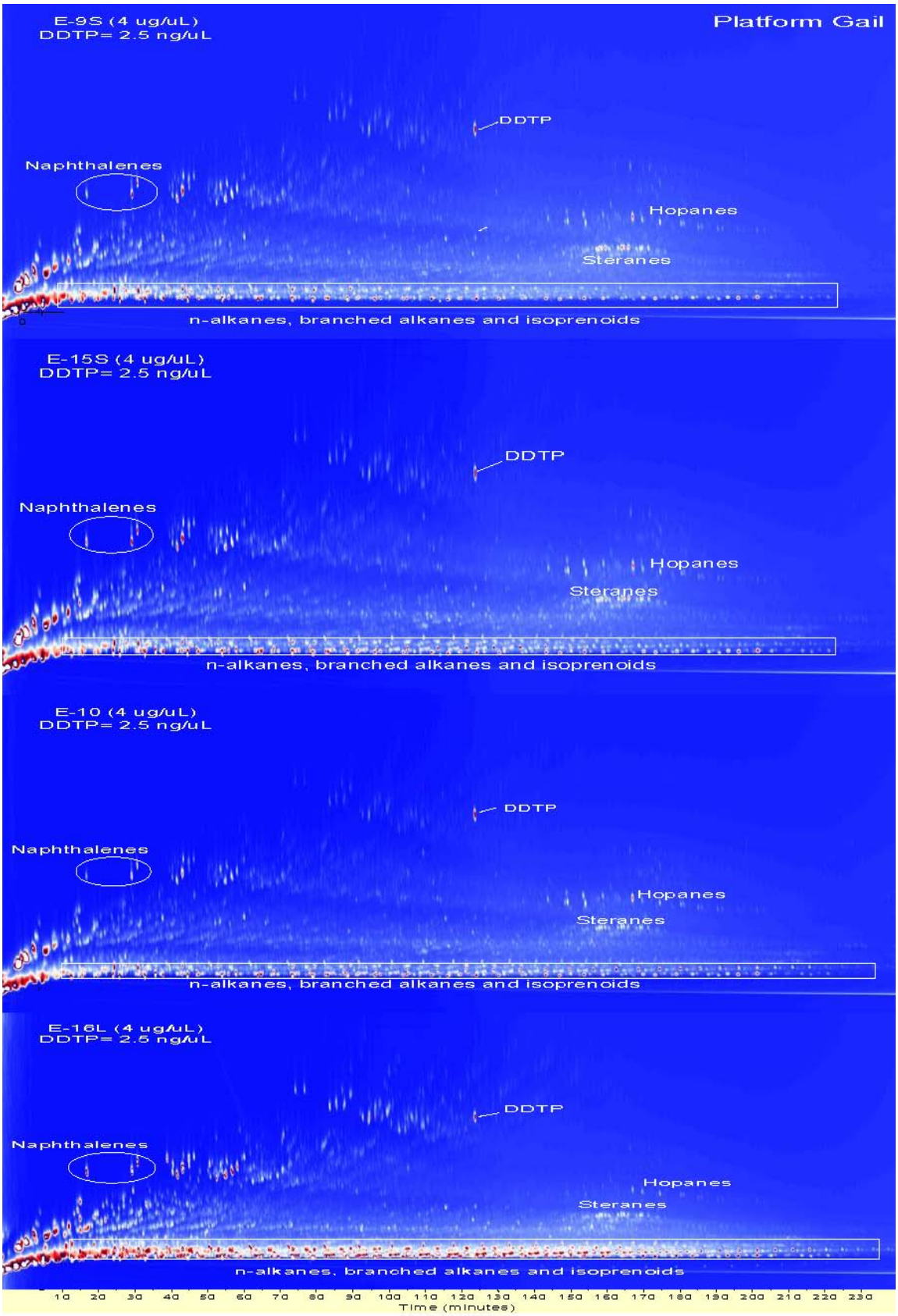

Figure 10. GC×GC chromatograms of petroleum collected from Platform Gail wells.

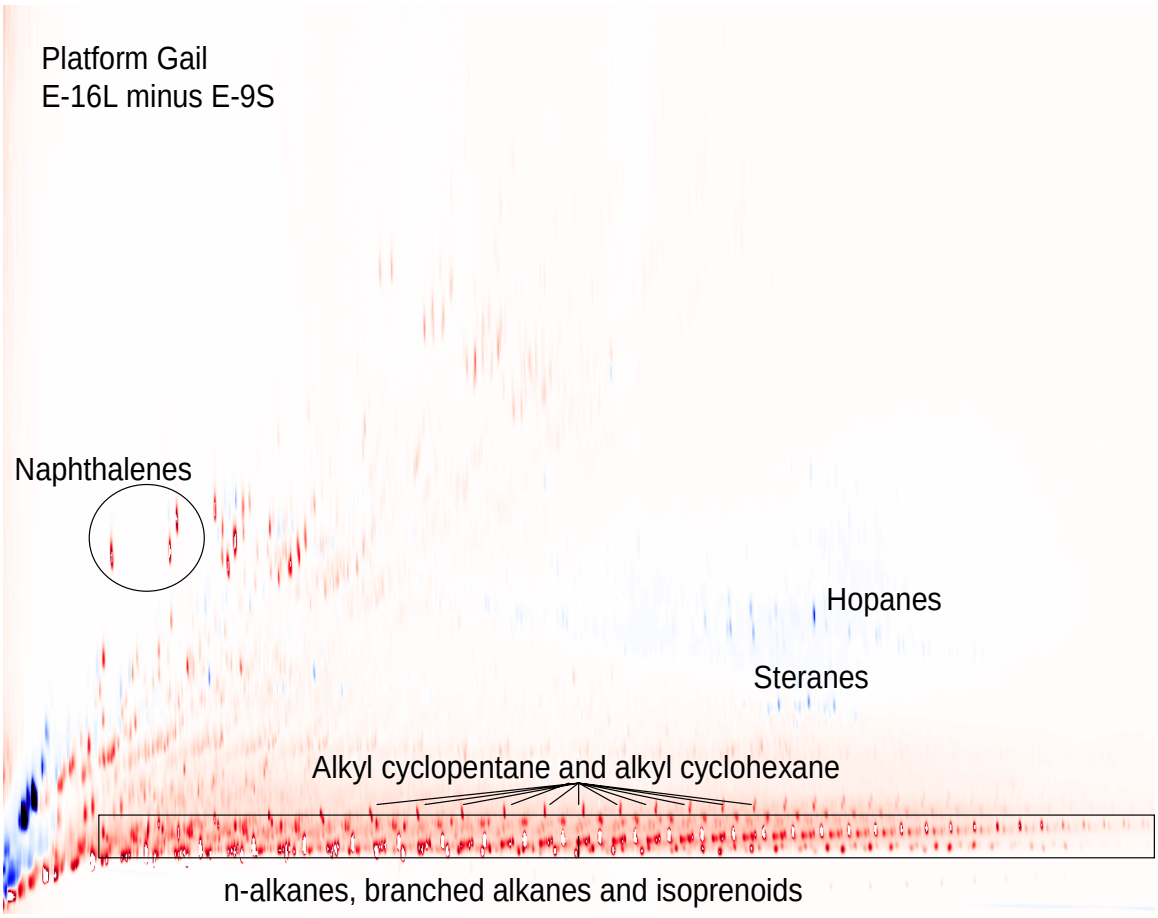

Figure 11. GC×GC difference chromatogram of petroleum collected at Platform Gail from the upper and lower most reservoirs sampled. The compounds shown in red are at a higher concentration in platform Gail well 16L than in well E-9.

Rates and Patterns of Petroleum Weathering During Transport from the Reservoir to the Beach

Oil samples were collected from 3 wells accessed by platform Holly (2342-15, #3242-9 and #3242-18). Additional samples were also collected from seeping sediment, the sea surface and on the beach in order to look at compositional variation during weathering processes taking place during the migration of oil from a reservoir to the beach. Analysis of these samples will allow us to determine compound-specific degradation index for petroleum migration between the following intervals: reservoir to sediment, sediment to sea-surface and from the sea-surface to the beach. The sample collection procedure and an oil sample collected from seep sediment are displayed in Figure 12. The GC×GC chromatograms for the starting and end points of each interval are included in Figure 13.

Figure 12. The top picture shows oil being emitted directly from sediment located just offshore of Coal Oil Point. The bottom picture documents the collection of oil by WHOI researcher Bob Nelson just after it had risen to the surface.

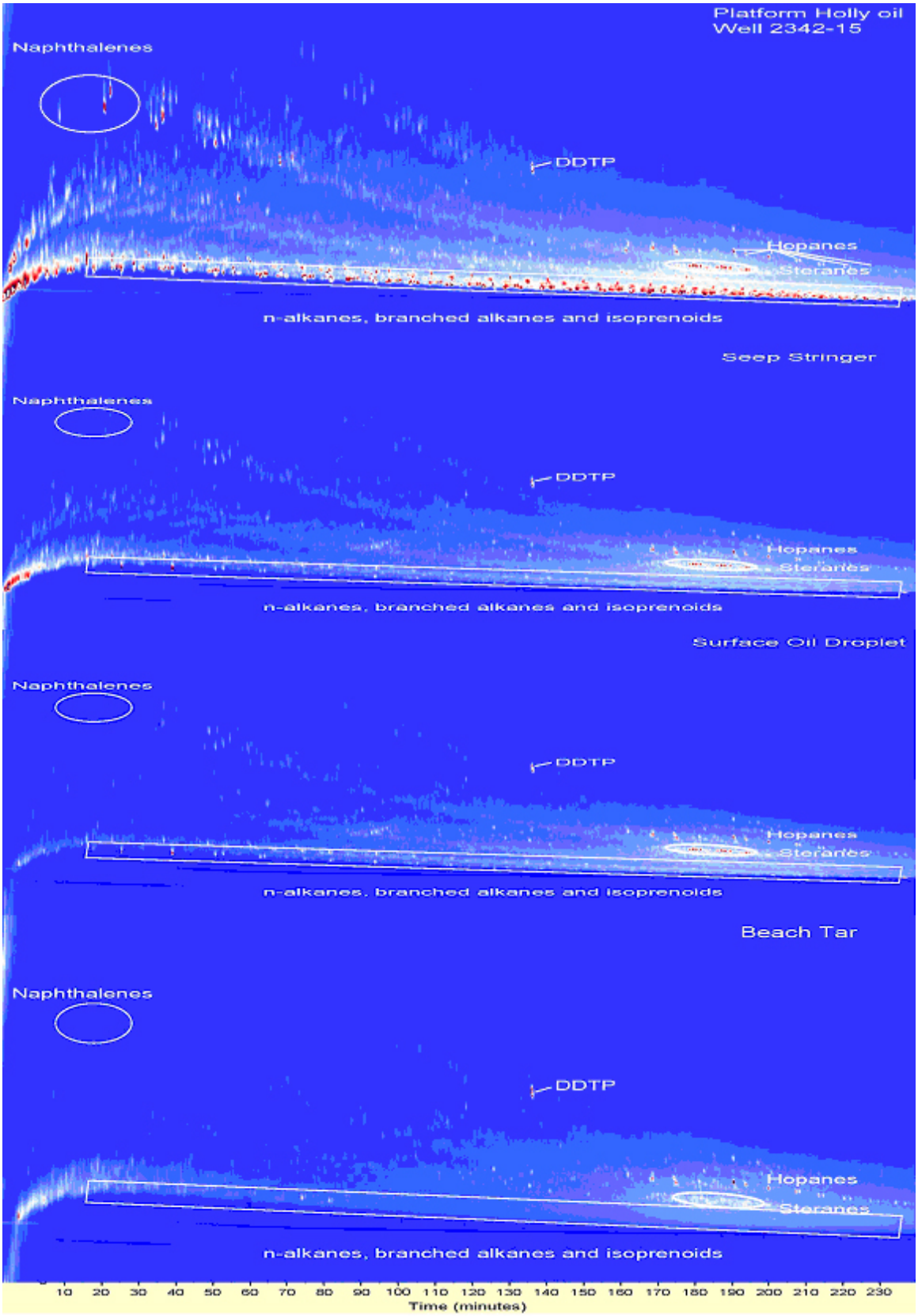

Figure 13. GC×GC chromatograms of petroleum collected from Platform Holly, well 2342-15, Jackpot oil seep, the sea surface over Jackpot oil seep and on Coal Oil Point beach.

Future plans:

We are in the process of analyzing samples and data 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 additional months, though our efforts will be necessarily cut back significantly due to lack of continued support. Samples will be sacrificed on a monthly basis and assayed using the methods described above, including the GC×GC analyses. We have also acquired a multicomponent electrode array system which will be used for analysis of various constituents in the aqueous phase of the experimental bottles including NO_3, NO_2, NH_4^+, and sulfide. George Wardlaw recently traveled to WHOI and stayed from April 10th through April 23rd to analyze several of the samples presented here and to learn the new GC×GC technique; he may return to perform additional analyses as needed. We are further working with our collaborators at WHOI to model the differential impacts of water washing (dissolution), volatilization and biodegradation on natural tar samples, in hopes to ultimately improve our predictive capacity in these areas.

Problems Encountered:

No major problems were encountered during the past year.

MMS Action Required:

None

Task No. 18234: *Spatial and Temporal Variation in Recruitment to Rocky Shores: Relationship to Recovery Rates of Intertidal Communities*

Principal Investigators: Peter Raimondi, Department of Ecology and Evolution, University of California, Santa Cruz, CA 95060 and **Richard Ambrose,** School of Public Health, Department of Environmental Sciences, University of California, Los Angeles, CA 90095-1772

Summary of Research

Recovery plot sampling:

Recovery plots (cleared Fall 2003, see Figure 1) were sampled (point contacts, mobile critter counts and photographs) at Point Sierra Nevada, Stairs and Point Fermin (Figure 2) in October 2004, February 2005 and June 2005.

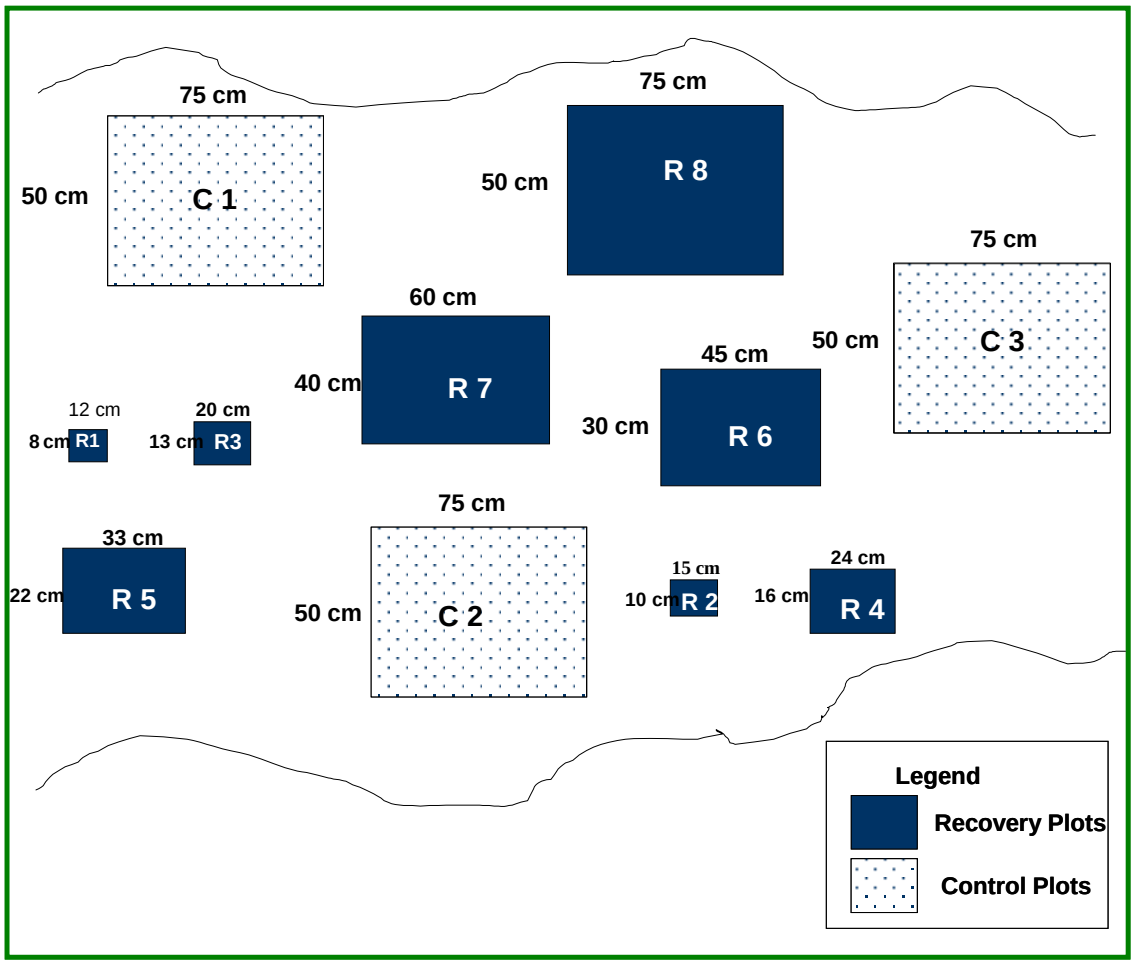

Figure 1. Schematic drawing of recovery (eight sizes ranging from 8 cm x 12 cm to 50 cm x 75 cm) and control plots (all 50 cm x 75 cm) in each assemblage (*Chthamalus*, *Endocladia*, *Silvetia* and *Mytilus*).

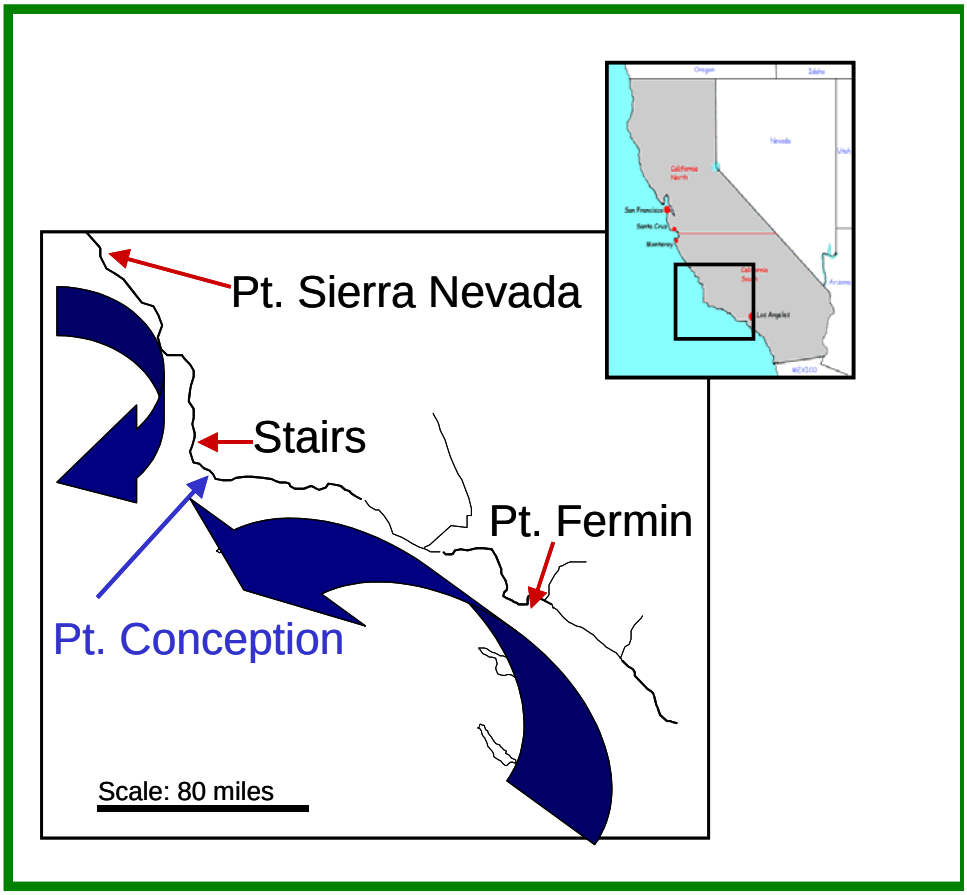

Figure 2. Site locations and prevailing oceanic currents north, near to and south of Pt. Conception.

Initial trends – Recovery plots

Chthamalus Assemblage

Data are shown from "Preclearing" to Summer 2004 due to the lag time between data collection and processing. At all three sites, plot size did not appear to affect the rate of barnacle recovery (Figures 3-5). Barnacle recovery was slightly higher (20 % – 40 % cover) at Point Fermin than at Point Sierra Nevada or Stairs (both 10 % - 20 %, see Figures 3-5). Sampling since June 2004 indicates that barnacle recovery became higher at Point Sierra Nevada and Point Fermin that at Stairs.

Endocladia Assemblage

Endocladia recovery was only very slight at all three sites in Summer 2004. At Point Fermin, *Chthamalus* recruited heavily to *Endocladia* plots, whereas *Chthamalus* recruitment was lower into *Endocladia* plots at Point Sierra Nevada and Stairs. This may be significant since *Chthamalus* may act as a facilitator species for *Endocladia*.

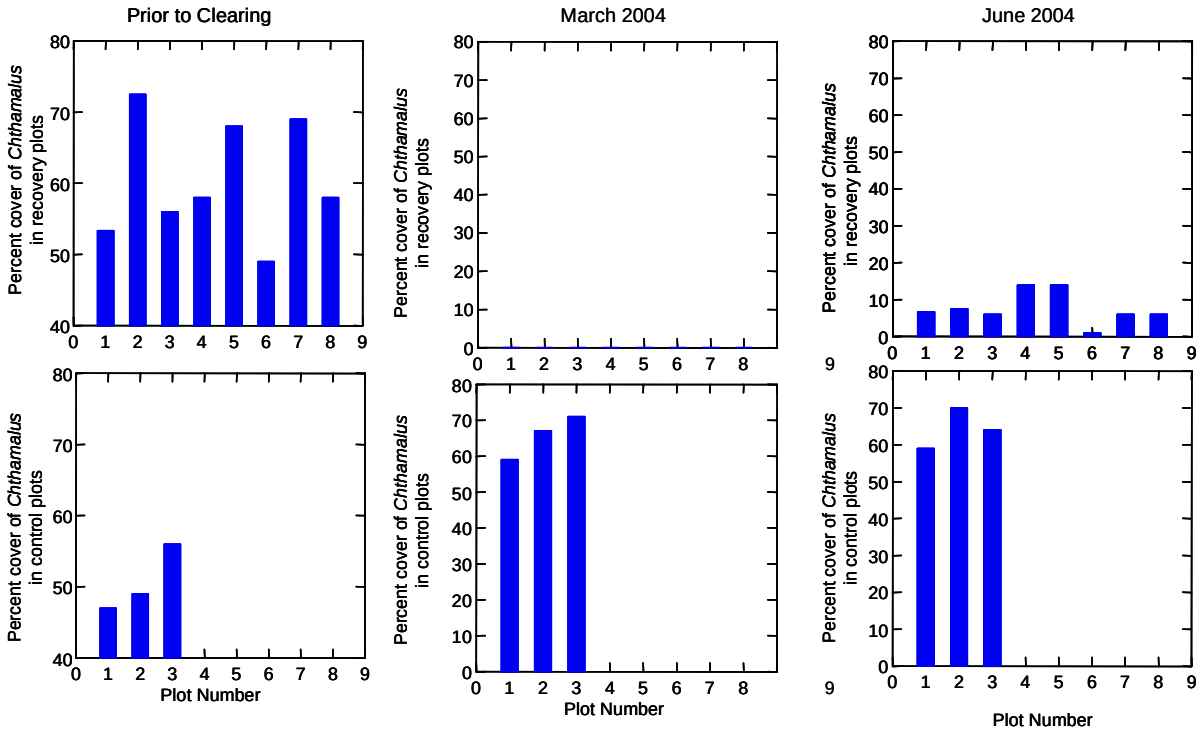

Figure 3. Percent cover of *Chthamalus* in control (bottom) and recovery (top) plots prior to clearing (left), in March 2004 (middle) and in June 2004 (right).

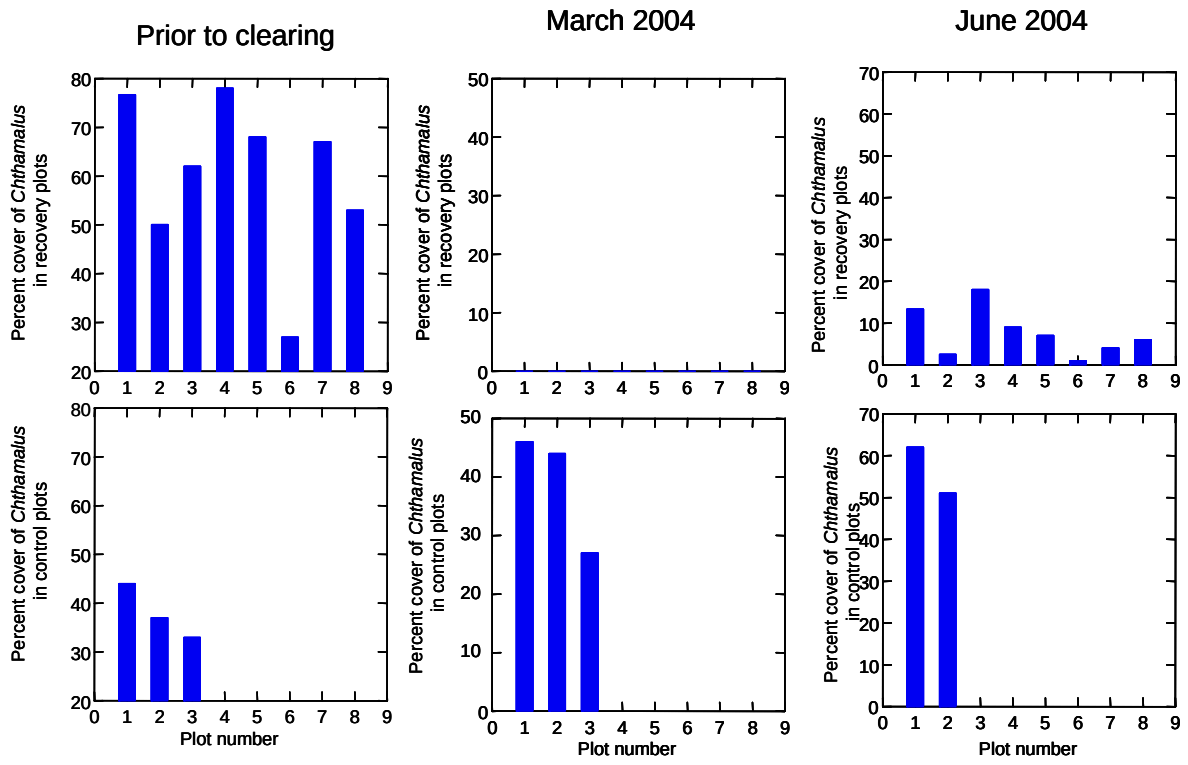

Figure 4. Percent cover of *Chthamalus* at Stairs in control (bottom) and recovery (top) plots prior to clearing (left), in March 2004 (middle) and in June 2004 (right).

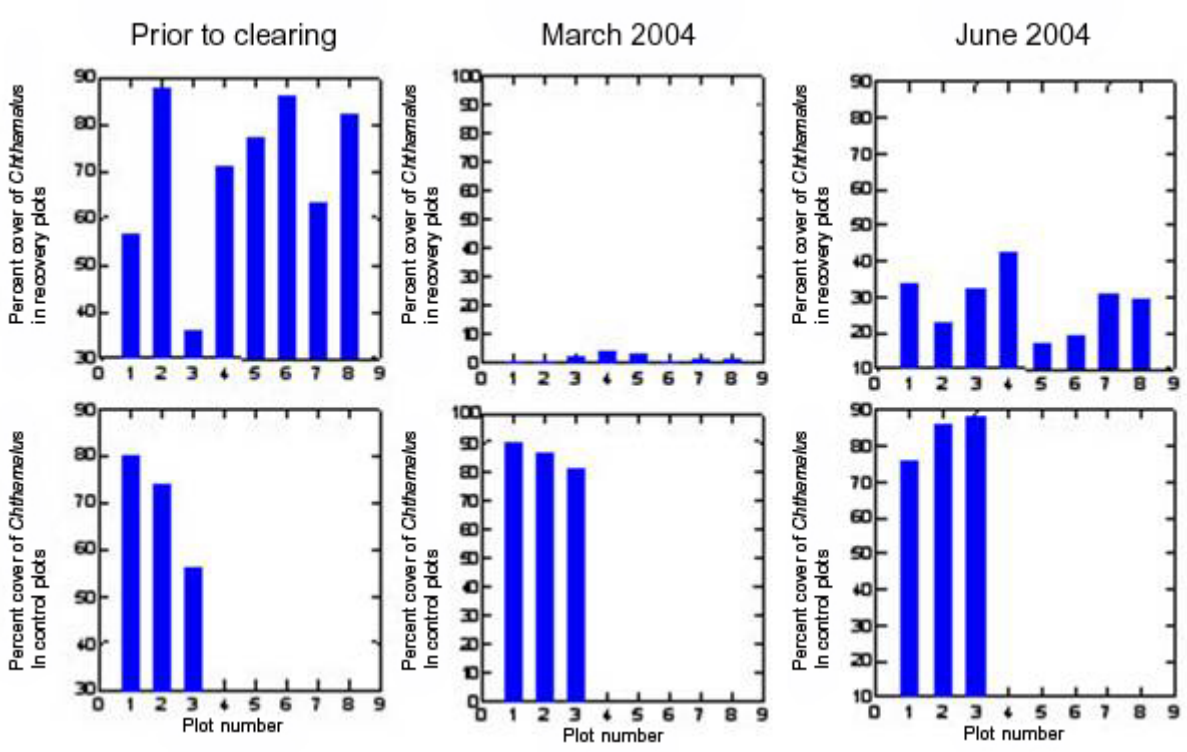

Figure 5. Percent cover of *Chthamalus* at Point Fermin in control (bottom) and recovery (top) plots prior to clearing (left), in March 2004 (middle) and in June 2004 (right).

Silvetia Assemblage

Silvetia recruits are present in some recovery plots at all three sites. Both Stairs and Point Fermin show more recruits per recovery plot than Point Sierra Nevada. This may be in part due to the difference in rock types among the three sites.

Mytilus Assemblage

At all three sites, the smaller *Mytilus* plots were showed some recovery by encroachment of surrounding conspecifics. As of June 2005, some *Mytilus* recruits are present in recovery plots at all three sites.

Recruitment Plots

Chthamalus

Field recruitment data from January 2004 – February 2005 show that Stairs has the lowest mean monthly *Cthamalus* recruitment and Pont Fermin has the highest mean monthly recruitment (Figure 6a).

Endocladia

Field recruitment data from January 2004 – February 2005 show approximately equal mean monthly *Endocladia* recruitment at all three sites (Figure 6b).

Silvetia

Field recruitment data from January 2004 – February 2005 show that Point Sierra Nevada and Stairs have much higher *Silvetia* recruitment into the recruitment plots than Point Fermin (Figure 6c).

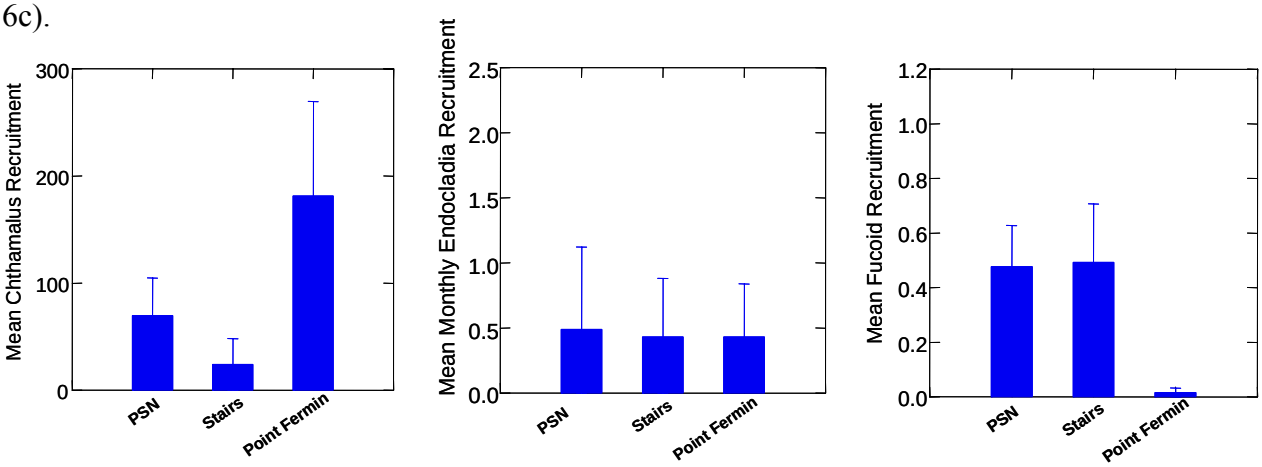

Figure 6. a) (Left) Monthly *Chthamalus* recruitment (mean ± SD) into 10 cm x 10 cm plots. b) (Middle) Monthly *Endocladia* recruitment (mean ± SD) into 10 cm x 10 cm plots. c) (Right) Monthly *Silvetia* recruitment (mean ± SD) into 10 cm x 10 cm plots.

Recruitment Surfaces

Volunteers have been trained to assist with the sampling of barnacle and mussel recruitment surfaces in the lab. These data will be processed and reported as soon as possible.

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. Data will be processed and summarized as soon as possible. Volunteers will continue to be trained to assist with processing of recruitment surfaces. Quantitative PCR will be performed on the juvenile *Mytilus* extracted from recruitment surfaces to determine the species recruiting.

MMS Action Required:

None

Task No. 18213: *Use of Biological Endpoints in Flatfish to Establish Sediment Quality Criteria for Polyaromatic Hydrocarbon Residues and Assess Remediation Strategies*

Principal Investigators: Daniel Schlenk, Department of Environmental Sciences, University of California, Riverside, CA, 92521

Consultant: Scott Steinert Computer Sciences Corporation, Marine Sciences Department, San Diego, CA.

Summary of Research

Input of polyaromatic hydrocarbons (PAHs) occurs through anthropogenic and natural mechanisms. Toxicities resulting from chronic exposure include immune suppression, reproductive dysfunction and carcinogenesis. As most PAHs tend to be lipophilic, there is a high propensity for accumulation in organisms and sediments with high organic content. While analytical measurements of specific compounds have been to be relevant indicators of exposure within invertebrates, rapid biotransformation prevents accurate assessments of exposure in vertebrates such as fish.

This study attempted to utilize biochemical and physiological indicators in flatfish to estimate a threshold concentration which could be used in risk assessment paradigms to evaluate sediments contaminated with PAHs. Two species of flatfish were exposed to various dilutions of sediments collected from the natural oil seep off the coast of Santa Barbara, California. In contrast to other studies carried out in anthropogenically contaminated areas, the predominant PAHs observed in the sediments were of low molecular weight. Hepatic cytochrome P450 1A (CYP1A), bilary fluorescent aromatic compounds (FACs), plasma steroid concentrations, gonadal somatic indices, and in some cases, hepatic DNA damage was utilized in each species exposed for wither seven (Hornyhead turbot) or thirty days (California halibut) to diluted sediments. Attempts were made to generate dose-response curves which could be calibrated against reproductive function (GSI, sex steroids) for estimation of sediment threshold concentrations.

During the past year a draft final report was completed and submitted to the Minerals Management Service in November of 2004.

MMS Action Required:

We are awaiting MMS comments and a MMS report study number on the draft final report.

Task No. 18212: *Transport over the Inner-Shelf of the Santa Barbara Channel*

Principal Investigators: Carter Ohlmann, Institute of Computational Earth System Science, University of California, Santa Barbara, CA 93106-3060

Project Objectives:

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.

Summary of Research:

During the past year a draft final report was completed and submitted to the Minerals Management Service in April of 2005.

MMS Action Required:

We are awaiting MMS comments and a MMS report study number on the draft final report.

Task No. 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, University of California, Santa Barbara, CA 93106-9610 **Jenifer Dugan,** Marine Science Institute, University of California, Santa Barbara, CA 93106-6150 **Scott Hodges,** Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610 **Robert Jacobs,** Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610 **Mark Page,** Marine Science Institute, University of California, Santa Barbara, CA 93106-6150 **Leslie Wilson,** Department of Molecular, Cellular and Developmental Biology, University of California, Santa Barbara, CA 93106-9610 and **Steven Gaines,** Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610

ECOLOGY:

Background

Interest in marine natural products continues to grow worldwide. However, concern over the impact of the harvest of organisms that contain these products on the environment has arisen because large quantities of organisms are typically needed to extract a small amount of a natural product. Harvest of organisms from man-made structures, particularly oil and gas platforms, may alleviate impacts to natural reefs as many species of invertebrates grow on these artificial structures. Unfortunately, little information is available on the distribution and abundance or dynamics of invertebrates on oil platforms. To examine the possibility of using OCS oil platforms as sustainable sources of, or as culturing sites for, invertebrates with important marine natural products, we have: 1) investigated spatial and temporal patterns in the distribution and abundance of invertebrates on selected offshore oil platforms in the Santa Barbara Channel, 2) explored whether the population dynamics (recruitment and growth) of common invertebrates vary among platforms (both spatially and temporally), and 3) examined the relationship between patterns of distribution and abundance and recruitment found at the platforms, and selected environmental factors (e.g., location, water temperature). Data collection on the Ecology component of this project is complete. One manuscript is in press in a non-peer-reviewed magazine and another manuscript is in preparation for the peer-reviewed literature.

Study Sites

We conducted our research at seven oil and gas platforms in the Santa Barbara Channel (Table 1, Figure 1). The platforms are arranged along the channel from the southeast to northwest across a region characterized by strong environmental and biogeographic gradients.

Table 1. Characteristics of study platforms. Key to abbreviations: Gi-Gina, Ga-Gail, Gil-Gilda, Gr-Grace, Hog-Hogan, Hou-Houchin, Hol-Holly.

Variable	Gi	Ga	Gil	Gr	Hog	Hou	Hol
Distance from shore (km)	5.0	13.2	11.9	14.4	5.1	7.0	2.9
Water depth (m)	29	225	64	97	46	49	64
Age (years from 2003)	23	16	22	23	35	34	37
Distance along channel (km)	0	12	15	19	33	36	65
Platform size (m^2 on bottom)	560	5600	2340	3120	1444	1444	1728

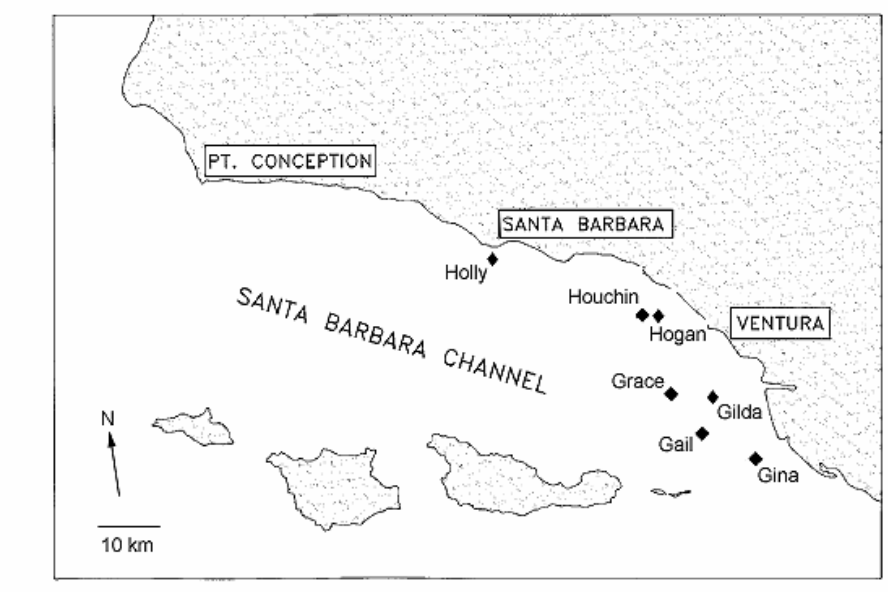

Figure 1. Locations of oil platforms in the Santa Barbara Channel involved in this study.

Summary of Research

We explored spatial variation in patterns of invertebrate distribution and abundance within and among platforms along the Santa Barbara Channel by photographically sampling the invertebrate community. The camera (Nikonos V 35 mm camera fitted with a 15 mm lens) and two strobes were mounted on a PVC frame designed to photograph 0.25 m^2 quadrats. The distribution and abundance of species was measured by photographing a single quadrat located inside and outside of the 4 corner legs and 4 randomly selected conductor pipes at depths of 6, 9, 18, and 24 m. A total of 128 quadrats were photographed per platform.

In the laboratory, we identified and estimated the percent cover of species within each quadrat using point-contact methods. Percent cover of species was estimated by projecting the photographic slide images onto 100 randomly located points and recording contacts to the lowest possible taxonomic level. For the purposes of this study, only the top layer was counted, except in the cases where a species obviously spread over the substratum, forming a "canopy", typical

of some arborescent bryozoans and hydroids. Cover of nonliving substrata (e.g., bare pipe) was also recorded.

Statistical analysis

The percent cover data were arcsine transformed (arcsin$\sqrt{x}$) prior to statistical analysis. We tested for significant differences in the composition of the invertebrate community and species (or most practical taxon) abundance across platforms using multivariate analysis of variance (MANOVA). We tested for significant differences in the cover of selected taxa between platforms using Tukey post hoc tests. We also examined community patterns using Canonical Discriminate Function Analysis and explored relationships between these patterns and physical variables using multiple regression analysis. Mobile taxa such as crabs and starfish were excluded from the analysis, as were rare taxa (<1% cover) and algae.

Distribution and abundance of selected taxa

Across all platforms, the most widely distributed and abundant taxa, accounting for 83% of the total cover were anemones (e.g., *Corynactis californicus*, *Metridium* sp.), tubiculous amphipods, (primarily *Ericthonius* sp.), hydroids (*Plumaria*, *Agalophenia*), and sponges (e.g., *Haliclona spp*., *Halichondria panicea*) (Figures 2, 3). Other widespread taxa included mussels, (*Mytilus californianus*, *M. edulis*), barnacles (*Megabalanus californicus*, *Balanus* spp.), and tunicates (e.g., *Styela montereyensis*). Exotic species were conspicuous on two platforms; the encrusting bryozoan, *Watersipora cucullata*, was observed only on Platform Gilda and the anemone, *Diadumene* sp. was recorded only on Platform Gail. Filamentous red algae were the most widely distributed algal taxon. However, the cover of algae was low (~5%) overall.

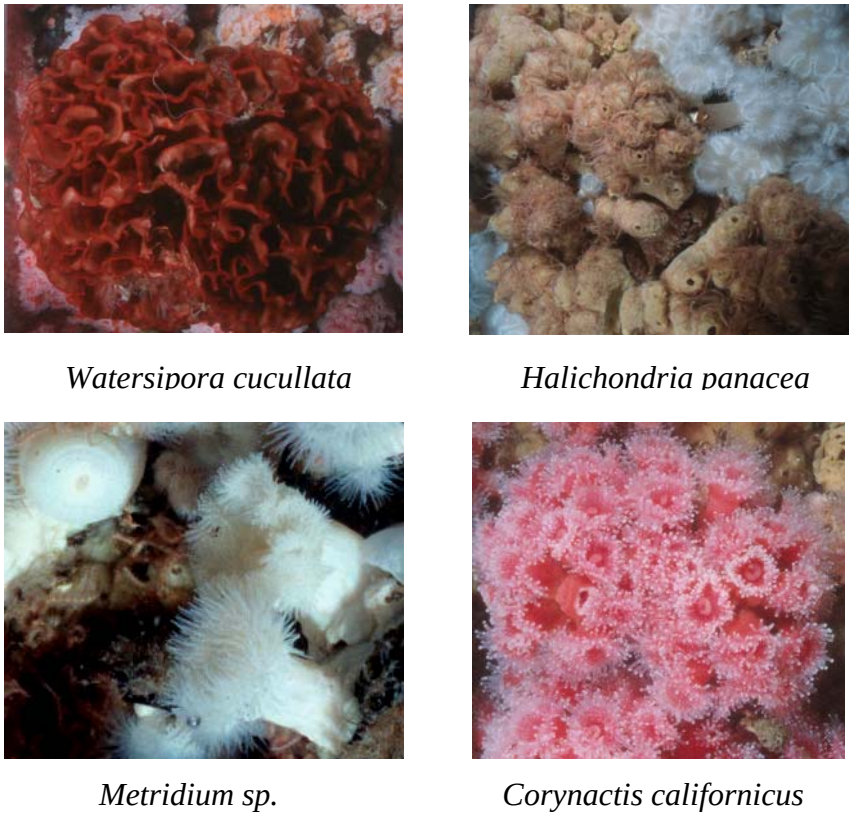

Figure 2. Examples of the encrusting bryzoan, *Watersipora cucullata*, sponge, *Halichondria panacea*, and the anemones, *Metridium sp*. and *Corynactis californicus*.

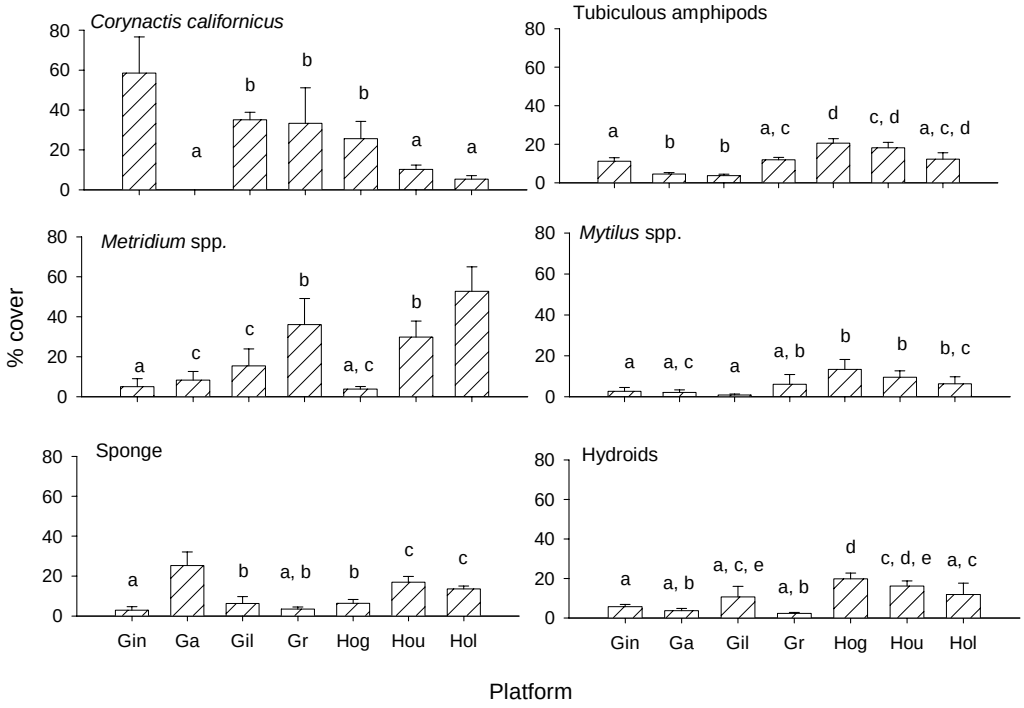

Figure 3. Comparison of the distribution and abundance of the anemones, *Corynactis californicus* and *Metridium sp.*, sponges, tubiculous amphipods, mussels (*Mytilus* spp.), and hydroids among study platforms. Letters in common indicates no significant different in the cover of the taxon between platforms in *post hoc* pairwise comparisons.

The structure of invertebrate communities varied greatly among platforms (P<0.001, F = 13.73, df=120, 1082.43, MANOVA: Figure 3). Anemones occurred in higher cover overall (up to 50 to 60%) than most other invertebrates, but the dominant species varied with location. *Corynactis californicnus* was the dominant anemone on platforms at southeast end of the channel (e.g., Gina, 59 ± 18%); cover of this anemone tended to be lower on platforms to the northwest (e.g., 5 ± 2% at Holly). An exception to this pattern occurred at Gail where mean cover of *C. californicus* was only 2 ± 1% and the most abundant anemone was the exotic species, *Diadumene* sp. (25%). In contrast, mean cover of *Metridium* sp. was generally highest at the most northwest platforms (Holly, 51 ± 13%) and lower on platforms to the southeast (Gina, 3 ± 2%). An exception to this pattern was evident at Hogan where cover of *Metridium* was only 2 ± 1% (Figure 3).

Tubiculous amphipods, hydroids, and mussels also generally occurred in higher cover on platforms with increasing distance along the channel from the southeast to the northwest (Figure 3). For example, tubiculous amphipods occurred at 15 to 20% cover on Hogan and Houchin, but <5% on Gail and Gilda. Highest cover of mussels was recorded for Grace and Hogan (up to 25%) and lowest cover at Gilda (<3%). In contrast, the cover of sponges was more variable, with highest cover at Gail (up to 35%) and the two most northerly platforms (Houchin, Holly). The bryozoan, *Watersipora cucullata*, occurred only on Gilda with mean cover of 41% (data not shown).

Community patterns

Discriminant Function Analysis (DFA) revealed that the communities of Gail and Gilda were clearly different from the other platforms, a pattern that can be attributed, in part, to the presence of introduced species on these platforms (Figure 4a). Canonical Discriminant Functions (CDF) 1 and 2 explained 80% of the variation in the data. Cover of the anemone, *Diadumene* sp. was positively correlated (0.482) with CDF1, and an important source of the separation of Gail from the other platforms along the CDF1 axis. For Platform Gilda, the negative correlation of cover of the bryozoan, *Watersipora cucullata*, with CDF2 (-0.379) contributed to the separation of this platform from the others (Figure 4a).

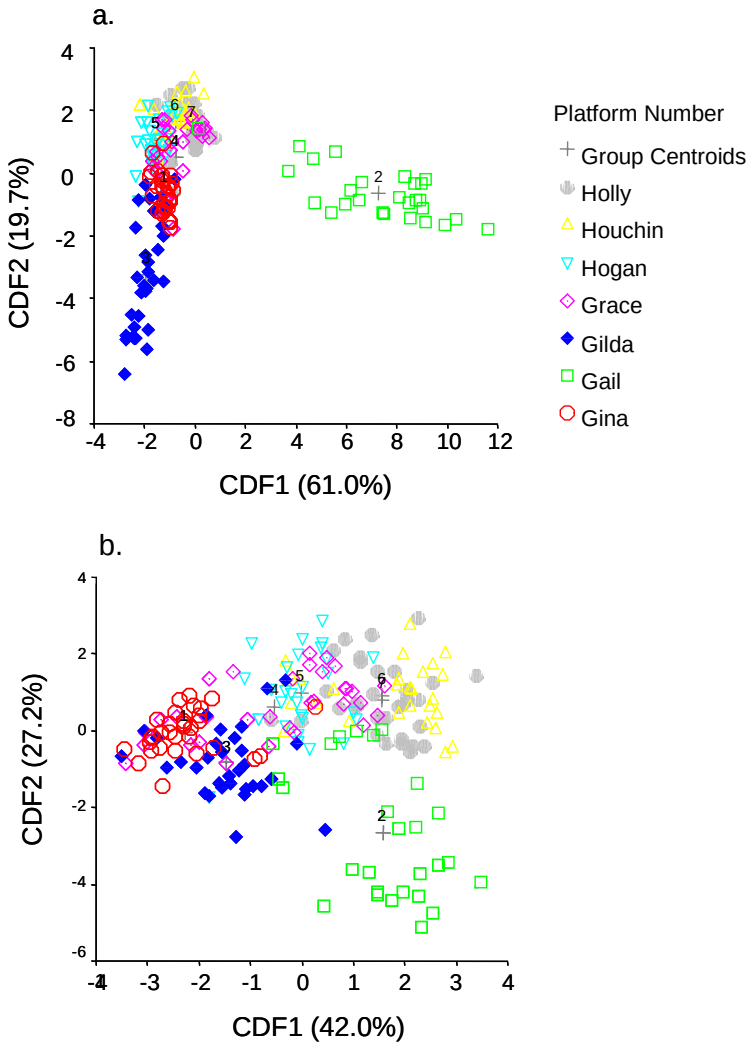

Figure 4. Results of Canonical Discriminant Function Analysis of invertebrate communities on the seven study platforms: a) all species, b) exotics species excluded.

To explore the effect that the exotic species might have on community patterns, we repeated the DFA, but excluded *Diadumene* sp. and *Watersipora cucullata* from the analysis (Figure 4b). The significant positive correlation of sponges (0.584) and negative correlation of *Corynactis californicus* (-0.614) with CDF1 contributed to the separation of all platforms except Gail along the CDF1 axis. In contrast, the positive correlation of cover of *Metridium* sp (0.605) and negative correlation of hydroids (-0.428) with CDF2 contributed to the separation of Gail from the other platforms along the CDF2 axis. Removal of *W. cullculata* from the analysis reduced variability in the Gilda data and community patterns at this platform tended to become more similar to those of the next closest platform (Gina). In contrast, the structure of the invertebrate community at Gail remained distinct from the other platforms (Figure 4b).

Community patterns and environmental variables

To explore relationships between community patterns and environmental variables, we used the values of CDF1 for each platform from the above analysis (calculated including and excluding *Diadumene* sp. and *Watersipora cullculata*), and the independent variables of distance along the channel, water depth, proximity to shore, and platform size (Table 1) in stepwise multiple regression analysis. Prior to this analysis, we tested for co-linearity among the independent variables. There was a significant correlation between platform size and both water depth ($P<0.001$, $r = 0.974$) and proximity to shore ($P = 0.049$, $r=0.758$). However, depth and proximity to shore were not significantly correlated ($P>0.1$). Therefore, we excluded platform size from the analysis, but included water depth and distance from shore. There was no relationship ($P>0.1$) between variation in CDF1 and any of the independent variables if the data from Gail were included in the analysis. If the data from Gail were excluded from the analysis, variation in CDF1 was best explained by distance along the channel ($P=0.014$: Figure 5).

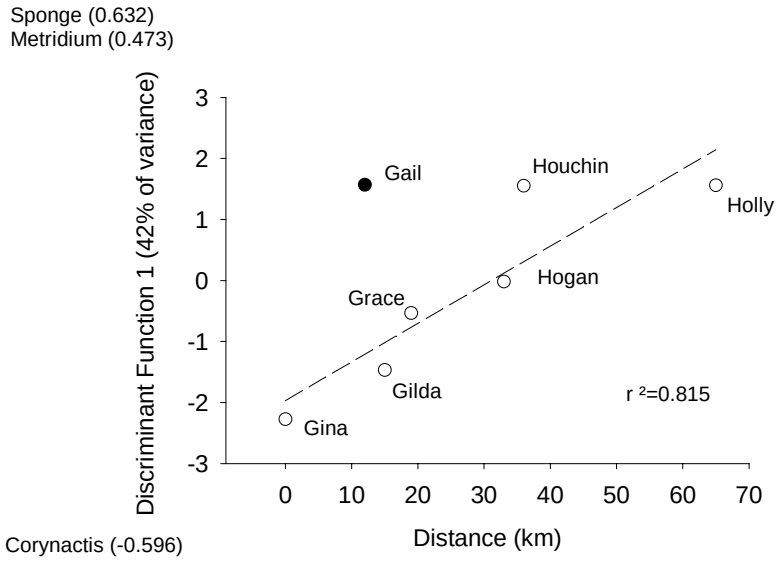

Figure 5. Relationship between canonical discriminant function 1 and location of platforms along the Santa Barbara Channel. R^2 value calculated excluding data from Platform Gail. Taxa most positively or negatively correlated with CDF1 are also shown on the y-axis.

Measurements of water temperature during deployment of experimental modules

The prevailing gradient in oceanographic conditions in the Santa Barbara Channel is evident in satellite images showing the intrusion of warm water into the channel from the south and cold water from the west. To examine variation in water temperature among platforms, which could help to explain variation in community patterns, a HOBO temperature logger was attached to one of the experimental modules at each platform. Water temperature was recorded hourly, with the loggers retrieved and downloaded at approximately three month intervals. To compare temperatures among sites we calculated the proportion of the time (hours) spent at each water temperature (Figure 6).

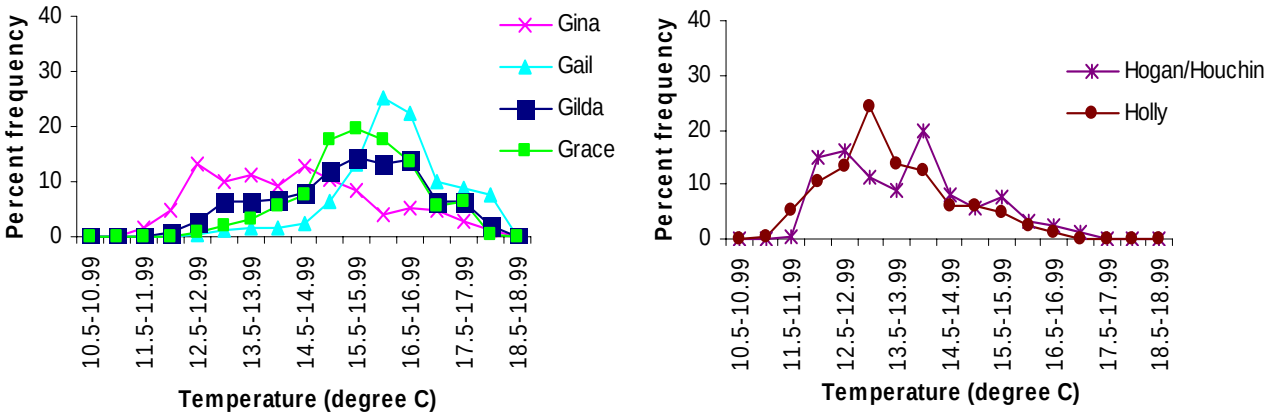

Figure 6. Distribution of water temperature, expressed as percent of total number of hours at a given water temperature, for the study platforms during the summer 2001.

Overall, the water temperatures at the three northern platforms were similar to each other throughout the year. Likewise, water temperatures of the four southern platforms were similar during all seasons, except in the summer. During the summer, one site (Gina) experienced large daily fluctuations in water temperatures, resulting in a broad range of temperatures throughout this season (Figure 6). Such large temperature ranges were not recorded at the other southern sites.

Recruitment Patterns and Oceanographic Factors

Recruitment data are useful for evaluating which platforms may provide sustainable sources of marine natural products. There were significant spatial and temporal differences in patterns of recruitment of several taxa, although to varying degrees (Figure 7). For example, for some species, recruitment was higher at the southern platforms (barnacles; *Balanus trigonus* and *B. regalis*), while for others recruitment was higher at the northern platforms (hydroids; *Plumularia* sp.). Further, for some species recruitment was spatially limited to just one (encrusting bryozoans; *Watersipora cucullata*) or two platforms (tunicates; *Diplosoma literianum*). Likewise, temporal patterns of recruitment varied among taxa, with recruitment of some species occurring seasonally while for others it was more continuous (e.g., tunicates).

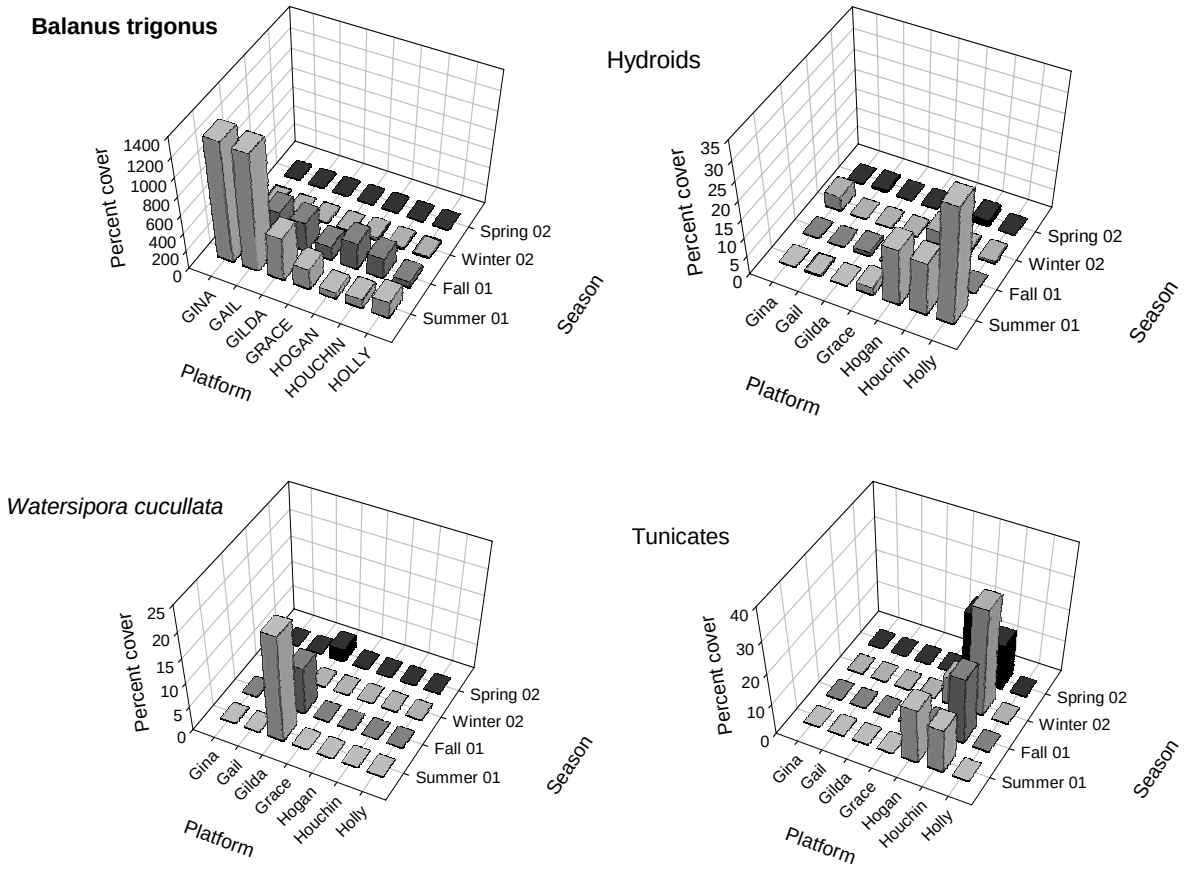

Figure 7. Comparison of spatial and temporal patterns of recruitment of four taxa, the barnacles, *Balanus trigonus*, the hydroids, *Plumularia* sp., the encrusting bryozoans, *Watersipora cucullata* and the tunicates, *Diplosoma listerianum*, among study platforms.

We used the nonparametric Spearman's Rho (Rs) to explore relationships between patterns of recruitment of selected invertebrates onto plates at the study platforms and location in the Santa Barbara Channel, platform depth, distance from shore and oceanographic factors (Table 2). For the three barnacle species, there was a significant effect of location, with higher recruitment densities occurring at the southern compared to the northern platforms. This pattern was consistent with predictions of oceanographic conditions bringing warm water masses and the longer-lived planktonic larvae of southern taxa into the channel. Recruitment density was also associated with location along the channel for the hydroid, *Plumularia* sp. For this species, recruitment was higher at the northern than at the southern platforms.

Table 2. The relationship between recruitment of selected invertebrates and location in the channel. Rs = Spearman correlation coeffiencient. * < 0.05; ** < 0.01; *** < 0.001. nsv = no significant variation in recruitment. nr=no recruitment

Species	Summer 2001	Fall 2001	Winter 2002	Spring 2002
Barnacles				
Balanus trigonus	-0.857**	-0.893***	0.607	0.509
Megabalanus californicus	nsv	-0.321	nsv	-0.786*
Balanus regalis	nsv	nr	nsv	-0.821*
Encrusting bryozoans				
Watersipora cucullata	-0.204	-0.204	nr	-0.204
Other encrusting bryozoans	nsv	-0.107	-0.054	0.071
Branching bryozoans				
Crisia complex/				
Bugula neritina	0.071	0.036	-0.286	0.029
Hydroids				
Plumaria sp.	0.901***	nsv	0.056	0.089
Tunicates				
Diplosoma listerianum	0.445	0.0490	0.0490	0.045

In contrast, patterns of recruitment were variable for the majority of invertebrate taxa with short lived larvae or direct development. For most of these species, there was no relationship between recruitment and location; many of these organisms recruited at only a few platforms (e.g., *Diplosoma listerianum*) or a single platform (*Watersipora cucullata)* where mature colonies occurred in high abundance. This recruitment pattern is consistent with the short larval development time and limited dispersal of these species.

Although there was an association between recruitment and location for hydroids, their limited dispersal ability (crawl away larvae) suggests that oceanographic factors associated with water masses likely had little influence on transport of the hydroid larvae and subsequent recruitment. Instead, biological interactions (predation, competition) or other factors may have influenced the recruitment patterns of this taxon.

Our water temperature data provide support for the hypothesis that oceanographic factors influenced recruitment patterns in the summer for those species with longer-lived planktonic larvae, as a gradient in water temperature occurred along the Santa Barbara Channel during this season. In particular, warm water intrusion was detected at the southern, but not at the northern platforms (Figure 6). There was a significant correlation between barnacle (*B. trigonus*) recruitment and water temperature in the summer, both with ($p = 0.05$, Spearman's Rho) and without ($p = 0.0003$) the outlying data from Platform Gina (Figure 8). This suggests that larvae of warm water species could have been transported in these water masses during the summer.

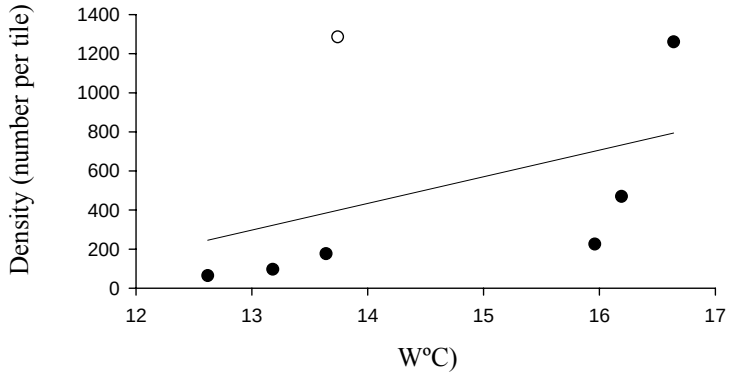

Figure 8. The relationship between recruitment of *Balanus trigonus* and water temperature (mode) at each location. Open circle = Platform Gina.

GENETICS:

Progress during 2004-2005

We have continued to make progress on determining the genetic variation among samples of *Bugula neritina* during this last year. Primarily, we have worked to analyze DNA sequence variation for the mtDNA segment we have PCR amplified. 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 (Figure 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. 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 because our technician left the laboratory and we were unable to recruit a new technician for the relatively short time period available with our remaining funds.

Currently, we are working to analyze the mtDNA sequence data and to conduct the bench-work to amplify and sequence DNA from the bacterial symbiont. We will re-amplify and sequence the few mtDNA sequences that were difficult to interpret. Our goal is to determine if there is a unique genetic lineage of the bacterial symbiont in the new bryozoan lineage we have identified (Figure 1).

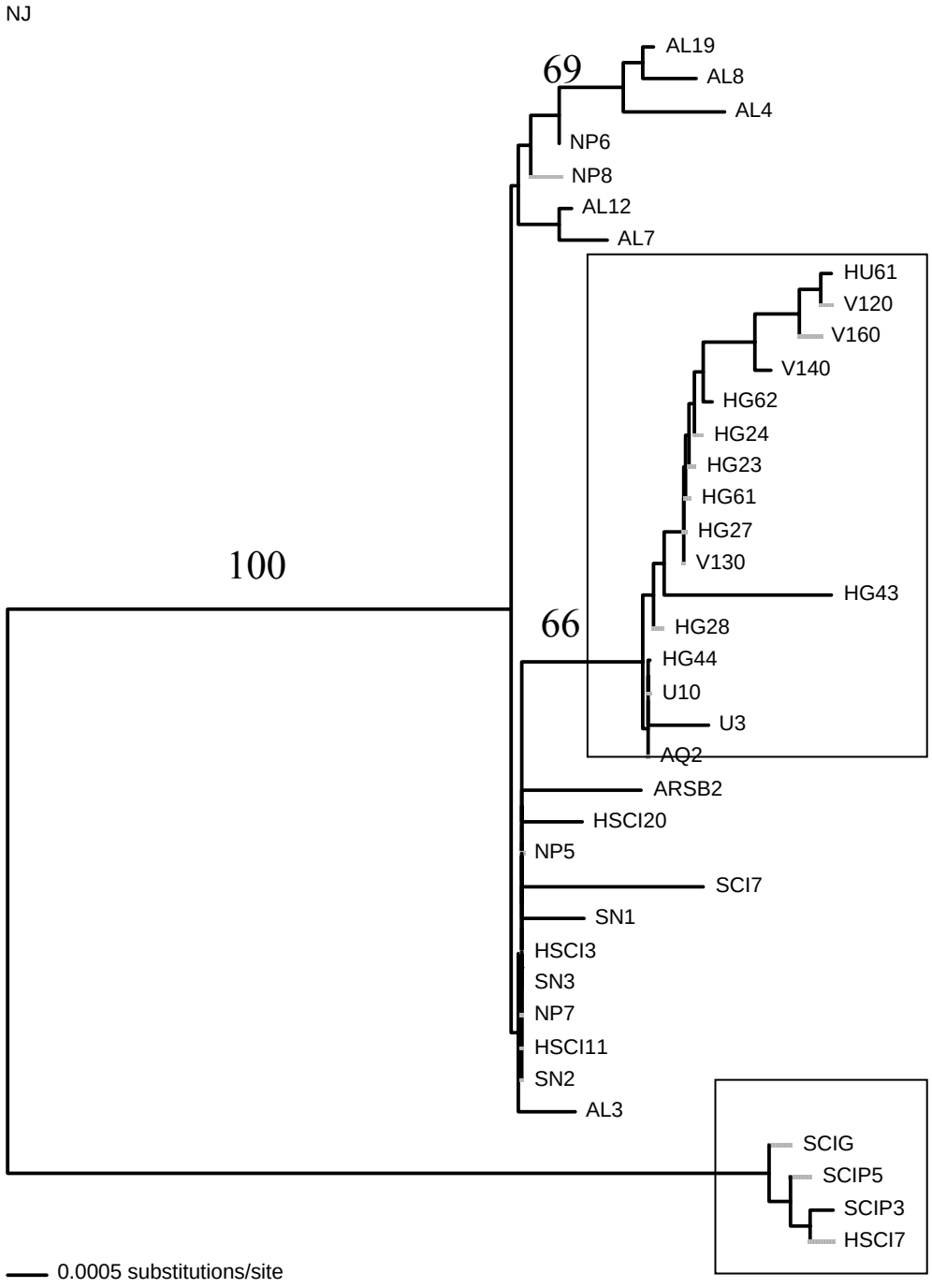

Figure 1. Neighbor joining analysis of DNA sequences from the 1.4 Kb mtDNA region of *Bugula neritina*. Numbers above lines indicate bootstrap support (1000 replicates). The large box encompasses the lineage containing samples from platform Hogan (HG) and platform Houchin (HU). The smaller box encompasses the new lineage of *B. neritina* found from samples on Santa Cruz Island.

PHARMACOLOGY:

Summary of Research

During the Fall quarter, Daniel Day (Jacobs Lab) focused on obtaining elemental analysis of the bioactive product to establish a working empirical formula for the novel compound. The bioactive compound was shown to have composition as follows: Carbon = 70.06%, Hydrogen = 7.25%, Nitrogen = <.05%, Sulfur = 3.8%, Oxygen = 19.35%. Simultaneously we conducted experiments on the association of the small molecule with a specific protein. Using SDS-PAGE we found that the bioactive (red) compound was highly associated with a single protein approximately 70kDa in size. Figures 1 and 2 exhibit the relationship of the pigment to the protein with and without coomassie staining.

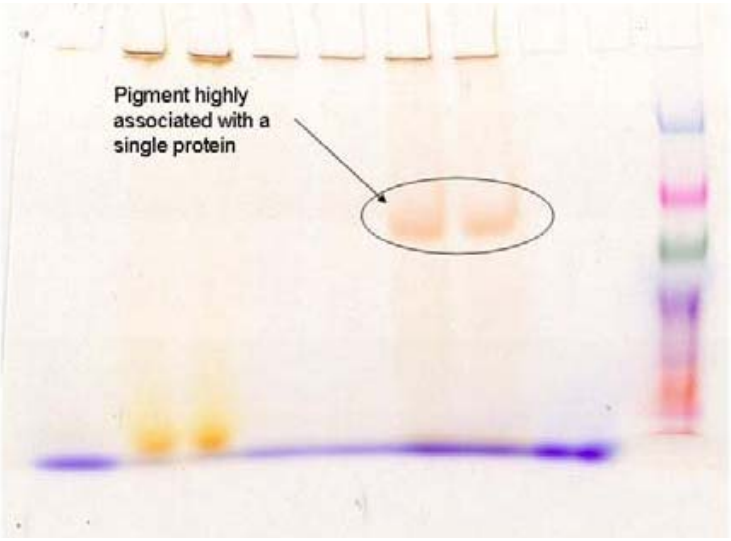

Figure 1. SDS-Page gel of the bioactive pigment associated with a single protein of 70kDa.

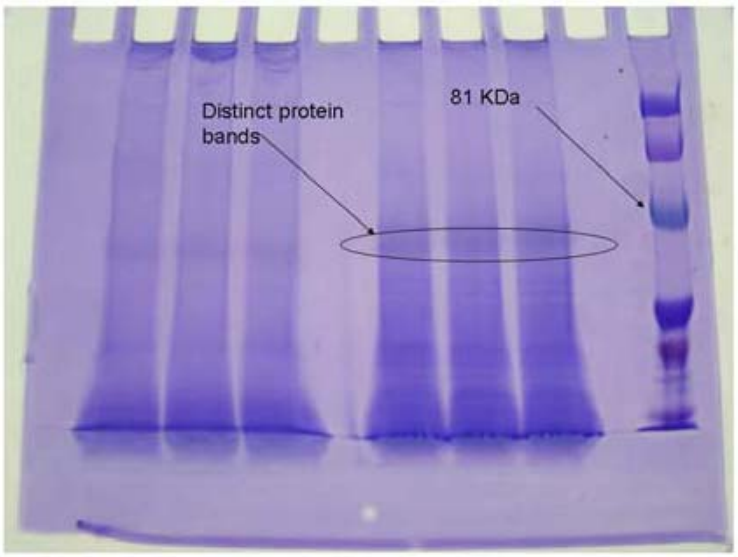

Figure 2. Coomassie stain shows a strong protein band at 70kDa as well as other proteins not affiliated with the colored bioactive compound.

The association of the pigment to a single protein is very unique in that most molecules with the ability to attach to a protein are generally ubiquitous in most systems (ie. they are generally attached to all proteins present; nonspecific).

During the Winter, Daniel Day continued work on isolation and purification of the bioactive product to obtain sufficient quantities required for C13 NMR and other structural work. During this time we were able to obtain infrared (IR) spectra for the compound which confirmed a sulfur conjugation but did not show characteristic aromaticity which should also be present in the sample (Figure 3). The presences of hydroxyl groups were also evident on the IR spectra collaborating evidence for a quinone type molecule.

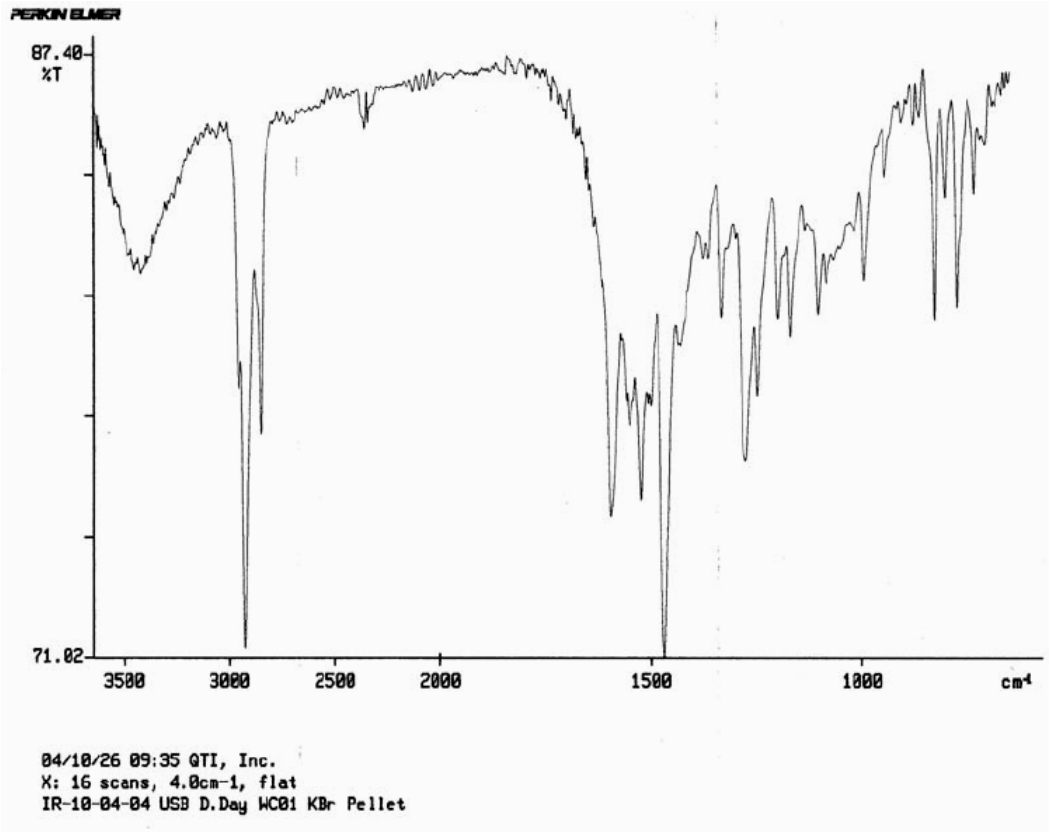

Figure 3. Infrared Spectra of Bioactive Compound WC01A.

During this time we also began running the sample on LCMS to obtain a molecular mass. As shown in Figure 4, a tentative mass was assumed at 304 confirming its small molecule status.

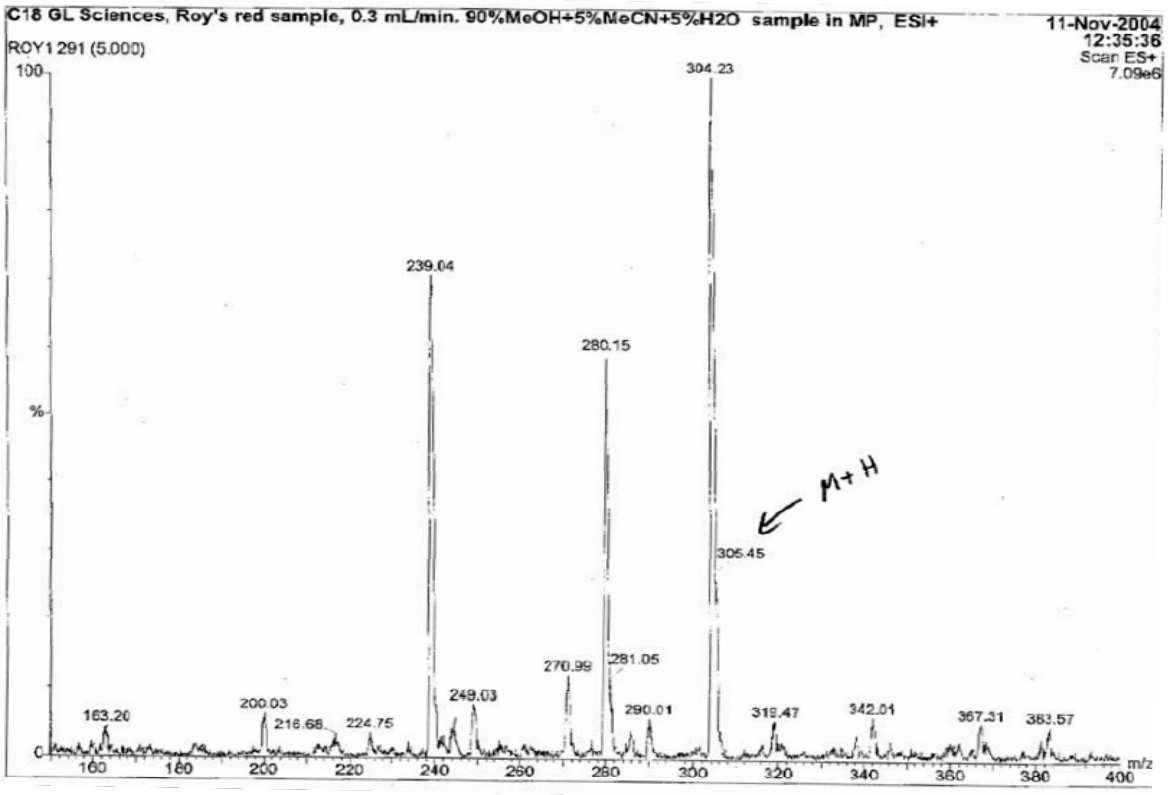

Figure 4. Liquid chromatography positive ion electrospray mass spectra of bioactive compound WC01A

Finally, in the Spring and Summer quarters, Daniel Day continued to isolate and purify fresh stock of WC01 for use in further NMR and mass spectrometry experiments. A new protocol was developed for the isolation of WC01 involving a preliminary acid hydrolysis step to cleave the small molecule from it associated protein. Samples of WC01 have been processed by NMR with the assistance of the National Cancer Institute (NCI) using a 900mhz NMR with cryoprobe. Figures 5 and 6 represent proton NMR and C13 NMR respectively.

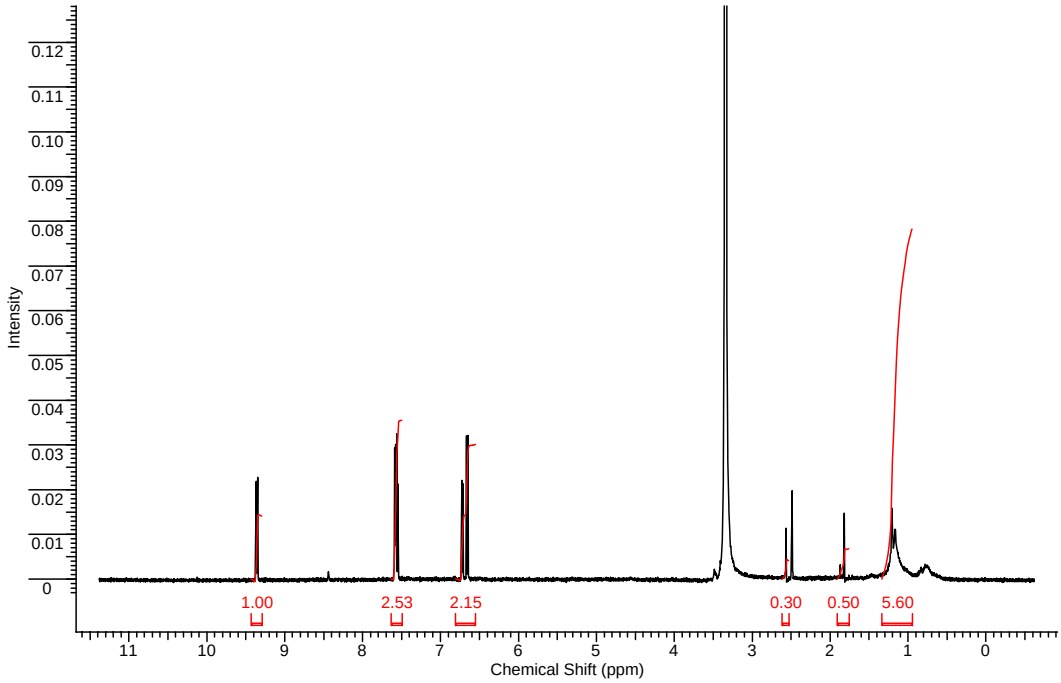

Figure 5. Proton NMR spectra of bioactive compound WC01A.

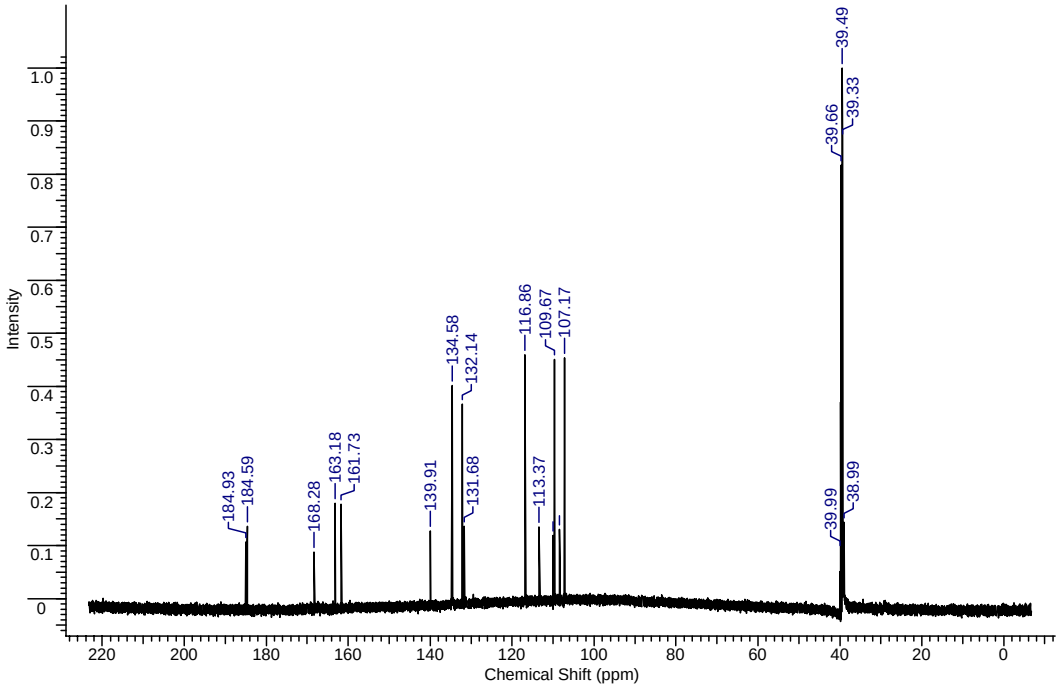

Figure 6. Carbon 13 NMR spectra of bioactive compound WC01A.

Recent mass spectra of the compound reveal a molecular ion of 312 using –ESI mass spectrometry (Figure 7). A tandem mass spectrometry (MS/MS) reveals a loss of 28 mass units from the $[M^{-H}]$ of 311 four consecutive times (Figure 8). The 28 mass units coincide with CO

fragments breaking off of the compound. The CO fragment is more evidence for the existence of the quinone compound.

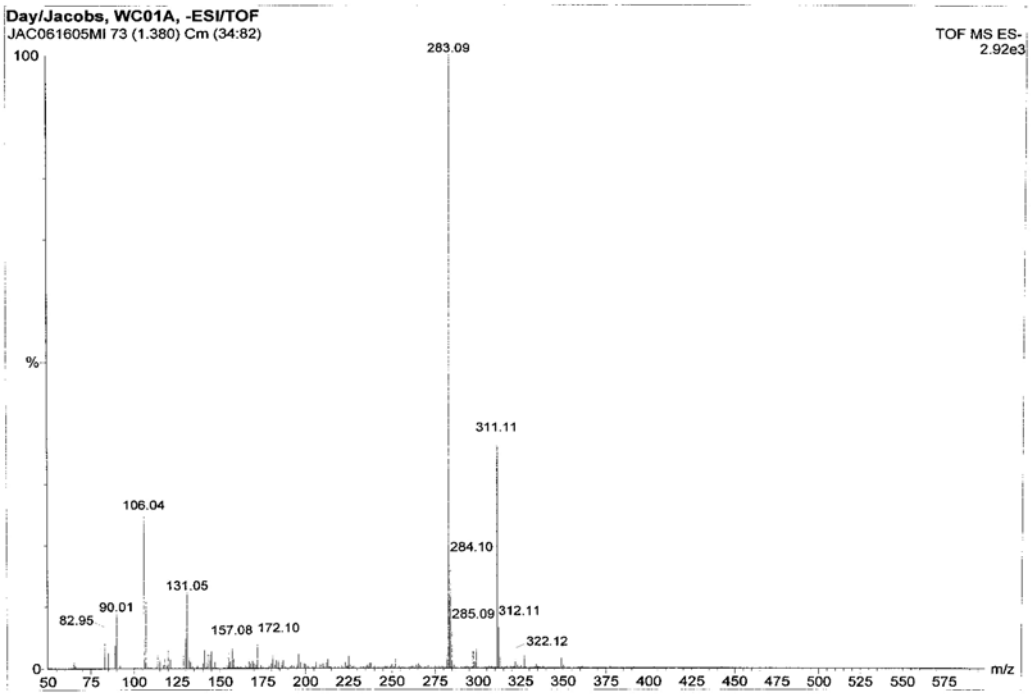

Figure 7. Negative ion electrospray mass spectra of bioactive compound WC01A.

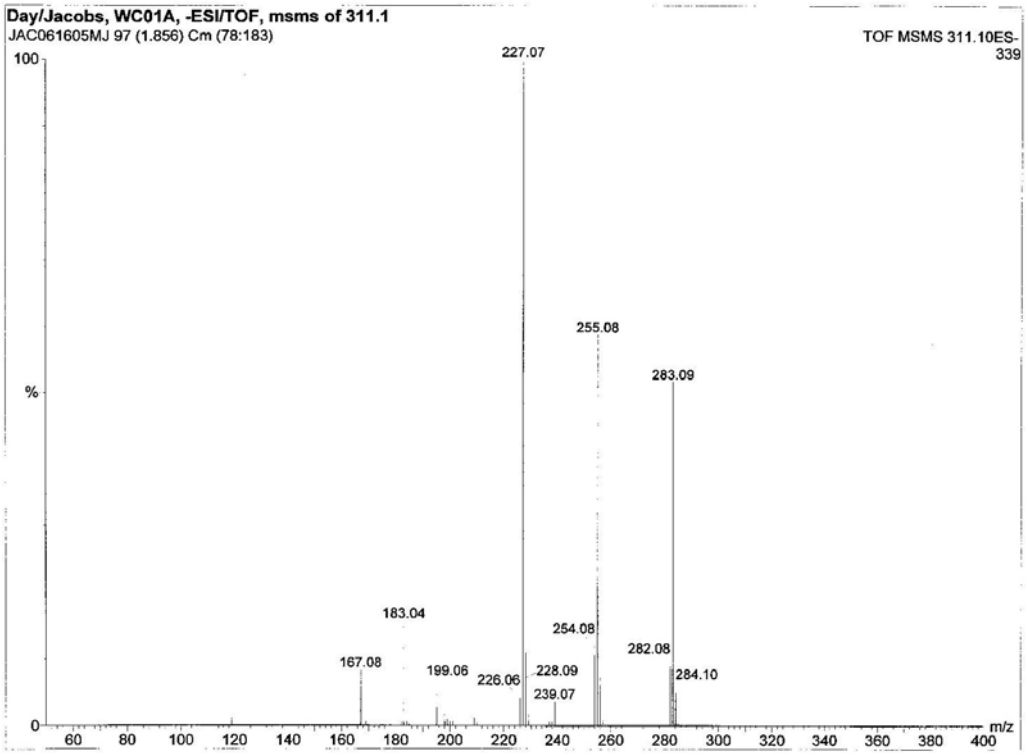

Figure 8. Negative Ion Tandem Electrospray Mass Spectra of 311.11 Peak from Bioactive Compound WC01A

Future Plans:

We will complete and submit a Draft Final Study report and Draft Technical Summary.

MMS Action Required:

We will require a report study number and comments from MMS upon submittal of our Draft Final report.

Task No. 17611: *Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSOS-HYS)* **and**

Task No. 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, University of California, Santa Barbara, CA 93106-9630 **Bruce Luyendyk**, Department of Geological Sciences, University of California, Santa Barbara, CA 93106-9630 and **Ira Leifer,** Institute of Crustal Studies, University of California, Santa Barbara, CA 93106-1100

Project Objectives

The main purpose of the project is to understand the role played by seep bubbles in the transport of hydrocarbons including oil from the seabed to the sea surface. The goal is to validate a numerical bubble model to better predict the surfacing footprint of oil, thereby improving spill mediation efforts and preparedness.

Numerical sensitivity studies showed sensitivity to several parameters, including size, seep depth, upwelling flows, and saturation of the plume water. Since these parameters are largely unknown in the literature, our approach has been to measure these parameters at a very active seep site, Shane Seep, as well as at several other seeps in the seep field. In the process several discoveries were made. Below outlines our progress during the preceding fiscal year.

Summary of Research

Bubble measurements

Measurements of the size distribution at the seabed are used to initialize bubble models and thus are highly critical. Bubble distributions were measured at Shane Seep at the seabed and published in Leifer and Boles (2005) which is now in press. This manuscript presents bubble size distributions at three different vents, and upwelling flows. Using these observations it was concluded that oil to gas ratio on individual bubbles varied significantly. Minor vents produce bubble streams at a low enough flow rate that the size distibution is very narrow, and were in the size range of 2000-3500 μm radius. Major vents produced bubble flows sufficiently strong that bubble breakup occurs, and have a broad and weakly size dependent bubble size distribution. Data presented in this manuscript is being used in a manuscript to Science on the significance of large transient seepage events, termed catastrophic seepage.

Oil Emissions

Bubble distributions and upwelling flows were analyzed and interpreted and showed a variability that could not be explained absent bubble oiliness. It was discovered that at major vents, very oil bubbles would occassionally be produced by the breakup of large bubbles. These bubble-oil droplets rose very slowly, following a different trajectory than the vast majority of bubbles from minor vents, occsional very oily bubbles escaped from the vent mouth. It was believed that a 4 hz oscillation in bubble emission resulted from the interaction between oil and gas flow through

the vents, resulting in a cyclical variation in oil/gas ratio. These results were published in Leifer and Boles (2005), revised and accepted during this fiscal cycle.

Numerical Modeling and Catastrophic Seepage

Collaborative efforts with Gregor Rehder (Geomar, Keil, Germany) have been used to improve the numerical model so that it includes effects of hydrate skins on bubbles. Hydrate skins allow methane bubbles to survive for much longer than a similar sized argon bubble, thereby potentially transporting their methane to much shallower depths. A manuscript from this effort is in preparation. This effort involved a significant improvement on the results presented at the IGGC7 conference (Rehder et al., 2003)

Numerical model simulations and data from air pollution measurements of a catastrophic seepage event are being analyzed for a paper for submission to Science in June 2005, and for presentation at an international conference in Vigo Spain, in Sept 2005. Numerical model results show that the dominant effect was the upwelling flow, which allowed almost all of the emitted gas to reach the sea surface. This has significant implications for interpretation of the effect of hydrate destabilization and global warming, and predicting the oil surfacing footprint of a blowout

Dissemination

As indicated above, most of the key results have been published or submitted. Results were presented at the International Oil SPill Conference in 2005 and in a peer reviewed article associated with the conference. Results were also presented including the video Surveying Shane Seep, at an ONR sponsored workshop on gassy sediments. Efforts to understand the study results in the context of deeper seeps were presented as part of a talk by Ian MacDonald at the EGU conference.

Cited references in report:

Rehder, G., I. Leifer, P.G. Brewer, G. Friederich and E.T. Peltzer. Enhanced lifetime of deep oceanic methane bubbles. 7th International Conference on Gas Geochemistry, Freiberg, Germany, September 22-26, 2003. Abstract ICGG7-A-00081.

Future Plans:

Complete and submit a draft final report.

MMS Action Required:

We will require a report study number and comments from MMS upon submittal of our Draft Final Study report.

Task No. 17608: *Observing the Surface Circulation along the South-Central California Coast Using High Frequency Radar: Consequences for Larval and Pollutant Dispersal* **and**

Task No. 85386: *Observations of the surface circulation in the Eastern Santa Barbara Channel Using High Frequency Radar and Lagrangian Drifters*

Principal Investigators: Libe Washburn, Department of Geography, University of California, Santa Barbara, CA 93106-4060 and **Steven Gaines,** Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610

Summary of Research

This report summarizes work by Washburn's research group on the project entitled "Observations of the surface circulation in the Eastern Santa Barbara Channel using high frequency radar and Lagrangian drifters" from 1 July 2004 through 31 June 2005. The project was scheduled to end on 30 September 2004, but a no-cost extension to extend the project to 30 September 2005 was requested several months before the project end date. One reason for the request was that we were unable to locate an additional high frequency (HF) radar site in the eastern Santa Barbara Channel (SBC) until May 2004. Locating a site and gaining permission to use it proved to be very challenging and time consuming. Another reason for the request was so we could participate in another MMS-sponsored experiment in the eastern channel to study juvenile fish settlement. The no-cost extension has not been granted as of the date of this writing (June 2005). Granting the no-cost extension would significantly contribute to this project.

A major difficulty in accomplishing the goals of this project has been obtaining permission to install an additional HF radar site in the eastern SBC, but this goal was accomplished in 2004. A temporary installation at a private residence in Summerland lasted from 1 May to 1 September 2004. Since that time a site has been installed on a long-term basis at the water treatment facility operated by the Summerland Sanitation District in Summerland, California. This site was installed in April 2005 and has been operating continuously since then.

The sections below describe the configuration of the HF radar array in the eastern SBC and present some results of the project so far. This MMS-sponsored project has helped Washburn's research group obtain funding from other sources including: (1) the National Science Foundation in collaboration with Dr. Carter Ohlmann of the Scripps Institution of Oceanography (SIO); (2) the California State Coastal Conservancy as part of Southern California Coastal Ocean Observing System (SCCOOS); and (3) the University of California Marine Council.

HF Radar and Oceanographic Observations in the Eastern Santa Barbara Channel

As discussed above, an additional HF radar system was installed at Summerland, CA as shown in Figure 1. The other three sites in the HF radar network at Refugio Beach, Coal Point, and the Mandalay power plant in Oxnard, California are also shown. The temporary installation from 1 May 2004 – 1 September 2004 provided extensive coverage over the eastern SBC as shown by the current vectors in the figure. The new site at the Summerland sanitation district provides comparable coverage.

The timing of the temporary installation was to support another MMS-sponsored project, collaboration with Dr. Milton Love's UCSB research group. One goal of that project is to understand the role of oceanographic processes in the settlement of various rockfishes on oil platforms. A particular target species of the project is the rockfish Bocaccio. The project will investigate possible larval exchange between two platforms in the eastern SBC, Platforms Grace and Gilda (shown by white squares in Figure 1). The period 1 May to 1 September was chosen because this is when pelagic juvenile Bocaccio settle on the platforms in the greatest numbers.

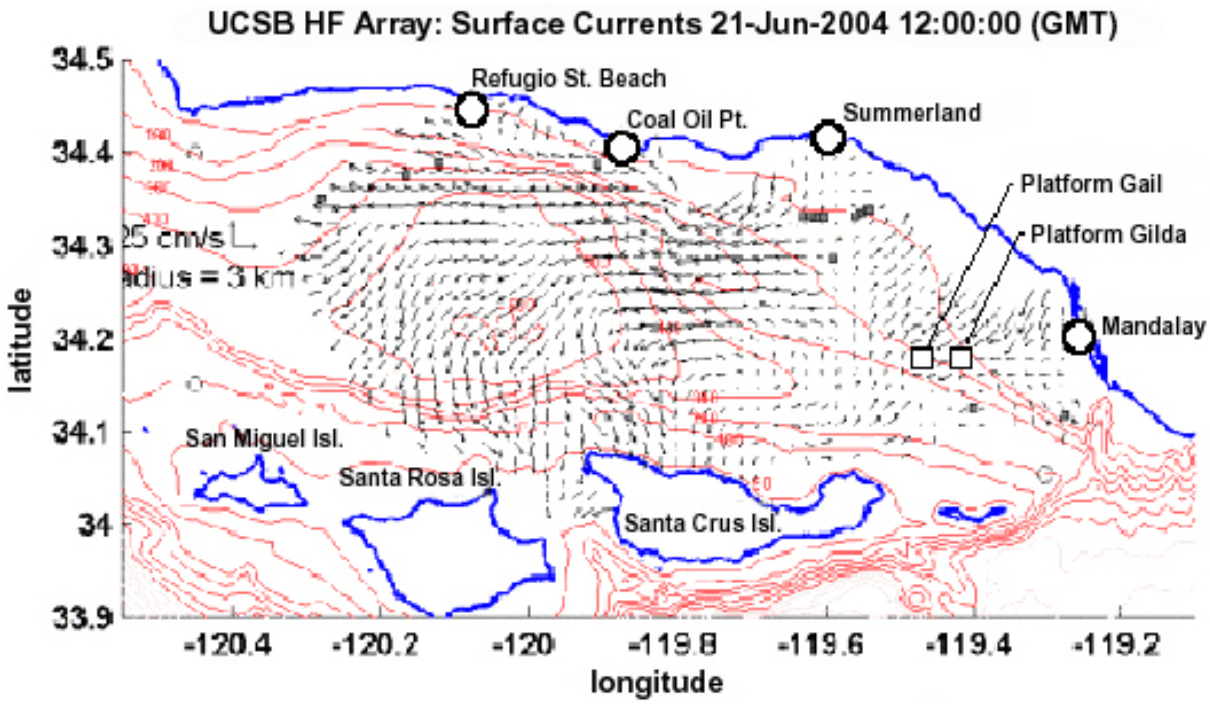

Figure 1. Study area in the Santa Barbara Channel. Open circles on mainland coast show location of HF radars at. Arrows show current vectors. Scale on right-hand side shows north and east vectors with speeds of 25 cm s^{-1}. Squares indicate oil production platforms. Recruitment time series for juvenile bocaccio were measured at Platform Gail and Gilda (large squares).

The observational goals of the project were to obtain times series of in situ oceanographic observations at the platforms while regional circulation patterns were observed using the HF radars. Time series of larval fish settlement were obtained via SCUBA surveys every three or four days at each platform. In situ oceanographic instrumentation at each platform included:

- one acoustic Doppler current profiler (ADCP)
- one moored conductivity, temperature, depth (CTD) sensor
- thermistors in vertical arrays on the platforms' legs

Some thermistors were lost, but overall data return for the 4 month deployment period was nearly 100% for the other instruments. HF radar coverage was also good as may be seen by examining the HF radar archive at http://www.icess.ucsb.edu/iog/codar.htm. Figure 1 shows a representative example from 21 June, 2005.

Time series of bocaccio settlement (Figure 2) show that over the first half of the experiment settlement rates were low, but beginning about year-day 182, settlement increased and remained high and variable for the rest of the experiment period.

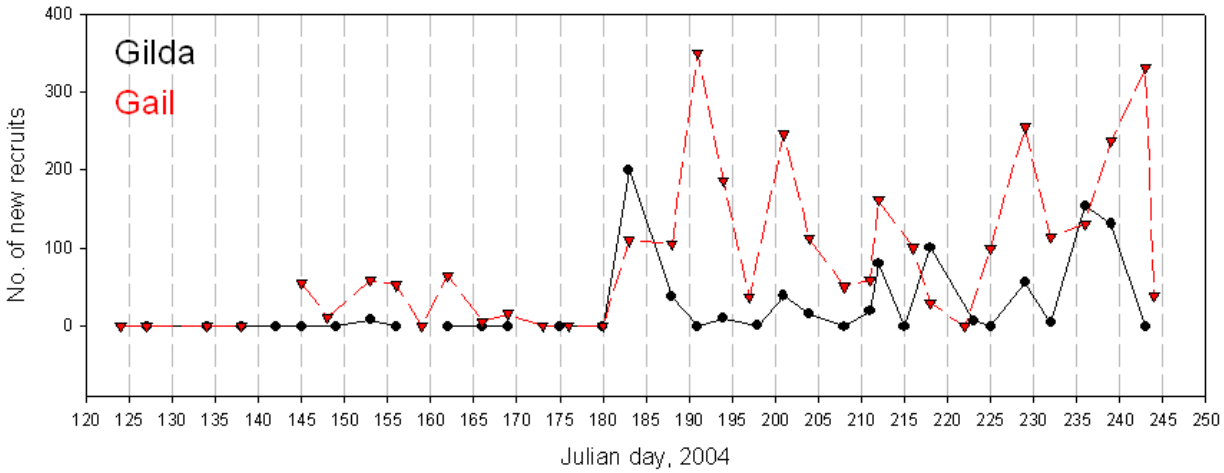

Figure 2. Settlement time series measured at oil production Platforms Gail and Gilda during 1 May – 30 August, 2004. Red dashed line and triangles show settlement at Gail and black line and circles show settlement time series at Gilda. Temporal spacing of data points is 2 or 4 days.

Settlement was generally higher at the deeper Platform Gail compared with Platform Gilda. Analysis of the large HF radar and in situ oceanographic data sets collected during the experiment is continuing. One line of investigation will be to determine whether some change in water masses or current structure can account for the large increase in settlement after year-day 182.

Lagrangian Drifter and HF Radar Observations

In collaboration with Dr. Carter Ohlmann of Scripps Institute of Oceanography, we have been investigating nearshore circulation processes in the SBC using a combination of HF radar and Lagrangian drifters. Another line of investigation has been determining how to optimize trajectory estimation using HF radar observations. Trajectory estimation is important for predicting how pollutants such as oil and storm water runoff are moved under the influence of surface ocean currents.

Figure 3a shows all drifters tracks obtained as of August 2004 in the SBC. Drifters are released in two grids, one labeled “inner shelf grid” and the other “HF radar grid.” All drifters are drogued at 1 m depth so their current measurements are comparable to the HF radar measurements. Observations in the inner shelf grid are being used to evaluate errors in trajectory predictions using HF radar based on comparison with actual drifter trajectories. Drifter observations have been made throughout the year so that representative conditions from all seasons are sampled. Deployments occur from small boats and real time reception of drifter positions allows field personnel to pick up and re-deploy drifters as needed.

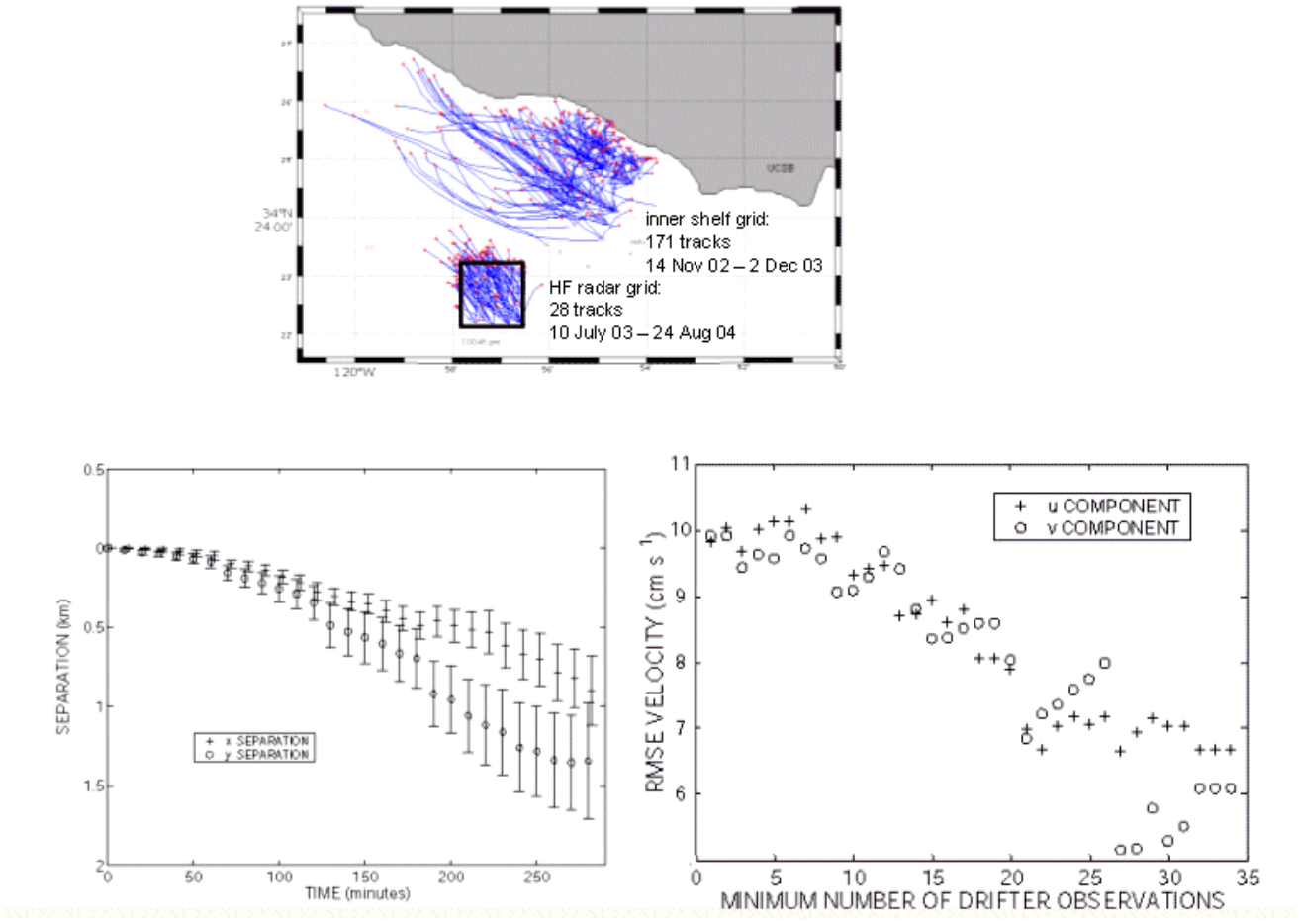

Figure 3. a) Study area on north side of Santa Barbara Channel. Blue lines show all drifter trajectories through 24 August 2004. Red dots mark trajectory end points. Typical trajectory duration is 2 – 4 hours. **b)** North-south (circles) and east-west (plus signs) separation distances between drifter and HF radar-derived trajectories. **c)** North-south (circles) and east-west (plus signs) root-mean-square speed differences between HF radar and drifter current time series. X-axis shows minimum number of drifters included in ensembles.

Observations from the inner shelf grid show that asymmetries occur in position differences predicted by HF radar and observed using drifters. Separation differences increase more rapidly in the north-south direction (y-direction) compared with the east-west direction (Figure 3b). We speculate that strong turning and horizontal shear of the nearshore current field may be responsible for this asymmetry.

Observations from the HF radar grid suggest an important result: they indicate that much of the differences between current time series measured by HF radar and those measured by in situ current meters are due to flow structures unresolved by the radars. Typically these differences are of order 10 - 14 cm s^{-1}. A number of speculations have been advanced to explain the differences including HF radar measurement error, vertical current shear, and spatial variability of current structure on scales of a few km and smaller.

Comparison of differences in current speeds between drifter ensembles and HF radar suggest part of the explanation. Figure 3c shows that speed differences decrease as the number of drifters in the ensembles increases. The change is significant: differences decrease from 9 - 11 cm s^{-1} to 5 – 7 cm s^{-1} as the minimum number of drifters in the ensembles increases from about 5 to about 35. Inclusion of larger numbers of drifters averages out small scale velocity variance therefore; these results indicate that underlying spatial variability in current structure is responsible for much of the measurement differences between HF radars and in situ current meters. To make the measurements of Figure 3c, drifters were released within the HF radar grid. If the drifters left the grid, they were picked up by field personnel and re-deployed within the grid. The goal was to keep the HF radar grid populated with as many drifters as possible over time scales of several hours. This allowed construction of velocity time series using variable numbers of drifters for comparison with the HF radars.

Future Plans:

In the future, we will continue these comparison observations to learn more about how HF radars measure surface currents and how they may best be used to estimate particle trajectories.

MMS Action Required:

None

Task No. 17607: *Public Perceptions of Risk Associated with Offshore Oil Development*

Principal Investigators: Eric R.A.N. Smith, Department of Political Science, University of California, Santa Barbara, CA 93106-9420

Project Objectives

The goal of this project was to design a set of public opinion surveys and news media content analysis methods in preparation for a time series analysis of NIMBY responses to proposed offshore oil development projects along the Santa Barbara coast in California. Current oil-lease holders are considering a number of new drilling projects. This project has produced a set of methods to study the public's reaction to the debate surrounding these proposed projects.

Background

Whenever a neighborhood or community group objects to a local development, someone suggests that the objections are part of a NIMBY, or "Not in My Backyard" pattern of responses. NIMBY behavior has been responsible for slowing or blocking a wide variety of government and industry proposals - including offshore oil developments. In some cases, such as housing developments, NIMBY resistance is motivated by people's preferences about the quality of life in their communities. In other cases, NIMBY resistance is motivated by people's perceptions of risks associated with the developments. In some of these cases, critics allege, the fears are irrational because they are based on misinformation. That is, people are said to fear hazards that have extremely small probabilities of occurring. Offshore oil development is one area in which exaggerated perceptions of risks may influence public opinion, and therefore government and industry decisions.

Despite the prominent role of NIMBY influence on many government and industry decisions, researchers have not yet developed a full understanding of it. Although there is a substantial literature on risk perceptions, relatively little of it examines risk perceptions in the context of actual NIMBY behavior, and none it has examined the development of a NIMBY response over an extended period of time. That is, no investigator has yet used a series of public opinion surveys to explore how people's knowledge, risk perceptions, policy preferences, and behavior change over time during the course of a public debate about proposed development such as a new offshore oil platform. This study developed a research design to do just that.

The core of the design was a series of public opinion surveys extending for a period of five years so that change was measured over time. A baseline survey - the 1998 Offshore Oil Drilling and Energy Policy Survey, funded by the University of California's Toxic Substances Research and Teaching Program - has already been conducted. Subsequent surveys measured the public's knowledge of oil development in general and the proposed projects in particular, as well as the public's perceptions of various risks associated with the projects, including both risks to people and to the environment. In addition, the surveys measured people's preferences about the projects and the extent to which they acted on their preferences by writing letters, attending meetings, and engaging in other forms of political activity. Finally, the surveys measured a

variety of variables that various theories suggest may explain people's knowledge, perceptions of risk, preferences, and activism.

In order to explain the public's response to the drilling project, we also studied the sources from which the public receives information or persuasive communications - that is, the news media, industry advocates, and political activists. These efforts included a content analysis study of local newspapers, television news, and radio as well as an effort to obtain and analyze any direct mail or other communications from the oil industry or advocates on either side of the conflict. Measuring these communications allowed us to test theories explaining changes in the public's knowledge, opinions, and behavior over time.

Summary of Research

Analysis and writing culminated in a Final Report which was submitted to the Minerals Management Service on April 15, 2005:

Smith, Eric R.A.N. Public Attitudes toward Oil and Gas Drilling among Californians: Support, Risk Perceptions, Trust, and Nimbyism. MMS OCS Study 2005-004. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 1435-01-00-CA-31063. 92 pages.

MMS Action Required:

None

Task No. 17606: *Population Genetics of surfgrass (Phyllospadix torreyi) for use in restoration*

Principal Investigators: Scott Hodges, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610 **Douglas Bush,** Marine Science Institute, University of California, Santa Barbara, CA 93106-6150 **Sally J. Holbrook**, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610 and **Daniel C. Reed,** Marine Science Institute, University of California, Santa Barbara, CA 93106-6150

Summary of Research

The overall objective of our study is to characterize genetic factors that may affect the success of restoring surfgrass populations in Santa Barbara County. Our proposed work focuses on two major factors. The first is the spatial boundaries of genetically differentiated populations and the second is the spatial distribution of male and female plants within interbreeding populations. This information will enhance restoration efforts that aim to maintain current levels of genetic diversity. It will be valuable not only in practical aspects of restoration practice, such as the choice of material for restoration, but it will also greatly increase our understanding of processes by which surfgrass stands are maintained and restored in nature.

Our study has three specific objectives:

1. To identify the boundaries of genetically differentiated surfgrass populations.
2. To determine if there is genetic differentiation within populations with respect to clone size and depth.
3. To develop genetic markers linked to gender and characterize the spatial distribution of male and female plants within surfgrass populations.

Future plans:

We are currently writing a manuscript on our gender-specific DNA markers and sex-ratio findings. We are also rescoring our AFLP data for the population genetic analysis.

Problems Encountered:

Our main computer containing the data for our AFLP analyses was hacked into by an outside source. Our IT group decided we needed to erase the entire hard drive and to install patches and security to stop the problem. Very unfortunately, there was a problem with the backup software provided with our AFLP analysis software such that when we reloaded the computer, we had lost all of the scoring. The gel images were not lost but we now need to rescore all of the gels. Because the original people working on the project have moved on to other positions, this has been left to the PI who has limited time. Hopefully, the scoring will be completed this Fall and analysis and writing of papers can commense.

MMS Action Required:

We will require MMS comments and issue of a MMS report study number upon completion and submittal of the Draft final study report.

Task No. 17605: *Population Dynamics and Biology of the California Sea Otter at the Southern End of its Range*

Principal Investigators: **James Estes**, USGS-BRD & Department of Biological Sciences, University of California, Santa Cruz, CA 95064 **Terrie Williams,** Department of Biological Sciences, University of California, Santa Cruz, CA 95064 **Daniel Costa,** Department of Biological Sciences, University of California, Santa Cruz, CA 95064 **Katherine Ralls,** Department of Zoological Research, National Zoological Park, Smithsonian Institution**,** Washington, DC 20008 and **Donald Siniff,** Professor of Ecology, Evolution and Behavior, University of Minnesota, St. Paul, MN 55108

Summary of Research

The present study was designed to obtain an updated picture of population dynamics and movement patterns, as well as an increased understanding of the problems currently facing the population. We had three main objectives:

1) better understand how overall population dynamics had changed since the mid-1980's (a period for which data exist from previous MMS-funded study) and the reasons for the recent population decline;

2) describe the population dynamics, behavior and seasonal movement patterns of sea otters at the southern end of their range; and

3) examine the inter-relationships between nutritional requirements, foraging strategies, energetics an and activity patterns and the ways in which theses relationships determine habitat suitability for sea otters in California.

Future Plans:

We will make the necessary corrections upon receiving them from MMS, and submit the Final Study Report for this project.

MMS Action Required:

We completed and submitted a draft final report to the Minerals Management Service in October 2004. We are awaiting MMS comments and a MMS report study number for the Draft final study report.

Task No. 17604: *Shoreline Inventory of Intertidal Resources of San Luis Obispo and Northern Santa Barbara Counties*

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

Summary of Research

**** This project is no longer under CMI funding. Future reports will be submitted directly to MMS. Summarized results for selected species are available to the public at:* www.marine.gov *****

The purpose of the Shoreline Inventory Project is to provide baseline information on the rocky intertidal plants and animals along the central and southern California coast. Information on coastal biota in these areas would be essential in the event of an oil spill or other major impact. In addition, the monitoring studies yield important data on population dynamics on a local and regional scale which can be utilized for more effective resource management as well as provide fundamental ecological knowledge about the dynamics of the systems. The rocky intertidal surveys of five sites in Northern Santa Barbara County (NSB) represent a continuation of previous semi-annual monitoring conducted for the Minerals Management Service from 1992 to 2002. Five additional sites were established in 1995 for San Luis Obispo County (SLO). A sixth site at which only black abalone and owl limpets are monitored was recently added in SLO County. The combination of previous and current year surveys in the two counties has resulted in a total of 23 semi-annual samples for NSB sites, and 16 semi-annual samples for SLO sites (with the exception of the newly added sixth site).

The sampling protocol focuses on target species or assemblages. Permanent photoplots are established in assemblages such as barnacles, mussels, anemones, turfweed, and rockweed. Cover of the major taxa is determined by point-contact photographic analysis for all plots except barnacles, which are scored in the field to allow samplers to distinguish *Chthamalus* spp. from *Balanus glandula*. Counts of mobile invertebrates occurring within the barnacle, mussel, *Endocladia, Mastocarpus, Silvetia*, and *Hesperophycus* photoplots are also done in the field. Additional permanent plots are established for large motile species such as owl limpets, black abalone, and seastars. Line transects are used to estimate the cover of surfgrass. Photographic overviews and field notes are used to describe general conditions at the site and to document the distribution and abundance of organisms not found within the photoplots.

Future Plans:

Completion of this project is anticipated this year.

MMS Action Required:

None

Task No. 17602: *Inventory of Rocky Intertidal Resources in Southern Santa Barbara, Ventura and Los Angeles Counties*

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

Summary of Research

**** This project is no longer under CMI funding. Future reports will be submitted directly to MMS. Summarized results for selected species are available to the public at:* www.marine.gov *****

The seven long term monitoring sites included in this report include five sites in Los Angeles County (Paradise Cove, White's Point, Point Fermin, Bird Rock and Little Harbor), and two in Ventura County (Old Stairs and Mussel Shoals). Two of these sites, Bird Rock and Little Harbor, continue to be sampled by Jack Engle (UC Santa Barbara) during Channel Islands Research Program cruises to the island. While the minimum set of photoplot photographs are taken during these visits, the full sampling effort including photosurveys and motile invertebrate data collection has not been completed for several years. The Catalina photoplot slides are sent to southern Santa Barbara County sites (Alegria, Arroyo Hondo, Coal Oil Point and Carpinteria). Pete Raimondi's group at UC Santa Cruz is responsible for the Inventory Program's four northern Santa Barbara and San Luis Obispo County sites. Under the current arrangement, the UCLA group collects and enters the data for the southern Santa Barbara sites, then the data files are sent to the UCSC group for data analysis and report preparation. The core team, along with regular help from MMS personnel, has provided the project with consistent, high quality data collection with notable efficiency.

During this report period, all monitoring sites were sampled as scheduled with no major problems.

Future Plans:

Completion of this project is anticipated this year.

MMS Action Required:

None

Task No. 17601: *Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species*

Principal Investigators: Mark Page, Marine Science Institute, University of California, Santa Barbara, CA 93106-6150 **Jenifer Dugan**, Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, CA 93106-6150 and **James Childress,** Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106-9610

Summary of Research

Shell mounds form over time under offshore oil platforms as encrusting invertebrates, chiefly mussels, barnacles, and scallops, fall from platform support surfaces and accumulate on the seafloor. These mounds provide habitat for a diverse invertebrate community that depends on the food subsidy provided by faunal litterfall from the overlying structure for nourishment. When platforms are decommissioned and removed, the shell mounds remain, but faunal litterfall is no longer available as a food source for the shell mound community. The fate of shell mounds following platform decommissioning and removal is controversial because their habitat value is unknown. To assess habitat value of these mounds relative to shell mounds with existing platforms, we are comparing the distribution and abundance and population size structure of commercially important crab species (*Cancer antennarius*, *C. anthonyi*, *C. productus*, and *Loxorhynchus grandis*) and other invertebrate and fish taxa. In addition, we are assessing the body weight of the chestnut cowry (*Cypraea spadicea*) at shell mounds with and without existing platforms.

Using shell mounds under existing platforms "Hogan," "Houchin" (Pacific Operators Offshore), and "Gina" (Nuevo Energy Company), and shell mounds at the sites of four decommissioned platforms "Hazel", "Hilda", "Heidi", and "Hope" we are: (1) quantifying the distribution and abundance of ecologically and commercially important benthic organisms on the shell mounds, (2) determining the population size structure of the most abundant taxa at each site, and (3) using the nutritional condition of organisms to evaluate the habitat value of shell mounds. The results of our research will potentially contribute to decisions regarding the fate of shell mounds following platform decommissioning.

We investigated the distribution and abundance of benthic invertebrates using two techniques. For commercially important crabs, baited commercial crab traps were deployed at each soft bottom, shell mound, and platform location (excluding platform Gina). Traps were lowered to the bottom at each sampling location and retrieved after a 24-hour soak time. Captured crabs were counted, sex was determined, and carapace length (for majid crabs) or carapace width (for cancrid crabs) was measured. Sampling was repeated once a month for 4 months beginning in September in 2000 and August 2001. Second, we used band transects to estimate the abundance of invertebrate taxa other than crabs on the two shallow shell mounds (Hazel and Hilda) and on the shell mound at platform Gina. Divers attached transect lines to a central point (the buoy chain at the shallow shell mounds and a conductor pipe on platform Gina), and extended the lines out in a radial fashion; the result was a "wheel spoke" sampling regime. The divers then swam the length of the transects and collected selected benthic macroinvertebrate taxa in a one

meter swath. In order to correct for potential over sampling of the area closest to the central point inherent in this sampling design, transects were divided into 4 segments. For analysis, data were weighted with regard to distance from the central point, e.g. the segments closest to the central point are weighted less than those farther away. We also compared the body weight of the chestnut cowry, *Cypraea spadicea,* among shallow shell mounds (Gina, Hazel, and Hilda). Dry body weight was regressed against shell length for each location. Divers collected animals of a range of sizes from the shell mounds such that the size distributions overlapped among locations. Collected individuals were measured, soft tissue excised, and oven dried at 90° C to a constant weight.

Analysis and writing culminated in the final report, which was submitted to the Minerals Management Service on March 09, 2005:

Page, Mark H., Jenifer Dugan and James 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 1435-01-00-CA-31063. 25 pages.

MMS Action Required:

None

Task No. 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 93106-9610 and **Andrew J. Brooks,** Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, CA 93106-6150

Background

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.

The behavior of the California Current System plays a critical role in determining the conditions of the nearshore marine environment off Southern California. The typically high productivity of this system is attributed to coastal upwelling which brings deeper, nutrient-rich water to the surface near shore. This high supply rate of nutrients enhances primary productivity, which in turn increases secondary productivity of the nearshore pelagic and benthic food webs. Time series studies of the California Current System conducted by the California Cooperative Fisheries Oceanic Investigations since the 1940's have revealed distinct seasonality within a year, and periodic wholesale change during El Niño Southern Oscillation (ENSO) events that have relatively brief (1-2 years) durations. There is abundant evidence that the California Current System has undergone a longer, interdecadal length change since the late 1970's and early 1980's. One manifestation off Southern California of this apparent regime shift was a rapid, large, and persistent increase in seawater temperature. Between 1976-1977, mean annual surface temperatures in the Southern California Bight rose an average of 1^{o}C or more above the mean for the previous two decades. Associated with this warming event were a number of changes in other physical processes and events that can influence marine biota. Among the more important manifestations in Southern California of these altered physical conditions was a decrease in productivity in surface waters near shore. Although the exact physical explanation is still under study, it appears reasonably certain that the amount of nutrients upwelled into surface waters has declined during this recent period of elevated seawater temperature. There is compelling evidence that the abundances of many coastal species off Southern California have undergone dramatic declines over the past 1-2 decades in response to falling productivity in near shore, surface waters.

The vast amount of long-term data on nearshore biota collected by a large number of separate monitoring programs in the Southern California OCS region represents a relatively untapped "gold mine" of information for environmental managers. The occurrence of a regime shift in the

ocean climate in the North Pacific in the past two decades provides a unique opportunity to determine whether and how various components of the biota respond to this source of perturbation. Data from long-term monitoring programs not only indicate the current state and recent history of the biota, they can revel much about the ecological structure of various coastal ecosystems, including the dynamical behavior and regulation of different food webs. Such knowledge provides managers with better understanding and enhanced predictive ability regarding the potential impacts to these ecosystems from other potential sources of disturbance. Further, analyses of existing data sets can expose whether and how our ability to estimate or interpret responses of the biota may be constrained by present monitoring practices.

Summary of Research

Analysis and writing are ongoing with efforts being focused on the completion of a Draft Final Report.

MMS Action Required:

We will require MMS comments and issue of a MMS report study number upon completion and submittal of the Draft final study report.

Task No. 12388 & **Task No. 17610:** *Joint UCSB-MMS Pacific OCS Student Internship and Trainee Program*

Principal Investigators: Jenifer Dugan, Marine Science Institute, University of California, Santa Barbara, CA 93106-6150 and **Edward Keller**, Environmental Studies and Geological Sciences Departments, University of California, Santa Barbara, CA 93106-9630

Summary of Research

The CMI internship program experienced continued success this year with excellent interest and participation by prospective interns and mentors. Feedback from all participating interns and mentors continues to be very positive and enthusiastic. As in previous years, the UC Santa Barbara Environmental Studies Internship Program served as an effective mechanism for advertising positions, screening applicants and reviewing intern performances. The expanded distribution of advertisements for intern positions to other academic departments at UC Santa Barbara including: Department of Ecology, Evolution and Marine Biology, Department of Geology, Department of Geography, Girvetz Graduate School of Education and the Donald Bren School of Environmental Science and Management was effective in locating prospective interns and was successful in reaching students from a range of academic majors, levels and backgrounds to fill various internship openings.

During the past year, 10 graduate and undergraduate students participated as interns in 7 projects at MMS headquarters and on the UCSB campus. We worked with MMS personnel to develop position descriptions and advertise new internships through UCSB academic departments and programs. Student interns were jointly mentored by MMS staff and/or a member of the UCSB faculty or professional research staff. During the Summer of 2004 and the 2004-2005 academic year, CMI interns were involved in a variety of projects. Jennifer Klaib, an undergraduate intern mentored by Ms. Dunaway of MMS and Dr. Engle of UCSB, assisted with the development of websites and online data reporting for the MARINE rocky intertidal monitoring program. Jennifer Lape, a graduate student, developed and implemented a comprehensive compilation of scientific reprints resulting from >15 years of MMS funded research and provided program assistance during Winter and Spring 2005. During that period, Corrine Kane, a graduate student mentored by Dr. Schmitt and Dugan, researched, collected and scanned scientific reprints and technical reports for the CMI program. In Summer and Fall 2004, an undergraduate student, Beth O'Connor (hired in May 2004) took photographs and developed content that was used to update the CMI website. Beth was mentored by Dr. Dugan. In Summer and Fall 2004, Kristina Estudillo, a UCSB graduate student, assisted with the development of K-12 educational curricula and materials comparing alternative energy sources for the summer months. She was mentored by Ms. Dunaway of MMS.

With the renewed funding from the UCSB Shoreline Preservation Fund that was obtained to expand our internship program and support additional undergraduate interns in the CMI program, we supported a total of 5 undergraduate student interns who assisted CMI Principal Investigators with several CMI research projects. The student interns for these projects included: Tom Littlejohn, mentored by Drs. Brooks and Lenihan (Marine Science Institute, Bren School),

assisted with field sampling and growth analyses of fish using otoliths for demographic studies of fishes on reefs and oil platforms, Zuag Yang, mentored by Dr. Valentine (Geology, UCSB), assisted with research on hydrocarbons in natural petroleum, Peter White, mentored by Dr. Ohlmann (ICESS, UCSB), conducted nearshore studies of surface currents using small drifters, and Justin Hoesterey and Dana Nakase, mentored by Drs. Page and Dugan of UCSB, assisted with laboratory sample analyses to compare benthic invertebrates from offshore oil platforms and natural reefs.

Joint UCSB-MMS Pacific OCS Graduate Trainee Program

Graduate students continued to be directly or indirectly exposed to research sponsored by the Coastal Marine Institute through a variety of mechanisms. This exposure ranged from short term participation in field studies to the development of thesis proposals related to CMI projects. Students involved in short-term participation in CMI projects received summaries of the objectives and the relevance of the studies to decision-making and policy development at MMS. In addition, some of the information produced by CMI sponsored projects has been incorporated into graduate and undergraduate curricula at UC Santa Barbara. A list of participating graduate students appears in a separate section of this Annual Report.

Information Transfer Seminars (ITS)

No information transfer seminars were presented during this reporting period.

Future Plans:

We will continue to support the students funded through the Internship program.

MMS Action Required:

None

TRAINEES AND STAFF

TRAINEES AND STAFF FUNDED BY THE COASTAL MARINE INSTITUTE

2004-2005

Name	Status	Task
Adam, Tom	Graduate Student	Recruitment to Rocky Shores
Alfano, Christine	Graduate Student	Sea Otter Population Dynamics
Anderson, Kristen	Undergraduate Student	Ecological Performance
Ang, Jason	Undergraduate Student	Ecological Performance
Bassin, Corrine	Graduate Student	Surface Circulation
Bayer, Pam	Staff	UCSB-MMS Internship
Beckenbach, Edwin	Graduate Student	Surface Circulation
Bentall, Gena	Graduate Student	Sea Otter Population Dynamics
Beyer, Sabrina	Undergraduate Student	Population Trends
Bodkin, James	Staff Research Associate	Sea Otter Population Dynamics
Bond, Morgan	Graduate Student	Recruitment to Rocky Shores
Bostic, Kadie	Undergraduate Student	Ecological Performance
Bricker-Shanahan, Tania	Staff Research Technician	Surfgrass Population Genetics
Bullard, Aimee	Graduate Student	Recruitment to Rocky Shores
Cantor, Emily	Undergraduate Student	Ecological Performance
Carlisle, Juliet	Graduate Student	Public Perceptions of Risk
Carr, Lindsey	Undergraduate Student	Population Trends
Casper, Dave	Staff Research Associate	Sea Otter Population Dynamics
Chambers, Jeanne	Staff	UCSB-MMS Internship
Chen, Jerry	Undergraduate Student	Ecological Performance
Cheng, Joe	Undergraduate Student	Ecological Performance
Cleland, Ashley	Undergraduate Student	Recruitment to Rocky Shores
Compton, Jacqueline	Undergraduate Student	Ecological Performance
Connors, Emma	Undergraduate Student	Ecological Performance
Conway-Cranos, Tish	Graduate Student	Recruitment to Rocky Shores
Crumly, Robert	Undergraduate Student	Ecological Performance
Culver, Carrie	Staff Research Associate	Marine Biotechnology
Day, Daniel	Graduate Student	Marine Biotechnology
Der, Lauren	High School Student	Ecological Performance
Dunaway, Mary Elaine	MMS – Staff	Recruitment to Rocky Shores
Emery, Brian	Staff Computer Technician	Surface Circulation
Engle, Caroline	Undergraduate Student	Recruitment to Rocky Shores
Engle, Jack	Staff Research Associate	S. Shoreline Inventory
Estudillo, Kristina	Graduate Student	UCSB-MMS Internship
Fejtek, Stacie	Post-Graduate Researcher	Population Trends
Fisher, Rachelle	Undergraduate Student	Ecological Performance
Foley, Melissa	Graduate Student	Recruitment to Rocky Shores
Grant, Nora	Graduate Student	Recruitment to Rocky Shores
Gray, Vanessa	Undergraduate Student	Ecological Performance
Haston, Laura	Staff	UCSB-MMS Internship
Hatfield, Brian	Staff Research Associate	Sea Otter Population Dynamics
Hayford, Hillary	Staff Research Technician	Recruitment to Rocky Shores
Herrer, Shannon	Undergraduate Student	Relative Importance of POCS
Herzberg, Stephanie	Undergraduate Student	Ecological Performance
Hessell, Eric	Staff Research Diver	Ecological Performance
Higgason, Kelley	Post-Graduate Researcher	Recruitment to Rocky Shores
Hoesterey, Justin	Undergraduate/Post-Graduate Researcher	Ecological Performance
Holloway, Stephen	Post-Graduate Researcher	Population Trends
Hubbard, Ashley	Undergraduate Student	Ecological Performance
Hurst, Alex	Undergraduate Student	Ecological Performance
Huxter, Mary	Undergraduate Student	Ecological Performance

Ireson, Kirk	Laboratory Technician	Transport over the Inner-Shelf
Jackson, Kathryn	Undergraduate Researcher	Surface Circulation
Jech, Dawn	Graduate Student	Recruitment to Rocky Shores
Jessup, Dave	Staff Research Associate	Sea Otter Population Dynamics
Johnson, Robin	Staff	UCSB-MMS Internship
Johnston, Karina	Staff	Ecological Performance
Jurick, David	Undergraduate Student	Ecological Performance
Kage, Alisha	Graduate Student	Sea Otter Population Dynamics
Kane, Corrine	Graduate Student	UCSB-MMS Internship
Kay, Mathew	Laboratory Technician	Relative Importance of POCS
Kinnaman, Frank	Undergraduate Student	Rates of Microbial Metabolism
Klaib, Jennifer	Undergraduate Student	UCSB-MMS Internship
Kopecky, Susannah	Undergraduate Student	Ecological Performance
Kress, Erica	Undergraduate Student	Ecological Performance
Kunkle, Katy	Undergraduate Student	Population Trends
Lape, Jennifer	Graduate Student	UCSB-MMS Internship
Larsen, Kim	Undergraduate Student	Ecological Performance
Leard, Christina	Undergraduate Student	Recruitment to Rocky Shores
Leckliter, Alexandria	Undergraduate Student	Recruitment to Rocky Shores
Lee, Esther	Undergraduate Student	Ecological Performance
Lee, Steven	Post-Graduate Researcher	S. & N. Shoreline Inventory
Lemein, Todd	Undergraduate Student	Ecological Performance
Lester, Sara	Graduate Student	Population Trends
Levenbach, Stu	Graduate Student	Relative Importance of POCS
Littlejohn, Tom	Undergraduate Student	UCSB-MMS Internship
Livingston, Haven	Staff Research Associate	Recruitment to Rocky Shores
Lopez, Veronica	Undergraduate Student	Ecological Performance
Mangairdi, Catrina	Graduate Student	Relative Importance of POCS
Martinez, Chris	Undergraduate Student	Population Trends
McNally, Samuel	Undergraduate Student	Ecological Performance
Meka, Meena	Undergraduate Student	Ecological Performance
Michaud, Kristy	Graduate Student	Public Perceptions of Risk
Milgrim, Justin	Undergraduate Student	Recruitment to Rocky Shores
Miller, Eric	Undergraduate Student	Recruitment to Rocky Shores
Miller, Melissa	Staff Research Associate	Sea Otter Population Dynamics
Monell, Colette	Undergraduate Student	Ecological Performance
Moore, Kelly	Undergraduate Student	Ecological Performance
Moya, Claudia	Graduate Student	Marine Biotechnology
Murray, Michael	Staff Research Associate	Sea Otter Population Dynamics
Mutz, Stephanie	Staff Research Associate	Relative Importance of POCS
Nakase, Dana	Undergraduate Student	UCSB-MMS Internship
Nishimoto, Mary	Graduate Student	Ecological Performance
Nguyen, Gigi	Undergraduate Student	Ecological Performance
O'Connor, Beth	Undergraduate/ Staff	UCSB-MMS Internship
Ong, Whitney	Undergraduate Student	Ecological Performance
Pearson, Justin	Undergraduate Student	Surface Circulation
Pena, Arlene	Undergraduate Student	Ecological Performance
Perlman, Ben	Undergraduate Student	Recruitment to Rocky Shores
Porzig, Libby	Undergraduate Student	Recruitment to Rocky Shores
Redfield, Melissa	Undergraduate Student	Recruitment to Rocky Shores
Rassweiler, Andrew	Graduate Student	Relative Importance of POCS
Readdie, Mark	Post-Doctoral Researcher	Recruitment to Rocky Shores
Roe, Christy	Staff Research Associate	N. Shoreline Inventory
Rosen, Jessica	Undergraduate Student	Ecological Performance
Seydel, Keith	Post-Graduate Researcher	Population Trends
Salazar, David	Staff Research Associate	Surface Circulation

Schlosser, Alison	Undergraduate Student	Rates of Microbial Metabolism
Schroeder, Donna	Staff	Ecological Performance
Spencer, Katie	Undergraduate Student	Recruitment to Rocky Shores
Springer, Yuri	Graduate Student	Recruitment to Rocky Shores
Staedler, Michelle	Staff Research Associate	Sea Otter Population Dynamics
Stone, Roslynn	Undergraduate Student	Ecological Performance
Strong, Erik	Undergraduate Student	Rates of Microbial Metabolism
Tanner, Christina	Undergraduate Student	Population Trends
Tinker, Tim	Post-Doctoral Researcher	Sea Otter Population Dynamics
Vance, Valerie	Undergraduate Student	Ecological Performance
Visin, Kyle	Undergraduate Student	Surface Circulation
Wardlaw, George	Graduate Student	Rates of Microbial Metabolism
Weidemann, Christine	Undergraduate Student	Ecological Performance
White, Peter	Undergraduate Student	UCSB-MMS Internship
Williamson, Bonnie	Staff	UCSB-MMS Internship
Wilson-Miner, Melissa	Staff Research Technician	Recruitment to Rocky Shores
Welche, Thomas	Undergraduate Student	Relative Importance of POCS
West, Candace	Undergraduate Student	Ecological Performance
Worton, Leslie	Undergraduate Student	Ecological Performance
Yang, Zuag	Undergraduate Student	UCSB-MMS Internship
Yeates, Laura	Graduate Student	Sea Otter Population Dynamics
Yi Ma, Ching	Undergraduate Student	Ecological Performance
Yoo, Edward	Undergraduate Student	Ecological Performance
Zimmerman, Eric	Staff	UCSB-MMS Internship

Key

Biological Endpoints in Flatfish—Task # 18213, PI Schlenk
Ecological Performance—Task # 85339, PIs Page, Dugan, Love, Lenihan
Habitat Value of Shell Mounds—Task # 17610, PIs Page, Dugan & Childress
Marine Biotechnology—Task # 17609, PIs Schmitt et al.
N. Shoreline Inventory—Task # 17604, PI Raimondi
Population Trends—Task # 14181, PIs Schmitt & Brooks
Public Perceptions of Risk—Task # 17607, PI Smith
Rates of Microbial Metabolism—Task # 85338, PI Valentine
Recruitment to Rocky Shores—Task # 18234, PIs Raimondi & Ambrose
Relative Importance of POCS—Task # 85340, PIs Lenihan & Brooks
S. Shoreline Inventory—Task # 17602, PI Ambrose
Sea Otter Population Dynamics—Task # 17605, PIs Estes, et al.
SSOS-HYS—Task #s 17611 & 18211, PIs Leifer, Clark, & Luyendyk
Surface Circulation—Task #, 17608, PIs Washburn and Gaines
Surfgrass Population Genetics—Task # 17606, PIs Hodges et al.
Surfgrass Restoration—Task # 15118, PIs Reed & Holbrook
Transport over the Inner-Shelf—Task # 18212, PI Ohlmann
UCSB-MMS Internship—Task #s 12388 & 17610, PIs Dugan, Keller

RESEARCH PRODUCTIVITY

PAPERS PUBLISHED

Bomkamp, R.E., H.M. Page and J.E. Dugan. 2004. Distribution and abundance of mobile benethic invertebrates on shell mounds at existing and former offshore oil platform sites. Marine Biology **142**(1): 201-211.

Bram, J.B., H.M. Page and J.E. Dugan. 2005. Spatial and temporal variability in early successional patterns of an in vertebrate assemblage at an offshore oil platform. Journal of Experimental Marine Biology and Ecology **317**: 223-237.

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Culver, C.S., H.M. Page and J.E. Dugan. 2005. Oil and gas platforms: Sources of natural marine products? Global Aquaculture Advocate June 2005: 60-61.

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*Estes, J.A., B.B. Hatfield, K. Ralls and J. Ames. 2003. Causes of mortality in California sea otters during periods of population growth and decline. Marine Mammal Science **19**: 198-216.

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*Hanni, K.D., J.A.K. Mazet, F.M.D. Gulland, J.A. Estes, M. Staedler, M.J. Murray and D.A. Jessup. 2003. Clinical pathological values and assessment of pathogen exposure in southern and Alaskan sea otters. Journal of Wildlife Disease **39**: 837-850.

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Ross, C., V. Vreeland, H. Waite and R.S. Jacobs. 2005. Rapid assembly of a wound plug: Stage one of a two-stage wound repair in the giant unicellular chlorophyte *Dasycladus vermicularis* (Chlorophyceae). Journal of Phycology **41**(1): 46-54.

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PUBLICATIONS IN PRESS

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Gerber, L.R., M.T. Tinker, J.A. Estes, D.F. Doak and D. Jessup. 2005. Mortality sensitivity in life-stage simulation analysis: A case study of southern sea otters. Ecological Applications, (in press).

Leifer, I. and J. Boles. 2005. Turbine seep-tent measurements of marine hydrocarbon seep forcing on sub-hourly time scales. Journal of Geophysical Research (in press).

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*Muller, E. B. and R. M. Nisbet. 2002. Sublethal effects of toxic compounds on dynamic energy budgets; theory and applications. Ecological Applications (in press).

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Bassin, C.J., L. Washburn, M. Brzezinski and E. McPhee-Shaw. 2005. Sub-mesoscale coastal eddies observed by High Frequencey Radar: A new mechanism for delivering nutrients to kelp forests in the Southern California Bight. Geophysical Research Letters **32**, L12604, doi:10.1029/2005GL023017.

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Love, M.S., D.S. Schroeder, W. Lenarz, A. MacCall, A. Scarborough-Bull and L. Thorsteinson. 2005. The unexpected utility of offshore marine structures in rebuilding an overfished species. Canadian Journal of Fisheries and Aquatic Science (submitted).

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Ohlmann, J.C., P.F. White, A.L. Sybrandy and P.P. Niiler. 2004. GPS-cellular Drifter Technology for Coastal Ocean Observing Systems. Journal of Oceanic and Atmospheric Technology (submitted).

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Sagarin, R.D., R.F. Ambrose, B.J. Becker, J.T. Engle, J. Kido, S.F. Lee, C.M. Miner, S.N. Murray, P.T. Raimondi, D.V. Richards and C. Roe. 2005. Effects of human foraging on the limpet *Lottia gigantea* across California rocky intertidal shores. Oikos (submitted).

Seruto, C., Y. Sapozhnikova and D.Schlenk. Evaluation of the relationships between biochemical endpoints of pah exposure and physiological endpoints of reproduction in male California halibut (*Paralichthys californicus*) exposed to sediments from a natural oil seep. Marine Environmental Research (submitted).

Smith, J.R., R.F. Ambrose and P. Fong. 2005. Long-term change in mussel (*Mytilus californianus* Conrad) populations along the wave-exposed coast of California. Marine Biology (submitted).

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PUBLICATIONS IN PREPARATION

*Brooks, A. J., Schmitt, R. J., and S. J. Holbrook. 2003. Parallel changes observed across several trophic levels suggest a common response by marine communities to short-term climate change. Ecology Letters (in prep).

Love, M.S. and A. York. 2005. A comparison of the fish assemblages associated with an oil/gas pipeline and adjacent seafloor in the Santa Barbara Channel, Southern California Bight. Bulletin of Marine Science (in prep).

Murray, S.N., R.F Ambrose and M.N. Dethier. 2005. Monitoring Rocky Shores. University of California Press (in prep).

Ohlmann, J.C. and P.F. White. High-resolution drifter measurements on the inner-shelf of the Santa Barbara Channel. Continental Shelf Research (in prep).

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*Ross, C., Kuepper, F., and R.S. Jacobs. 2003. A pharmacological analysis of the oxidative burst in *Dasycladus vermicularis* (Chlorophyta) (in prep).

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Beckenbach, E. and L. Washburn. Low Frequency Waves in the Santa Barbara Channel Observed by High Frequency Radar. MMS OCS Study 2004-008. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-01-00-CA-31063. 43 pages.

Minchinton, T.E. and Raimondi, P.T. Effects of Temporal and Spatial Separation of Samples on Estimation of Impacts. MMS OCS Study 2005-002. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001 -30758. 85 pages.

Page, H.M., J.E. Dugan, J. Childress. Role of Food Subsides 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 14-35-01-00-CA-31063. 32 pages.

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Page, H.M., J.E. Dugan, and J. Bram. Spatial and Temporal Variability in Early Successional Patterns of an Invertebrate Assemblage at an Offshore Oil Platform. MMS OCS Study 2005-001. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-01-00-CA-30761. 39 pages.

RESEARCH PRESENTATIONS

*Ambrose, R. Understanding rocky intertidal communities through long-term monitoring: The MARINe experience. CEA-CREST Annual Environmental Science Conference, Pasadena, California, May 2004.

Ambrose, R. Protecting Rocky Intertidal Resources. Santa Monica Bay Restoration Commission's State of the Bay Conference, Los Angeles, January 13, 2005.

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.

*Estes, J.A., K. Ralls, B. Hatfield and J. Ames. Mortality patterns and population dynamics of the threatened California sea otter. Carnivores 2002 - From the Mountains to the Sea: A Conference on Carnivore Biology and Conservation, Monterey, California, November 17-20, 2002.

*Estes, J.A. Process advocacy colors scientific objectivity. Plenary lecture, 2002 Annual Pew Fellows meeting. Bonnaire, Dutch West Indies, November 2002.

*Estes, J.A. Some historical dimensions to kelp forest ecosystem dynamics. 83rd Invited speaker, Annual Meeting of Western Society of Naturalists, Monterey, California, November 2002.

*Estes, J.A. Defaunated food webs: large vertebrates and nature's balance. Invited speaker, 17th Annual Ricketts Memorial Lecture Monterey Bay National Sanctuary Symposium Monterey, California, March 2003.

*Estes, J.A. Carnivory and connectivity in 'pristine' island food webs. Keynote lecture, 6th California Islands Symposium, Ventura, California, December 1-3, 2003.

*Estes, J.A. Large vertebrates and nature's balance. Invited speaker, 40th Annual Paul L. Errington Memorial Lecture, Iowa State University, Ames, Iowa, March 25, 2004.

Estes, J.A. Large predators and ecosystem resilience: examples and hypotheses from 3 case studies. Invited speaker, 100th anniversary of Friday Harbor Laboratories, University of Washington, Friday Harbor, Washington, July 17, 2004.

Estes, J.A., 2004. Sea otters: science, policy and the future. Keynote lecture for sea otter awareness week. Sponsored by Defenders of Wildlife, Monterey, California, September 30, 2005.

*Fink, T.L. and L.C. Yeates. Bridging the Gap between Training and Conservation: Training Sea otters for Diving Physiology research. International Marine Animal Trainers Conference Long Beach, California, November 19-23, 2003.

Jessup, D.A. Linking sea otter ecology, epidemiology and pathology: a bridge over troubled water. Joint meetings of the Wildlife Disease Association, American Association of Wildlife Veterinarians and American Association of Zoo Veterinarians, San Diego, California, September 1, 2004.

*Kage, A.H. California Sea Otter Movement as a Correlated Random Walk. International Otter Colloquium, Frostburg, Maryland, June 4-10, 2004.

*Kage, A.H. and D. Doak. Using California Sea Otter Long-Term Census Data for Population Viability Analysis: Implications for the Endangered Species Act. 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, British Columbia, Canada, November 28 – December 3, 2001.

MacDonald, I., M. Kastner and I. Leifer. Estimates of natural hydrocarbon flux in the Gulf of Mexico basin from remote sensing data, European Geosciences Union General Assembly 2005, Vienna, Austria, April 24-29, 2005.

Leifer I, T. Del Sontro, K. Broderick and B. Luyendyk. Time evolution of beach tar, oil slicks, and seeps in the Coal Oil Point seep field, California. 2005 International Oil Spill Conference, Miami Beach, Florida, May 15 - 19, 2005.

Leifer I, T. Del Sontro, K. Broderick and B. Luyendyk. Tracking an oil slick offshore Coal Oil Point, California. 2005 International Oil Spill Conference, Miami Beach, Florida, May 15-19, 2005.

Leifer I. Directions in water column bubble and bubble-plume research. Office of Naval Research Gassy Sediments Workshop, Bay City, Mississippi, April 24-27, 2005.

*Leifer, I. Keynote speaker: The multiphase flow of Gais's breath: Our leaking planet. 7th International Conference on Gas Geochemistry, Freiberg, Germany, September 22-26, 2003. Abstract ICGG7-A-00080.

Nishimoto, M.M., L. Washburn, M. Love, D. Schroeder and B.M. 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.

*Ohlmann, J.C. and A.L. Sybrandy. A catch-and-release Lagrangian drifter for near-shore ocean circulation research. California and World Ocean Conference, Santa Barbara, California. October 27-30, 2002. Poster.

Ohlmann, J.C., P.F White, A.L. Sybrandy, and P.P. Niller. GPS-cellular drifter technology for coastal ocean observing systems. 2005 International Ocean Research Conference, Paris, France, June 6-10, 2005.

Ohlmann, J. C. Statistical analysis of high-resolution drifter data collected just beyond the surf zone in the Santa Barbara Channel. Lagrangian Analysis and Prediction of Coastal and Ocean Dynamics conference, Lerici, Italy, June 13-17, 2005.

Page, H.M., J.E. Dugan, M. Love, D.M. Schroeder and M. Nishimoto. Trophic links and ecological performance: comparisons among offshore oil platforms and natural reefs for a resident fish and its prey. 8th International Conference on Artificial Reefs and Artifical Habitats, Biloxi, Mississippi, April 10-14, 2005.

*Raimondi, P.T, R. Sagarin, R. Ambrose, M. George, S. Lee, D. Lohse, C.M. Miner, S. Murray and C. Roe. Color change and consistency in the sea star *Pisaster ochraceus*. Society for Integrative and Comparative Biology Annual Meeting, New Orleans, Louisiana, January 5-9, 2004.

*Raimondi, P.T, R. Sagarin, R. Ambrose, M. George, S. Lee, D. Lohse, C.M. Miner, S. Murray and C. Roe. Color change and consistency in the sea star *Pisaster ochraceus*. Western Society of Naturalists Annual Symposium, Rohnert Park, California, November 5-9, 2004.

Sagarin, R., R. Ambrose, B. Becker, J. Engle, S. Murray, P. Raimondi and D. Richards. Using monitoring to study unpredictable, high impact events: effects of human collection of the intertidal limpet *Lottia gigantea*. Western Society of Malacologists, Ensenada, Baja California, Mexico, June 24-28, 2004.

*Sagarin R., R. Ambrose, B. Becker, J. Engle, S. Murray, P. Raimondi and D. Richards. Using monitoring to study unpredictable, high impact events: effects of human collection of the intertidal limpet *Lottia gigantea*. CEA-CREST Annual Environmental Science Conference, Pasadena, California, May 2004.

Washburn, L., C. Blanchette, C.N. Cudaback, B.M. Emery and C. Gotschalk. Poleward flow events around Point Conception, California: An analysis based on HF radar and moored time series. Fall AGU Meeting, San Francisco, California, December 13-17, 2004.

Washburn, L., J.C. Ohlmann, M.M. Nishimoto, C. Blanchette and B.M. Emery. Some Applications of Current-Measuring, High Frequency Radars on the Southern-Central California Coast. Fifth International Radiowave Oceanography Workshop, Costanoa Lodge, Pescadero, California, May 4-6, 2005.

* Research presentations given before 2004 not included in previous annual reports

CURRICULUM VITAE

RICHARD F. AMBROSE
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Los Angeles, CA

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

Education:

B.S.	University of California, Irvine	1975
Ph.D.	University of California, Los Angeles	1982

Positions:

2000-present	Professor, Environmental Science and Engineering Program, Department of Environmental Health Sciences, University of California, Los Angeles
1998-present	Director, Environmental Science and Engineering Program, UCLA
1992-2000	Associate Professor, Environmental Science and Engineering Program, Department of Environmental Health Sciences, UCLA
1991-present	Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
1985-1991	Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
1983-1984	Postdoctoral Fellow, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C., Canada
1982	Visiting Lecturer, Department of Biology, University of California, Los Angeles
1976-1981	Teaching Assistant, Department of Biology, University of California, Los Angeles

Major Research Interests:

- Restoration ecology, especially for coastal marine and estuarine environments
- Development and scientific evaluation of mitigation techniques
- Long-term ecological monitoring
- Development of habitat valuation techniques
- Ecology of artificial and natural reefs
- Ecology of Coastal wetlands and estuaries
- Marine ecology
- Interface between environmental biology and resource management policy

Selected Publications:

Shuman, C.S., G. Hodgson, and R.F. Ambrose. 2004. Managing the Marine Aquarium Trade: Is Eco-Certification the Answer? *Environmental Conservation* **31**(4):339-348.

Vance, R.R., R.F. Ambrose, S.S. Anderson, S. MacNeil, T. McPherson, I. Beers and T.W. Keeney. 2003. Effects of sewage sludge on the growth of potted salt marsh plants exposed to natural tidal inundation. *Restoration Ecology* **11**:155-167.

Shuman, C.S. and R.F. Ambrose. 2003. A comparison of remote sensing and ground-based methods for monitoring wetland restoration success. *Restoration Ecology* **11**:325-333.

Page, H.M., S. Schroeter, D. Reed, R.F. Ambrose, J. Callaway and J. Dixon. 2003. An inexpensive method to identify the elevation of tidally inundated habitat in coastal wetlands. *Bulletin of the Southern California Academy of Sciences* **102**:130-142.

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Cohen, T., S.S. Que Hee and R.F. Ambrose. 2001. Comparison of trace metal concentrations in fish and invertebrates in three Southern California wetlands. *Marine Pollution Bulletin* **42**:224-232.

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Stein, E.D. and R.F. Ambrose. 2001. Landscape-scale analysis and management of cumulative impacts to riparian ecosystems: past, present and future. *Journal of American Water Resources Association* **37**(6):1597-1614.

Ambrose, R.F. 2000. Wetland mitigation in the United States: Assessing the success of mitigation policies. *Wetlands* (Australia) **19**:1-27.

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Lafferty, K., C. Swift and R.F. Ambrose. 1999. Extirpation and recovery of local populations of the endangered tidewater goby, *Eucyclogobius newberryi*. *Conservation Biology* **13**:1447-1453.

Stein, E.D. and R.F. Ambrose. 1998. A rapid impact assessment method for use in a regulatory context. *Wetlands* **18**:379-392.

Ambrose, R.F. 1997. Ecological value in restored coastal ecosystems. Pp. 67-86 *in* Saving the Seas: Values, Scientists, and International Governance, L.A. Brooks and S.D. VanDeveer, editors. Maryland Sea Grant College, College Park, MD.

Dunaway, M.E., R.F. Ambrose, J. Campbell, J.M. Engle, M. Hill, Z. Hymanson, and D. Richards. 1997. Establishing a Southern California rocky intertidal monitoring network. Pp. 1278-1294. *in* California and the World Ocean '97, O.T. Magoon, H. Converse, B. Baird, and M. Miller-Henson, editors. American Society of Civil Engineers, Reston, Virginia.

Engle, J.M., R.F. Ambrose, and P.T. Raimondi. 1997. Synopsis of the Interagency Rocky Intertidal Monitory Network Workshop. Final Report, OCS Study MMS 97-0012. U.S. Minerals Management Service, Pacific OCS Region. 18p.

Palmer, M.A., N.L. Poff, and R.F. Ambrose. 1997. Ecological theory and community restoration ecology. *Restoration Ecology* 5:291-300.

ANDREW J. BROOKS
Department of Ecology, Evolution and Marine Biology
University of California
Santa Barbara, CA

Projects: *Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell Us?*
Relative importance of POCS oil platforms on the population dynamics of two reef fishes in the Eastern Santa Barbara Channel

Education:

B.A.	Biology with Marine Emphasis, Occidental College	1984
Certificate	Aquatic Biology and Fisheries Management, University College of North Wales, U.K.	1987
M.A.	Biological Sciences, University of California, Santa Barbara	1993
Ph.D.	Ecology, Evolution and Marine Biology, University of California, Santa Barbara	1999

Positions:

2004 –Present	Deputy Director, Moorea Coral Reef LTER, University of California
2001-Present	Director, Carpinteria Salt Marsh Reserve, University of California
1999-Present	Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
1998-Present	Lecturer, Dept. of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1998-1999	Post-Doctoral Researcher, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1998	Teaching Associate, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1990-1998:	Research Assistant, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1988-89	Instructor, Department of Physics, Los Angeles Valley College
1988-91	Instructor, Department of Biology, Occidental College
1987-89	Marine Ecologist and Project Leader, Vantuna Research Group, Occidental College
1984-86	Marine Ecologist, Vantuna Research Group, Occidental College

Grants and Awards:

2002-2005	W.M. Keck Foundation
2002-2004	Minerals Management Service CMI Project Award
2001-2004	US Environmental Protection Agency
2001	Member, American Institute of Fishery Research Biologists
1997-2001	Minerals Management Service CMI Project Award
1997	University Award of Distinction, University of California, Santa Barbara
1995-1999	UC TSR&TP Fellowship, University of California, Santa Barbara
1994-1996	Mildred Mathias Grant, University of California, Santa Barbara
1994-1996	Crocker Grant
1994-1995	Continuing Graduate Student Fellowship, University of California, Santa Barbara

Selected Publications:

Brooks, A.J., S.J. Holbrook, and R.J. Schmitt. Patterns of Microhabitat Use by Fishes in the Patch-forming Coral *Porites rus*. *Raffles Bulletin of Zoology*. (submitted).

Morgan, S.G., S. Spilseth, H.M. Page, T. Grosholz, and A. J. Brooks. Spatial and temporal movement patterns of the lined shore (*Pachygrapsus crassipes*) and its utility as an indicator of habitat condition. *Marine Ecological Progress Series*. (submitted).

Anderson, S.L., G.N. Cherr, S.G. Morgan, C.A. Vines, R.M. Higashi, W.A. Bennett,W.L. Rose, A.J. Brooks and R.M. Nisbet. Integrating contaminant responses in indicator saltmarsh species. (submitted).

Holbrook, S.J., A.J. Brooks, and R.J. Schmitt. Relationships between Live Coral Cover and Reef Fishes: Implications for Predicting Effects of Environmental Disturbances. Proceedings of the 10th International Coral Reef Symposium. (in press).

Brooks, A. J., R.J. Schmitt, and S. J. Holbrook. Parallel changes observed across several trophic levels suggest a common response by marine communities to short-term climate change. *Ecology Letters* (in prep).

Swearer, S. E., G.E. Forrester, M.A. Steele, A.J. Brooks, and D.W. Lea. Spatio-temporal and interspecific variation in otolith trace-elemental fingerprints in a temperate estuarine fish assemblage. *Estuarine, Coastal and Shelf Science* (in press).

Holbrook, S.J., A.J. Brooks, and R. J. Schmitt. 2002. Are fish assemblages on coral patch reefs predictable? *Marine and Freshwater Research* **53** (2):181-188.

Brooks, A.J., R.J. Schmitt, and S. J. Holbrook. 2002. Declines in regional fish populations: have different species responded similarly to environmental change? *Marine and Freshwater Research* **53** (2):189-198.

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Brooks, A.J. 1999. Factors Influencing the Structure of an Estuarine Fish Community: The Role of Interspecific Competition. Ph.D. Dissertation. University of California, Santa Barbara, 219 pp.

Nisbet, R.M., E.B. Muller, A.J. Brooks, and P. Hosseini. 1997. Models relating individual and population response to contaminants. *Environmental Modeling and Assessment* **2**:7-12.

Love, M.S., A.J. Brooks, and J.R.R. Ally. 1996. An analysis of the commercial passenger fishing vessel fisheries for kelp and barred sand basses (*Paralabrax clathratus* and *P. nebulifer*) in the Southern California Bight. *California Fish and Game* **82**:105-121.

Nisbet, R.M., A.H. Ross, and A.J. Brooks. 1996. Empirically-based dynamic energy budget models: theory and an application to ecotoxicology. *Nonlinear World* **3**:85-106.

Love, M.S., A.J. Brooks, D. Busatto, J. Stephens Jr., and P. Gregory. 1996. Aspects of the life histories of the kelp bass and barred sand bass (*Paralabrax clathratus* and *P. nebulifer*) from the Southern California Bight. *Fisheries Bulletin* **94**:472-481.

Love, M.S., J. Hyland, A. Ebeling, T. Herrlinger, A.J. Brooks, and E. Imamura. 1994. A pilot study of the distribution and abundance of rockfishes in relation to natural environmental factors and an offshore oil and gas production platform off the coast of Southern California. *Bulletin Marine Science* **55**:1062.-1085.

Love, M.S. and A.J. Brooks. 1990. Size and age at first maturity of the California halibut, *Paralichthys californicus*, in the Southern California Bight. Pp. 167-174 in: *The California halibut*, *Paralichthys californicus, resource and fisheries. California Fish and Game Fisheries Bulletin*.

Love, M.S., B. Axell, P. Morris, R. Collins, and A.J. Brooks. 1987. Life history and fishery of the California scorpionfish, *Scorpaena guttata*, within the Southern California Bight. *Fisheries Bulletin* **85**:99-116.

Brooks, A.J. 1987. Two species of Kyphosidae seen in King Harbor, Redondo Beach, California. *California Fish and Game* **73**:49-61.

DOUGLAS S. BUSH
Marine Science Institute
University of California
Santa Barbara, CA

Project: *Population Genetics of Surfgrass (Phyllospadix torreyi) for Use in Restoration*

Education:	B.A.	Botany, University of Hawaii	1974
	M.S.	Plant Physiology, UC Berkeley	1979
	Ph.D.	Plant Physiology, UC Berkeley	1983

Positions:	2003-Present	Academic Coordinator, UC Santa Barbara
	1998-2003	Associate Research Biologist, Marine Science Institute, UC Santa Barbara
	1998-2003	Adjunct Associate Professor, Dept. of Ecology, Evolution, and Marine Biology, UC Santa Barbara
	1990-1997	Assistant/Associate Professor, Rutgers University, Dept. of Biological Sciences
	1989-1990	Assistant Research Botanist, UC Berkeley, Dept. of Botany
	1984-1989	Postdoctoral Associate, UC Berkeley, Dept. of Botany
	1979-1983	Research Associate, UC Berkeley, Dept. of Plant and Soil Biology
	1977-1979	Statistician, UC Berkeley, Dept. of Plant and Soil Biology

Research Interests:

Genetics of natural plant populations, Evolutionary Genetics, Plant cell biology, cell calcium and transduction of hormonal signals. Membrane transport events induced by plant growth regulators. Programmed cell death.

Awards: Henry Rutgers Fellow, 1990
EMBO Workshop Fellowship, Patch Clamp Techniques, Göttingen, West Germany, 1987
Presidents Fellowship, University of California, Berkeley, 1980-1981

Selected Publications:

Rodriguez, M.T. and D.S. Bush. 1999. Gibberellin-induced cell death in the wheat aleurone. *Plant Physiology* (submitted).

Silverman, P., A. Assiahmah, and D.S. Bush. 1998. Cytokinin action in root hairs of *Medicago sativa*. *Planta* **205**:25-31.

Subbaiah, C., D.S. Bush, and M. Sachs. 1998. Mitochondria contribution to the anoxic Ca^{2+} signal in maize suspension-cultured sells. *Plant Physiology* **118**:759-771.

Thompson, M.D., D.S. Bush, and L.E. Bello. 1997. Possible Wilson's disease: A case presentation. *Archives of Clinical Neuropsychology* **12**(4):416-416.

Bush, D.S. 1996. Effects of gibberellic acid and environmental factors on cytosolic calcium in wheat aleurone cells. *Planta*. **199**:89-99.

Kuo, A., S. Cappellutti, M.Cervantes-Cervantes, M. Rodriquez, and D.S. Bush. 1996. Okadaic acid, a protein phosphatase inhibitor, blocks calcium changes, gene expression and cell death induced by gibberellin in wheat aleurone. *The Plant Cell* **8**:259-269.

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Drøbak, B.K., D.S. Bush, R.L. Jones, A.P. Dawson, and I.B. Ferguson. 1992. Analysis of calcium involvement in host-pathogen interactions. In: Gurr, S.J., M.J. McPherson, and D.J. Bowles eds. "Molecular Plant Pathology: A Practical Approach". Vol. II, pp. 159-194. IRL Press at Oxford University Press, Cambridge.

Arnalte, M.E., M.J. Cornejo, D.S. Bush, and R.L. Jones. 1991. The effect of gibberellic acid on the lipid composition of barley aleurone protoplasts. *Plant Science* **77**:223-232.

Bush, D.S., L. Sticher, and R.L. Jones. 1991. Gibberellic acid-regulated α-amylase synthesis and calcium transport in the endoplasmic reticulum of barley aleurone cells. In: "Gibberellins: Tokyo 1989". pp. 106-113.

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Bush, D.S. and R.L. Jones. 1990. Measuring intracellular Ca^{2+} levels in plant cells using the fluorescent probes, indo-1 and fura-2: progress and prospects. *Plant Physiology* **93**:841-845.

DuPont, F.M., D.S. Bush, J.J. Windle, and R.L. Jones. 1990. Calcium and proton transport in membrane vesicles from barley roots. *Plant Physiology* **94**:179-188.

Hillmer, S., D.S. Bush, D.G. Robinson, I. Zingen-Sell, and R.L. Jones. 1990. Endomembrane structure and function in barley aleurone protoplasts. *European Journal of Cell Biology* **52**:169-173.

Sticher, L., A.K. Biswas, D.S. Bush, and R.L. Jones. 1990. Heat shock inhibits α-amylase synthesis in barley aleurone without inhibiting the activity of endoplasmic reticulum marker enzymes. *Plant Physiology* **92**:506-513.

JAMES J. CHILDRESS
Department of Ecology, Evolution and Marine Biology
University of California
Santa Barbara, CA

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

Education:	B.A.	Biological Sciences, Wabash College	1964
	Ph.D.	Physiology, Stanford University	1969

Positions: 1969-present Professor, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, California.

Selected Publications:

Felbeck, H., C. Arndt, U. Hentschel, and J.J. Childress. 2004. Experimental application of vascular and coelomic catheterization to identify vascular transport mechanisms for inorganic carbon in the vent tubeworm, *Riftia pachyptila*. *Deep-Sea Research* **51**:401-411.

Childress, J.J., C.R. Fisher, H. Felbeck, and P. Girguis. 2003. On the edge of a deep biosphere: Real animals in extreme environments. *American Geophysical Union* volume on the subsurface biosphere. (in press)

Girguis, P.R., J.J. Childress, J.K. Freytag, K. Klose, and R. Stuber. 2002. Effects of metabolite uptake on proton-equivalent elimination by two species of deep-sea vestimentiferan tubeworm, *Riftia pachyptila* and *Lamellibrachia cf luymesi*: proton elimination is a necessary adaptation to sulfide-oxidizing chemoautotrophic symbionts. *Journal of Experimental Marine Biology and Ecology* **205**(19):3055-3066.

Freytag, J.K., P.R. Girguis, D.C. Bergquist, J.P. Andras, J.J. Childress, and C.R. Fisher. 2001. A paradox resolved: Sulfide acquisition by roots of seep tubeworms sustains net chemoautotrophy. *P National Academy of Science USA* **98**(23):13408-13413.

Goffredi, S.K., and J.J. Childress. 2001. Activity and inhibitor sensitivity of ATPases in the hydrothermal vent tubeworm *Riftia pachyptila*: a comparative approach. *Marine Biology* **138**(2):259-265.

Chevaldonne, P., C.R. Fisher, J.J. Childress, D. Desbruyeres, D. Jollivet, F. Zal, and A. Toulmond. 2000. Thermotolerance and the 'Pompeii worms'. *Marine Ecology Progress Series* **208**:293-295.

Girguis, P.R., R.W. Lee, N. Desaulniers, J.J. Childress, M. Pospesel, H. Felbeck, and F. Zal. 2000. Fate of nitrate acuired by the tubeworm *Riftia pachyptila*. *Applied and Environmental Microbiology* **66**:2783-2790.

Janssens, B.J., J.J. Childress, F. Baguet, Rees, J.F. 2000. Reduced enzymatic antioxidative defense in deep-sea fish. *Journal of Experimental Biology* **203**(24):3717-3725.

Seibel, B.A. and J.J. Childress. 2000. Metabolism of benthic octopods (Cephalopoda) as a function of habitat depth and oxygen concentration. *Deep-Sea Research Part I Oceanographic Research Papers* **47**(7):1247-1260.

Seibel, B.A., E.V. Thuesen, and J.J. Childress. 2000. Light-limitation on predator-prey interactions: Consequences for metabolism and locomotion of deep-sea cephalopods. *Biological Bulletin* **198**(2):284-298.

Zal, F., B.N. Green, P. Martineu, F.H. Lallier, A. Toulmond, S.N. Vinogradov, and J.J. Childress. 2000. Polypeptide chain composition diversity of hexagonal-bilayer haemoglobins within a single family of annelids, the Alvinellidae. *European Journal Biochemistry* **267**(16):5227-5236.

Zal, F., E. Leize, D.R. Oros, S. Hourdez, A. Van Dorsselaer, and J.J. Childress. 2000. Haemoglobin structure and biochemical characteristics of the sulphide-binding component from the deep-sea clam *Calyptogena magnifica* . *Cahiers de Biologie Marine* **41**(4):413-423.

Goffredi, S.K., J.J. Childress, F.H. Lallier, and N.T. Desaulniers. 1999. The internal ionic composition of the hydrothermal vent tubeworm Riftia pachyptila; evidence for the accumulation of SO_4^{2-} and H^+ and for a Cl^- /HCO^{3-} shift. *Physiological and Biochemical Zoology* **72**:296-306.

Goffredi, S.K., P.R. Girguis, J.J. Childress, and N.T. Desaulniers. 1999. The physiological functioning of carbonic anhydrase in the hydrothermal vent tubeworm *Riftia pachyptila*. *Biological Bulletin* **196**:257-264.

Shillito, B., J. Ravaux, F. Gaill, J. Delachambre, E. Thiebaut, and J.J. Childress. 1999. Preliminary data on carbon production of deep-sea vent tubeworms. *Marine Ecology Progress Series* **183**:275-279.

Childress, J.J. and B.A. Seibel. 1998. Life at stable low oxygen: Adaptations of animals to oceanic oxygen minimum layers. *Journal of Experimental Biology* **201**:1223-1232.

Girguis, P.R. and J.J. Childress. 1998. H+ equivalent elimination by the tube-worm *Riftia pachyptila*. *Cahiers de Biologie Marine* **39**(3-4):295-296.

Goffredi, S.K., J.J. Childress, F.H. Lallier, and N.T. Desaulniers. 1998. How to be the perfect host: CO_2 and HS^- accumulation and H^+ elimination in the hydrothermal vent tube-worm *Riftia pachyptila*. *Cahiers de Biologie Marine* **39**(3-4):297-300.

Ravaux, J., B. Shillito, F. Gaill, L. Gay, M.F. Voss-Foucart, and J.J. Childress. 1998. Tube synthesis and growth processes in the hydrothermal vent tube-worm *Riftia pachyptila*. *Cahiers de Biologie Marine* **39**(3-4):325-326.

Thuesen, E.V., C.B. Miller, and J.J. Childress. 1998. Ecophysiological interpretation of oxygen consumption rates and enzymatic activities of deep-sea copepods. *Marine Ecology Progress Series* **168**:95-107.

Zal, F., E. Leize, F.H. Lallier, A. Toulmond, A.V. Dorsselaer, and J.J. Childress. 1998. S-sulfohemoglobin and disulfide-exhange: The mechanisms of sulfide-binding by *Riftia pachyptila* hemoglobins. *Proceedings of the National Academy of Sciences* **95**:8997-9002.

Goffredi, S.K., J.J. Childress, N.T. Desaulniers, and F.H. Lallier. 1997. Sulfide uptake by the hydrothermal vent tubeworm *Riftia* is via diffusion of HS^-, rather than H_2S. *Journal Experimental Biology* **200**:2609-2616.

Goffredi, S.K., J.J. Childress, N.T. Desaulniers, R.W. Lee, F.H. Lallier, and D. Hammond. 1997. Inorganic carbon acquisition by hydrothermal vent tubeworm *Riftia pachyptila* depends upon high external PCO_2 and on proton equivalent ion transport by the worm. *Journal of Experimental Biology* **200**:883-896.

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Lee, R.W. and J.J. Childress. 1994. Assimilation of inorganic nitrogen by marine invertebrates and their chemoautotrophic and methanotrophic symbionts. *Applied and Environmental Microbiology* **60**:1852-1858.

Childress, J.J., C.R. Fisher, J.A. Favuzzi, A.J. Arp and D.R. Oros. 1993. The role of a zinc-based, serum-borne sulphide-binding component in the uptake and transport of dissolved sulphide by the chemoautotrophic symbiont containing clam *Calyptogena elongate*. *Journal of Experimental Biology* **179**:131-158.

Childress, J.J., R.W. Lee, N.K. Sanders, H. Felbeck, D. Oros, A. Toulmond, D. Desbruyères, J. Brooks, and M.C. Kennicutt II. 1993. Inorganic carbon uptake in hydrothermal vent tubeworms facilitated by high environmental pCO_2. *Nature* **362**:147-149.

Childress, J.J. and C.R. Fisher. 1992. The biology of hydrothermal vent animals: physiology, biochemistry, and autotrophic symbioses. *Oceanography and Marine Biology: an Annual Review* **30**:337-441.

JORDAN CLARK
Department of Geological Sciences
Program of Environmental Studies
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Projects: *Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSOS-HYS).*
Oil Slicks in the Ocean: Predicting their Release PointsUsing the Natural Laboratory of the Santa Barbara Channel.

Education:	B.S.	Yale University, New Haven, Connecticut	1988
	M.A.	Columbia University, New York City, New York	1991
	Ph.D.	Columbia University, New York City, New York	1995

Positions:	2002-present	Associate Professor, Dept. of Geological Sciences and Program of Environmental Studies, University of California, Santa Barbara
	1996-2002	Assistant Professor, Dept. of Geological Sciences and Program of Environmental Studies, University of California, Santa Barbara
	1995 -1996	Post-doctoral Fellowship, Isotope Hydrology Group, Lawrence Livermore National Laboratory
	1989-1995	Graduate Research Assistant, Columbia University

Selected Publications:

Avisar, D. and J.F. Clark. Evaluating ground water flow beneath an artificial recharge pond using sulfur hexafluoride. *Environmental and Engineering Geoscience*. (submitted).

Cook, P.G., T. Stieglitz and J.F. Clark. Quantifying groundwater discharge to the Burdekin River, northeastern Australia, using dissolved gas tracers 222Rn and SF6. *Water Resources Research*. (submitted).

Clark, J.F. and T. Stieglitz. 2.2.2 Isotope and Tracer Techniques. In: Submarine Groundwater, ed. Zektser, I., Lewis Press (submitted).

Rademacher, L.K., J.F. Clark, D.W. Clow, and G.B. Hudson. 2005. Old groundwater influence on stream hydrochemistry and catchment response in a small Sierra Nevada catchment: Sagehen Creek, California. *Water Resources Research* **41**:W02004, doi:10.1029/2003WR002805.

Clark, J.F., G.B. Hudson, and D. Avisar. 2005. Gas transport below artificial recharge ponds: Insights from dissolved noble gases and a dual gas (SF6 and 3He) tracer experiment. *Environmental Science and Technology* **39**:3939-3945.

Washburn, L., J.F. Clark, and P. Kyriakidis. 2005. The spatial scales, distribution, and intensity of natural marine hydrocarbon seeps near Coal Oil Point, California. *Marine and Petroleum Geology* **22**:569-578.

Luyendyk, B.P., J.P. Kennett, and J.F. Clark. 2005. Hypothesis for increased atmospheric methane input from hydrocarbon seeps on exposed continental shelves during glacial low sea level. *Marine and Petroleum Geology* **22**:591-596.

Clark, J. F., G.B. Hudson, M.L. Davisson, G. Woodside, and R. Herndon. 2004. Geochemical imaging of flow near an artificial recharge facility, Orange County, CA. *Ground Water* **42**:167-174.

Cook, P.G., T. Stieglitz, and J.F. Clark. 2004. Groundwater discharge from the Burdekin Floodplain aquifer, North Queensland. CSIRO Land and Water Technical Report N. **26**(04), 118 p.

Leifer, I., J.R. Boles, B.P. Luyendyk, and J.F. Clark. 2004. Transient discharges from marine hydrocarbon seeps: Spatial and temporal variability. *Environmental Geology* **46**:1038-1052.

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

Education:	B.A.	Zoology, University of California, Los Angeles	1974
	Ph.D.	Biology, University of California, Santa Cruz	1977

Positions:	1996	Elected Fellow of the California Academy of Sciences
	1995-Present	Associate Director of the Institute of Marine Sciences, University of California, Santa Cruz, CA
	1995-Present	Editorial Board of Physiological Zoology
	1993-Present	Professor of Biology, University of California, Santa Cruz, CA
	1991-1993	Associate Professor of Biology, University of California, Santa Cruz, CA
	1991-1993	Scientific Officer, Physiology and Marine Mammal Biology, Office of Naval Research
	1987 & 1989	ASEE Senior Faculty Fellow, NOSC, US Navy, Hawaii
	1985 & 1987	Visiting Scientist, British Antarctic Survey, Cambridge, England
	1979-1982	National Institutes of Health Postdoctoral Fellowship, Scripps Institution of Oceanography, San Diego, CA

Selected Publications:

Burns, J.M., D.P. Costa, M.A. Fedak, C.J.A. Bradshaw, M.A. Hindell, N. Gales, G. McDonald, S.J. Trumble, and D.E. Crocker. Winter habitat use and foraging behavior of crabeater seals along the Western Antarctic Peninsula. *Deep Sea Research* (in press).

Crocker, D.E., D.P. Costa, B.J. Le Boeuf, P.M. Webb, and D.S. Houser. Impact of El Niño on the foraging behavior of female northern elephant seals. *Marine Ecology Progress Series* (in press).

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Fish, F.E., J. Hurley, and D.P. Costa. 2003. Maneuverability by the sea lion *Zalophus californianus* : turning performance of an unstable body design. *Journal of Experimental Biology* **206**:667-674.

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Weimerskirch, H., T. Guionnet, J. Martin, S.A. Shaffer, and D.P. Costa. 2000. Fast and fuel efficient? Optimal use of wind by flying albatrosses. *Proceedings of the Royal Society of London B* **267**: 1869-1874.

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Projects: *Joint UCSB-MMS Pacific OCS Student Internship and Trainee Program*
Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products
Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species

Education:

A.A.	Liberal Arts, De Anza Junior College, Cupertino, CA	1977
B.A.	Aquatic Biology, University of California, Santa Barbara	1980
Ph.D.	Biology, University of California, Santa Barbara	1990

Positions:

2003-present	Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
1991-2004	Lecturer, Environemntal Studies Program and Deptarment of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1995-2003	Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
1990-1995	Postdoctoral Researcher, Marine Science Institute, University of California, Santa Barbara
1994	Postdoctoral Fellow, Department of Marine Science, University of Otago, New Zealand
1993	Postdoctoral Fellow, Department of Zoology, University of Port Elizabeth, Republic of South Africa
1988-1993	Marine Biologist, Cooperative Park Science Unit, University of California, Davis, Channel Islands National Park, Ventura, CA

Selected Publications:

Bram, J.B., H.M. Page and J.E. Dugan. 2005. Spatial and temporal variability in early successional patterns of an invertebrate assemblage at an offshore oil platform. *Journal of Experimental Marine Biology and Ecology* **317**:223-237.

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	M.S.	Zoology, Washington State University	1969
	Ph.D.	Biological Sciences/Statistics, University of Arizona	1974

Positions:	1984-present	Supervisory Zoologist, GM-486/15, California Science Center, National Biological Service, Santa Cruz, California
	1978-pressent	Adjunct Professor, Biological Sciences, University of California, Santa Cruz
	1979-present	Research Biologist, Institute for Marine Sciences, University of California, Santa Cruz
	1978-1981	Wildlife Biologist (Research), GS-486/12, Marine Mammal Section, National Fish and Wildlife Laboratory, FWS, Santa Cruz, California
	1977-1978	Wildlife Biologist (Research), GS-486/12, Marine Mammal Section, National Fish and Wildlife Laboratory, FWS, Anchorage, Alaska
	1974-1977	Wildlife Biologist (Research), GS-486/11, Marine Mammal Section, National Fish and Wildlife Laboratory, FWS, Anchorage, Alaska

Selected Publications:

Estes, J.A., M.T. Tinker, A.M. Doroff and D. Burn. 2005. Continuing decline of sea otter populations in the Aleutian archipelago. *Marine Mammal Science* **21**:169-172.

Croll, D.A., J.L. Maron, J.A. Estes, E.M. Danner and G.V. Byrd. 2005. Introduced predators transform subarctic islands from grassland to tundra. *Science* **307**:1959-1961.

Estes, J.A. 2005. Carnivory and trophic connectivity in kelp forests. Pages 61-81 *in* J.C. Ray, K.H. Redford, R.S. Steneck, and J. Berger (editors). Large carnivores and the conservation of biodiversity. Island Press, Washington, D.C., USA

Estes, J.A., E.M. Danner, D.F. Doak, B. Konar, A.M. Springer, P.D. Steinberg, M.T. Tinker and T.M. Williams. 2004. Complex trophic interactions in kelp forest ecosystems. *Bulletin of Marine Sciences* **74**:621-638.

Gerber, L.R., M.T. Tinker, D. F. Doak, J.A. Estes and D.A. Jessup. 2004. Mortality sensitivity in life-stage population analysis: a case study of southern sea otters. *Ecological Applications* **14**:1554-1565.

Golet, G.H., J.A. Schmutz, D.B. Irons and J.A. Estes. 2004. Mechanistic determinants of reproductive costs in a long-lived seabird: a multiyear experimental study of the blacklegged kittiwake. *Ecological Monographs* **74**:353-372.

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Williams, T.M., J.A. Estes, D.F. Doak and A.M. Springer. 2004. Killer appetites: assessing the role of predators in ecological communities. *Ecology* **85**:3373-3384.

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Soulé, M.E., J.A. Estes, B. Miller and D.A. Honnold. 2004. Strongly interacting species: conservation policy, management, and ethics. *BioScience* **55**:168-176.

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Carr, M., J. Neigel, S. Andelman, J. Estes, R. Warner, J. Largier and J. Lubchenco. 2003. Comparing marine and terrestrial ecosystems: implications for principles of reserve design in marine systems. *Ecological Applications* **13**:S90-S106.

Steneck, R. S., M.H. Graham, B.J. Bourque, D. Corbett, J.M. Erlandson, J.A. Estes and M.J. Tegner. 2003. Kelp forest ecosystem: biodiversity, stability, resilience and future. *Environmental Conservation* **29**:436-459.

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Soulé, M.E., J.A. Estes, J. Berger and C. Martinez del Rio. 2003. Recovery goals for ecologically effective numbers of endangered keystone species. *Conservation Biology* **17**:1238-1250.

Hanni, K.D., J.A.K. Mazet, F.M.D. Gulland, J.A. Estes, M. Staedler, M.J. Murray and D.A. Jessup. 2003. Clinical pathological values and assessment of pathogen exposure in southern and Alaskan sea otters. *Journal of Wildlife Disease* **39**:837-850.

Konar, B., and J.A. Estes. 2003. The stability of boundary regions between kelp beds and deforested areas. *Ecology* **84**:174-185.

Estes, J.A. 2003. From killer whales to kelp: food web complexity in kelp forest ecosystems. *Wild Earth* **4**:24-28.

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Gelatt, T.S., D.B. Siniff, and J.A. Estes. 2002. Activity patterns and time budgets of the declining sea otter population at Amchitka Island, Alaska. *Journal of Wildlife Management* **66**(1):29-39.

Schroeter, S.C., D.C. Reed, D.J. Kushner, J.A. Estes, and D.S. Ono. 2001. The use of marine reserves in evaluating the dive fishery for the warty sea cucumber (*Parastichopus parvimensis*) in California, USA. *Canadian Journal of Fisheries and Aquatic Sciences* ***58***(9):1773-1781.

Jackson, J.B.C., M.X. Kirby, W.H. Berger, et al. 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* **293**(5530):629-638.

Monson, D.H., J.A. Estes, J.L. Bodkin, D.B. Siniff. 2000. Life history plasticity and population regulation in sea otters. *Oikos* **90**(3):457-468.

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Paddack, M., and J.A. Estes. 2000. Comparison of kelp forest fish populations inside and outside of marine reserves in central California. *Ecological Applications* **10**(3):855-870.

Estes, J.A. and C.H. Peterson. 2000. Marine ecological research in seashore and seafloor systems: accomplishments and future directions. *Marine Ecology Progress Series* **195**:281-289.

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Observing the Surface Circulation Along the South-Central California Coast Using High Frequency Radar: Consequences for Larval and Pollutant Dispersal
Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products

Education:

B.S.	Biology, University of California, Irvine	1977
Ph.D.	Ecology, Oregon State University	1982

Positions:

1997-present	Director, Marine Science Institute, University of California, Santa Barbara
1994-present	Associate Professor, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA
1993-1994	Associate Professor, Brown University, Providence, RI
1987-1993	Assistant Professor, Brown University, Providence, RI
1986-1987	Research Associate, Brown University, Providence, RI
1982-1986	Postdoctoral Fellow, Stanford University, Stanford, CA

Selected Publications:

Kinlan, B. and S.D. Gaines. 2003. A comparative analysis of dispersal scales in marine and terrestrial systems. *Ecology*. In press.

Gaines, S.D., B. Gaylord, and J. Largier. 2003. Avoiding current oversights in marine reserve design. *Ecological Applications* **13(1)**: 532-546.

Allison, G., S. Gaines, J. Lubchenco, and H. Possingham. 2003. Ensuring persistence of marine reserves: Catastrophes require adopting an insurance factor. *Ecological Applications* **13(1)**: s8-s24.

Gerber, L.R., S.J. Andelman, L.W. Botsford, S.D. Gaines, A. Hastings, S.R. Palumbi, and H.P. Possingham. 2003. Population models for marine reserve design: A retrospective and prospective synthesis. *Ecological Application* **13(1)**: s47-s64.

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Botsford, L.W., A. Hastings, and S.D. Gaines. 2001. Dependence of sustainability on the configuration of marine reserves and larval dispersal distance. *Ecology Letters* **4**(2):144-150.

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Bertness, M.D., S.D. Gaines, and S.M. Yeh. 1998. Making mountains out of barnacles: the dynamics of hummock formation. *Ecology* **79**:1382-1394.

Hacker, S. and S.D. Gaines. 1997. Some implications of direct positive interactions for community species diversity. *Ecology* **78**:1990-2003.

Worcester, S. and S.D. Gaines. 1997. Quantifying hermit crab recruitment rates and larval shell selection on wave swept shores. *Marine Ecology Progress Series* **157**:307-310.

Bertness, M., S.D. Gaines, and R. Wahle. 1996. Wind-driven settlement patterns in the acorn barnacle, *Semibalanus balanoides.* *Marine Ecology Progress Series* **137**:103-110.

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Bertness, M. and S.D. Gaines. 1993. Larval dispersal and local adaptation in acorn barnacles. *Evolution* **47**:316-320.

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Bertness, M., S.D. Gaines, E. Stephens, and P. Yund. 1992. Components of recruitment in populations of the acorn barnacle *Semibalanus balanoides*. *Journal of Experimental Marine Biology and Ecology* **156**:199-215.

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Projects: *Population Genetics of Surfgrass (Phyllospadix torreyi) for Use in Restoration*
Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products

Education:

B.A.	Botany & Biology, University of California, Berkeley, CA	1983
Ph.D.	Botany, University of California, Berkeley, CA	1990

Positions:

2000-Present	Associate Professor, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA
1995-2000	Assistant Professor, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA
1993-1995	Postdoctoral Associate, Departments of Botany and Genetics, University of Georgia, Athens, GA
1992	Research Associate, Department of Genetics, University of Georgia, Athens, GA
1991	Visiting Assistant Professor of Biology, Bernard College, Columbia University, New York, NY
1983-1990	Research Associate, Research Associate, Teaching Assistantship at UC Berkeley

Awards and Honors:

2004	George Saul Lecturer, Middlebury College
1998	UCSB nominee for Packard Fellowship
1997	Regents' Junior Faculty Fellowship
1996	Regents' Junior Faculty Fellowship
1996-2000	White Mountain Research Station, Faculty Fellowship
1994	Menzel Award, Genetics Section, Botanical Society of America
1988	Distinguished Instructor, University of California, Berkeley
1987-88	Regents Fellowship, University of California, Berkeley

Selected Publications:

Whittall, J.B. and S.A. Hodges. Speciation and floral evolution in the North American *Aquilegia*: inferences from an AFLP phylogeny. (In preparation)

Hawkins, A, D.D. Kaska and S.A. Hodges. Genetic differentiation within and among islands in paleo-endemic California Island Ironwood, *Lyonothamnus floribundus*. (In preparation)

Whittall, J.B., C. Voelckel and S.A. Hodges. Convergence of floral color among species of *Aquilegia*: Gene expression patterns in the anthocyanin biosynthetic pathway. (In preparation)

Whittall, J.B., A. Medina-Marino, E.A. Zimmer and S.A. Hodges. Generating single-copy nuclear gene data in a recent adaptive radiation. Submitted to *Molecular Phylogenetics and Evolution*. (submitted)

Tucker, S.C. and S.A. Hodges 2005. Floral ontogeny of *Aquilegia, Semiaquilegia and Enemion* (Ranunculaceae). *International Journal of Plant Sciences* **166**(4):557-574.

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Yang, J.Y., B.A. Counterman, C.G. Eckert and S.A. Hodges 2005. Microsatellite markers for evolutionary studies in *Aquilegia*. *Molecular Ecology Notes* **5**:317-320.

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Taylor, D.L., T.D. Bruns, and S.A. Hodges. 2004. Evidence for mycorrhizal races in a cheating orchid. *Proceedings of the Royal Society of London, Series B* **271**:35-43.

Hodges, S.A., M. Fulton, J.Y. Yang and J.B. Whittall 2004. Verne Grant and evolutionary studies of *Aquilegia*. *New Phytologist* **161**:113-120.

Bush, D.S., D. Reed, S. Hollbrook, and S.A. Hodges. Sex-specific markers for surfgrass (*Phyllospadix torreyi*) reveal extreme female-biased sex ratios. *Molecular Ecology* (in prep).

Taylor, D.L., T.D. Bruns, T.M. Szaro, and S.A. Hodges. 2003. Divergence in mycorrhizal specialization within *Hexalectris spicata* (Orchidaceae), a non-photosynthetic desert orchid. *American Journal of Botany* **90**:1168-1179.

Whittall, J.B., E. Zimmer, A. Molina-Medino, and S.A. Hodges. 3'-UTR anchored amplification of nuclear genes: an efficient method for isolating numerous low copy nuclear introns. *Molecular Phylogenetics & Evolution* (in prep).

Yang, J. B.A. Counterman, C.G. Eckert and S.A. Hodges. Microsatellite markers for evolutionary studies in *Aquilegia*. *Molecular Ecology Notes* **5**:317-320.

Hodges, S.A., J.B. Whittall, M. Fulton, and J.Y. Yang. 2002. Genetics of floral traits influencing reproductive isolation between *Aquilegia Formosa* and *A. pubescens*. *American Naturalist* **159**: S51-S60.

Bushakra, J.M., S.A. Hodges, J.B. Cooper, and D.D. Kaska. 1999. The extent of clonality and genetic diversity in the Santa Cruz Island Ironwood *Lyonothamnus floribundus*. *Molecular Ecology* **8**:471-476 (cover photo).

Fulton, M. and S.A. Hodges. 1999. Floral isolation between *Aquilegia formosa* and *A. pubescens. Proceedings of the Royal Society of London, Series B* **266**:2247-2252

Baker, H.G., I. Baker, and S.A. Hodges. 1998. Sugar composition of nectars and fruits consumed by birds and bats in the tropics and subtropics. *Biotropica* **30**:559-586.

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Hodges, S.A. 1997. Floral nectar spurs and diversification. *International Journal of Plant Sciences* **158**:S81-S88.

Carney, S.E., S.A. Hodges, and M.L. Arnold. 1996. Effects of differential pollen-tube growth on hybridization in the Louisiana irises. *Evolution* **47**:1432-1445.

Emms, S.K., S.A. Hodges, and M.L. Arnold. 1996. Pollen-tube competition, siring success and consistent asymmetric hybridization in the Louisiana irises. *Evolution* **50**:2201-2206.

Hodges, S.A., J. Burke, and M.L. Arnold. 1996. Natural formation of iris hybrids: experimental evidence on the establishment of hybrid zones. *Evolution* **47**:2504-2509

Arnold, M.L. and S.A. Hodges. 1995. Are natural hybrids fit or unfit relative to their parents? *Trends in Ecology and Evolution* **10**:67-70.

Arnold, M.L. and S.A. Hodges. 1995. The fitness of Hybrids - A response to Day and Schluter. *Trends in Ecology and Evolution* **10**:289.

Hodges, S.A. 1995. The influence of nectar production on hawkmoth behavior, self pollination and seed production in *Mirabilis multiflora* (*Nyctaginaceae*). *American Journal of Botany* **82**:197-229.

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Education:	B.A.	Biology, Smith College	1970
	Ph.D.	Zoology, University of California, Berkeley	1975

Positions:	1987-present	Professor, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
	1981-87	Associate Professor, Department of Biological Sciences, University of California, Santa Barbara
	1975-81	Assistant Professor, Department of Biological Sciences, University of California, Santa Barbara

Selected Publications:

Holbrook, S.J. and R.J. Schmitt. 2005. Growth, reproduction and survival of a tropical sea anemone (actiniaria): benefits of hosting anemonefish. *Coral Reefs* (in press).

Bull, J.S., D.C. Reed, and S. J. Holbrook. 2004. An experimental evaluation of different methods of restoring *Phyllospadix torreyi* (Surfgrass). *Restoration Ecology* **12**:70-79.

Holbrook, S. J. and R. J. Schmitt. 2004. Population dynamics of a damselfish: effects of a competitor that also is an indirect mutualist. *Ecology* **85**:979-985.

Schmitt, R. J. and S. J. Holbrook. 2003. Mutualism can mediate competition and promote coexistence. *Ecology Letters* **6**:898-902.

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Holbrook, S.J. and R. J. Schmitt. 2003. Spatial and temporal variation in mortality of newly settled damselfish: patterns, causes and co-variation with settlement. *Oecologia* **135**:532-541.

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Schmitt, R.J., S.J. Holbrook, and C.W. Osenberg. 1999. Quantifying the effects of multiple processes on local abundance: A cohort approach for open populations. *Ecology Letters* **2**:294-303.

Holbrook, S.J. and R.J. Schmitt. 1998. Have field experiments aided in the understanding of abundance and dynamics of reef fishes? Pages 152-169 *in* Issues and Perspectives in Experimental Ecology, W.J. Resetarits and J. Bernado editors. Oxford University Press, Oxford, England.

Reed, D.C., S.J. Holbrook, E. Solomon, and M. Anghera. 1998. Studies on germination and root development in the surfgrass *Phyllospadix torreyi*: Implications for habitat restoration. *Aquatic Botany* **62**:71-80.

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

Education:	B.S.	Biology, Northwestern University, Evanston, IL	1964
	Ph.D.	Pharmacology, Stritch School of Medicine, Loyola University, Chicago, IL	1971

Positions:	1995-Present	Professor of Pharmacology, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA
	1982-1995	Professor of Pharmacology, Department of Biological Sciences, University of California, Santa Barbara, CA
	1978-1982	Associate Professor of Pharmacology, Department of Biological Sciences, University of California, Santa Barbara, CA
	1974-1978	Assistant Professor of Pharmacology, Department of Biological Sciences, University of California, Santa Barbara, CA
	1971-1974	Assistant Professor of Pharmacology, Department of Pharmacology, Stritch School of Medicine, Loyola University, Chicago, IL

Selected Publications:

Ross, C., V. Vreeland, J.H. Waite, and R.S. Jacobs. 2005. Rapid assembly of a wound plug: stage one of two stage wound repair mechanism in the giant unicellular chlorophyte *Dasycladus vermicularis*. *Journal of Phycology* **40**(1):46-54.

Madari, H. and R.S. Jacobs. 2004. An ethnopharmacological stydy of medicinal plant extracts used in ancient Persian medicinal formulations. *Journal of Natural Products* **67**(8):1204-1210.

Mydlarz, L.D. and R.S. Jacobs. 2004. Inducible oxidative burst in dinoflagellates and inhibition by the marine natural products, the psuedopterosins. *Phytochemistry* **65**:3231-3241.

Santiago-Vazquez, L., L.D. Mydlarz, R.S. Jacobs, and J.G. Pavlovich. 2004. Identification of hydroxyl fatty acids by liquid chromatography-atmospheric pressure chemical ionization mass spectrometry in *Euglena gracilis*. *Journal of Chromatography B.* **803**:233-236.

Ata, A., R.G. Kerr, C.E. Moya, and R.S. Jacobs. 2003. Identification of anti-inflammatory diterpenes from the marine gorgonian *Pseudopterogorgia elisabethae*. *Tetrahedron* **59**:4215-4222.

Madari, H., D. Panda, L. Wilson, and R.S. Jacobs. 2003. Dicoumarol: A unique microtubule stabilizing natural product that is synergistic with taxol. *Cancer Research* **63**:1214-1220.

Mydlarz, L.D., R.S. Jacobs, J. Bohnlein, and R.G. Kerr. 2003. Pseudopterosin biosynthesis in *Symbiodinium* sp., the dinoflagellate symbiont of *Pseudopterogorgia elisabethae. Chemistry and Biology* **10** (Nov.):11.

Stevenson, C.S., E.A. Capper, A.K. Roshak, B. Marquez, C. Eichman, J.R. Jackson, M. Mattern, W.H. Gerwick, R.S. Jacobs, and L.A. Marshall. 2002. The identification and characterization of the marine natural product scytonemin as a novel antiproliferative pharmacophore. *Journal of Pharmacology and Experimental Therapeutics* **303**(2):858-866.

Stevenson, C.S., E.A. Capper, A.K. Roshak, B. Marquez, K. Grace, W.H. Gerwick, R.S. Jacobs, and L.A. Marshall. 2002. Scytonemin - a marine natural product inhibitor of kinases key in hyperproliferative inflammatory diseases. *Inflammation Research* **51**(2):112-114.

Bemis, D.L., V. Roussis, C. Vagias, and R.S. Jacobs. 2000. Chloroplast fatty acid composition in Mediterranean populations of the marine Chlorophyte, *Anadyomene stellata*. *Zeitschrift Fur Naturforschung C-A Journal of Biosciences* **55**(7-8):569-575.

MacPherson, J.C. and R.S. Jacobs. 2000. An 18.5 kDa protein from the amebocyte of Limulus polyphemus, homologous to the previously described amebocyte aggregation factor, expresses alternative phospholipase A(2) activity. *Comparative Biochemistry and Physiology B* **127**(1):31-44.

Mayer, A.M.S., W. Fenical, and R.S. Jacobs. 2000. The marine pseudopterosins modulate rat microglia superoxide and thromboxane generation. *FASEB Journal* **14**(8):266.

Mayer, A.M.S., S. Oh, W. Fenical, and R.S. Jacobs. 1999. *Escherichia coli* LPS-primed rat brain microglia superoxide and thromboxane B-2 generation is inhibited by the marine pseudopterosins. *Shock* **11**:58 Suppl. 1.

Pennings, S.C., V.J. Paul, D.C. Dunbar, M.T. Hamann, W.A. Lumbang, B. Novack, and R.S. Jacobs. 1999. Unpalatable compounds in the marine gastropod *Dolabella auricularia*: Distribution and effect of diet. *Journal of Chemical Ecology* **25**(4):735-755.

Qureshi, A., C.S. Stevenson, C.L. Albert, R.S. Jacobs, and D.J. Faulkner. 1999. Homo- and nor-plakotenin, new carboxylic acids from the Palauan sponge *Plakortis lita*. *Journal of Natural Products* **62**(8):1205-1207 Aug 1999.

MacPherson, J.C., J.G. Pavlovich, and R.S. Jacobs. 1998. Phospholipid composition of the granular amebocyte from the horseshoe crab, *Limulus polyphemus*. *Lipids* **33**(9):931-940.

Mayer, A.M.S., P.B. Jacobson, W. Fenical, R.S. Jacobs, and K.B. Glaser. 1998. Pharmacological characterization of the pseudopterosins: Novel anti-inflammatory natural products isolated from the caribbean soft coral, *Pseudopterogorgia elisabethae*. *Life Sciences* **62**(26):401-7.

Wylie, B.L., N.B. Ernst, K.J. Grace, and R.S. Jacobs. 1997. Marine natural products as phospholipase A_2 inhibitors. In: Progress in Surgery, Eds. W. Uhl, T.J. Nevalainen, and M.W. Büchler. Basel, Karger. **24**:146-152.

MacPherson, J.C., J.G. Pavlovich, and R.S. Jacobs. 1996. Biosynthesis of arachidonic acid metabolites in *Limulus polyphemus amebocytes*: Analysis by liquid chromatography-electrospray ionization mass spectrometry. *Biochimica et Biophysica Acta* **1303**(2):127-36.

Michailova, M.V., D.L. Bemis, M.L. Wise, W.H. Gerwick, J.N. Norris, and R.S. Jacobs. 1995. Structure and synthesis of novel conjugated polene fatty acids from the marine green alga, *Anadyomene stellate*. *Lipids* **30**:583-589.

Grace, K.J.S., D. Zavortink, and R.S. Jacobs. 1994. Inactivation of bee venom phospholipase A_2 by a sesquiterpene furanoic acid marine natural product. *Biochemical Pharmacology* **47**:1427-1434.

Marshall, L.A., J.D. Winkler, D.E. Griswold, B. Bolognese, A. Roshak, S.M. Sung, E.F. Webb, and R.S. Jacobs. 1994. Effects of scaradial, a type II phospholipase A_2 inhibitor on human neutrophil arachidonic acid mobilization and lipid media for formation. *Journal of Pharmacology and Experimental Therapeutics* **268**:709-717.

Jacobs, R.S., M.A. Bober, I. Pinto, A.B. Williams, P.B. Jacobson, and M.S. de Carvalho. 1993. Pharmacological studies of marine novel marine metabolites. In: Advances of Marine Biotechnology, Vol. 1, Plenum, NY, p. 77-99.

Mayer, A.M.S., V.J. Paul, W. Fenical, J.N. Norris, M.S. de Carvalho, and R.S. Jacobs. 1993. Phospholipase A_2 inhibitors from marine algae. *Hydrobiologia* **260**(1):1-9.

Williams, A.B. and R.S. Jacobs. 1993. A marine natural product, Patellamide D, reverses multidrug resistance in a human leukemic cell line. *Cancer Letters* **71**:97-102.

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Project: *Joint UCSB-MMS Pacific OCS Student Internship and Trainee Program*

Education:	B.S.	Mathematics, California State University, Fresno	1965
	B.A.	Geology, California State University, Fresno	1968
	M.S.	Geology, University of California	1969
	Ph.D.	Geology, Purdue University	1973

Positions:	1993-present	Chair of the Environmental Studies Program, University of California, Santa Barbara
	1976-present	Professor, Department of Geological Sciences, University of California, Santa Barbara
	1973-76	Asst. Professor, Department of Environmental Studies, University of North Carolina

Selected Publications:

Keller, E.A. 2002. Introduction to Environmental Geology, second edition, Prentice Hall, Upper Saddle River, New Jersey.

Keller, E.A., and N. Pinter. 2002. Active Tectonics, 2nd edition, Upper Saddle River. New Jersey, Prentice Hall.

Keller, E.A. 2001. Environmental Geology, 8th Edition, Upper Saddle River, New Jersey, Prentice Hall.

Keller, E.A., D.L. Johnson, D.L. Laduzinsky, D.B. Seaver, and T.L. Ku. 2000. Tectonic Geomorphology of Active Folding Over Buried Reverse Faults: San Emigdio Mountain Front, Southern San Joaquin Valley, California, *Geological Society of America Bulletin* **112**:86-97.

Botkin, D.B. and E.A. Keller. 1999. Environmental Science, 3rd Edition, New York, John Wiley and Sons, Inc.

Keller, E.A., L. Gurrola, and T.E. Tierney. 1999. Geomorphic criteria to determine direction of lateral propagation of reverse faulting and folding. *Geology* **27**:515-518.

Botkin, D.B. and E.A. Keller. 1998. *Environmental Science.* New York, John Wiley and Sons. 649 p.

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Oil Slicks in the Ocean: Predicting their Release Points Using the Natural Laboratory of the Santa Barbara Channel

Education:	B.S.	Physics/ Astronomy, SUNY at Stony Brook, New York	1984
	M.S.	Aeronomy, University of Michigan	1989
	Ph.D.	Atmospheric Sciences, Georgia Institute of Technology	1995

Positions:	2003-Present	Researcher III, Marine Science Institute and Chemical Engineering Department, University of California, Santa Barbara, CA.
	2001-2003	Researcher I, Marine Science Institute and Chemical Engineering Department, University of California, Santa Barbara, CA.
	1999-2001	Post Doctoral Researcher, Chemical Engineering Department, University of California, Santa Barbara, CA.
	1998-1999	Visiting Scientist, TNO Physics and Electronics Laboratory, The Hague, The Netherlands.
	1996-1999	Post Doctoral Researcher, Martin Ryan Institute of Marine Science, National University of Ireland, Galway, Ireland.

Selected Publications:

Leifer I. and J. Boles. 2005. Measurement of marine hydrocarbon seep flow through fractured rock and unconsolidated sediment. *Marine Petroleum Geology* (in press).

Leifer, I. and J. Boles. 2005. Turbine seep-tent measurements of marine hydrocarbon seep forcing on sub-hourly time scales. *Journal of Geophysical Research* (in press).

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Projects: *Ecological performance and trophic links: comparisons among platforms and natural reefs for selected fishes and their prey*
Relative importance of POCS oil platforms on the population dynamics of two reef fishes in the Eastern Santa Barbara Channel

Education:	B.S.	Conservation of Natural Resources, University of California, Berkeley	1986
	M.S.	Marine Sciences, Moss Landing Marine Laboratories, San Jose State University	1994
	Ph.D.	Marine Sciences, University of North Carolina at Chapel Hill	1996

Positions:	2002-Present	Assistant Professor, Donald Bren School of Environmental Science and Management, UCSB
	2001-2002	Assistant Research Biologist II, UCSB
	2001	Fishery Biologist, NOAA-National Marine Fisheries Service
	1998-2000	Postdoctoral Research, NSF, Office of Polar Programs
	1996-1997	Postdoctoral Research Associate, NRC, NOAA-National Marine Fisheries Service, Beaufort, NC
	1992-1996	Research assistant, Institute of Marine Sciences, University of North Carolina at Chapel Hill, NC
	1988-1992	Research assistant, Moss Landing Marine Laboratories, Moss Landing, CA

Grants and Awards:

2002-2004	US Minerals Management Service
1999-2000	National Geographic Society
1997-2000	National Science Foundation
1996-1997	National Marine Fisheries Service

Selected Publications:

Lenihan, H.S. and M. Adjeroud. Physical-biological coupling on coral reefs: current flow reduces coral bleaching and mortality. *Oecologia* (submitted).

Powers, S.P., C.H. Peterson, J.H. Grabowski and H.S. Lenihan. The realities of native oyster restoration and why the myth of failure intensifies a conservation crisis. *Restoration Ecology* (submitted).

Griffiths, J., M.N. Dehtier, A. Newsom, J.E. Byers, J.J. Myers, F. Oyarzun and H.S. Lenihan. Infaunal Responses to Recreational Clam Digging. *Marine Biology* (submitted).

Lenihan, H.S., S. Mills, L.S. Mullineaux, F. Micheli, C.R. Fisher and C.H. Peterson. Biotic interactions at hydrothermal vents: negative density-dependent recruitment in mussels beds. *Oecologia* (submitted).

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Education:	B.A.	Environmental Biology (Honors), University of California Santa Barbara	1970
	M.A.	Zoology, UCSB	1974
	Ph.D.	Zoology, UCSB	1978

Positions:	1985-present	Assistant and Associate Research Biologist, Marine Science Institute, UCSB
	1993-present	Science writer and Science Editor of *Dolphin Log*, Cousteau Society
	1978-1988	Project Director, VANTUNA Research Group, Occidental College, Los Angeles

Grants and Awards:

2002-2003	Packard Foundation
2002	Sea Grant
2001-2002	California Artificial Reef Enhancement Program and Biological Resources Division, U. S. Geological Survey
2000-2001	National Marine Fisheries Service

Selected Publications:

Love, M.S., C.W. Mecklenburg, T.A. Mecklenburg, and L.K. Thorsteinson. 2005. Inventory of marine and estuarine fishes of the eastern North Pacific Ocean from Alaska to Baja California. OCS Study MMS

Berkeley, S.A., M.A. Hixon, R.J. Larson and M.S. Love. 2004. Fisheries sustainability via protection of age structure and spatial distribution of fish populations. *Fisheries* **29**(8):23-32.

Matala, A., A. Gray, A. Gharett and M. Love. 2004. Microsatellite variation indicates population genetic structure of bocaccio (*Sebastes paucispinis*). *North American Journal of Fisheries Management* **24**:1189-1202.

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Education:	B.S.	Geology/ Geophysics, San Diego State College, California	1965
	Ph.D.	Oceanography/ Marine Geophysics, Scripps Inst. of Oceanography, San Diego, California.	1969

Positions:	1997-2003	Chair, Department of Geological Sciences, University of California, Santa Barbara
	1988-1997	Director, Institute of Crustal Studies, UC Santa Barbara
	1987-1988	Acting Director, Institute of Crustal Studies, UC Santa Barbara
	1981-Present	Professor, Department of Geological Sciences, UC Santa Barbara
	1975-1981	Associate Professor, Department of Geological Sciences, UC Santa Barbara
	1973-1975	Assistant Professor, Department of Geological Sciences, UC Santa Barbara

Selected Publications:

Siddoway, C.H. and B.P. Luyendyk. Crustal structure and Cenozoic tectonics on the eastern margin of the Ross Sea, Marie Byrd Land. Antarctic J. of the U.S. (in press).

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Hornafius, J.S., D. Quigley, and B.P. Luyendyk. 1999. The World's Most Spectacular Marine Hydrocarbon Seeps (Coal Oil Point, Santa Barbara Channel, California): Quantification of Emissions. *Journal of Geophysical Research - Oceans* **104**(C9):20,703-20,711.

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Sorlien, C.C., C.N. Nicholson, and B.P. Luyendyk. 1999. Miocene Extension and Post-Miocene Transpression Offshore of South-Central California. In Keller, M.A. ed., Evolution of Sedimentary Basins, Onshore Oil and Gas Investigations - Santa Maria Province: *U.S. Geological Survey Bulletin*, 11995-Y, 38p.

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Richard, S.M., C.H. Smith, D.L. Kimbrough, P.G. Fitzgerald, B.P. Luyendyk, and M.O. McWilliams. 1994. Cooling history of the northern Ford Ranges, Marie Byrd Land, West Antarctica. *Tectonics* **13**:837-857.

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

Education:	B.A.	Applied Mathematics, University of California, San Diego, CA	1986
	MA.	Architecture, California Polytechnic University, San Luis Opispo, CA	1991
	M.S.	Mechanical Engineering, University of Calfornia, Santa Barbara, CA	1995
	Ph.D.	Geography (Oceanography), University of California, Santa Barbara, CA	1997

Positions:	2003-Present	Visiting Research Oceanographer, Physical Oceanography Research Division, Scripps Institution of Oceanography, La Jolla, CA
	2000-Present	Assistant Research Oceanographer, Institute for Computational Earth System Science, University of California, Santa Barbara, CA
	1998-2000	Postdoctoral Researcher, Physical Oceanography Research Division, Scripps Institution of Oceanography, La Jolla, CA
	1997-1998	Post Postdoctoral Researcher, Institute for Computational Earth System Science, University of California, Santa Barbara, CA
	1992-1997	Research Assistant, Institute for Computational Earth System Science, University of California, Santa Barbara, CA

Selected Publications:

Ohlmann, J. C., and A.L. Sybrandy. A catch-and-release Lagrangian drifter for near-shore ocean circulation research. Proceedings, *California and the World Ocean '02* (in press)

Ohlmann, J.C., P.F White, A.L. Sybrandy and P.P. Niller. GPS-cellular drifter technology for coastal ocean observing systems. *Journal of Atmospheric and Oceanic Technology* (in press).

Emery, B.E., L. Washburn, M. Love, M.M. Nishimoto and J.C. Ohlmann, Do Oil and Gas Platforms off California Reduce Recruitment of Bocaccio (*Sebastes Paucispinis*) to Natural Habitat? An Analysis based on Trajectories derived from High Frequency Radar. *Fisheries Bulletin* (in review).

Ohlmann, J.C. and P.F. White. High-resolution drifter measurements on the inner-shelf of the Santa Barbara Channel. *Continental Shelf Research* (in prep).

Ohlmann, J.C. and J.H. LaCasce. Shear dispersion in the coastal ocean. Journal of Marine Research (in prep).

Miller, A.J., M.A. Alexander, G.J. Boer, F. Chai, K. Denman, D.J. Erickson, R. Frouin, A.J. Gabric, E.A. Laws, M.R. Lewis, Z. Liu, R. Murtugudde, S. Nakamoto, D.J. Neilson, J.R. Norris, J.C. Ohlmann, R.I. Perry, N. Schneider, K.M. Shell and A. Timmermann. 2003. Potential feedbacks between Pacific Ocean ecosystems and interdecadal climate variations. *Bulletin of the American Meteorological Society* **84**:617-633.

Ohlmann, J.C. 2003. Ocean radiant heating in climate models. *Journal of Climate* **16**:1337-1351.

LaCasce, J.H. and J.C. Ohlmann. 2003. Relative dispersion at the surface of the Gulf of Mexico. *Journal of Marine Research* **61**:285-312.

Ohlmann, J.C. and P.P. Niiler. 2005. Circulation over the continental shelf in the northern Gulf of Mexico. *Progress in Oceanography* **64**:45-81.

Ohlmann, J.C. and P.P. Niiler. 2001. A two-dimensional response to a tropical storm on the Gulf of Mexico shelf. *Journal of Marine Systems* **29**(1-4):87-99.

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Blaha, J. P., G.H. Born Jr., N.L. Guinasso, H.J. Herring, G.A. Jacobs, F.J. Kelly, R.R. Leben Jr., R.D. Martin, G.L. Mellor, P.P. Niiler, M.E. Parke, R.C. Patchen, K. Schaudt, N.W. Scheffner, C.K. Shum, C. Ohlmann, W. Sturges, G.L. Weatherly, D. Webb, and H. J. White. 2000. Gulf of Mexico ocean monitoring system. *Oceanography* **13**(2):10-17.

Ohlmann, J.C., and D.A. Siegel. 2000. Ocean radiant heating: Part II. Parameterizing solar radiation transmission through the upper ocean. *Journal of Physical Oceanography* **30**(8):1849-1865.

Ohlmann, J.C., D.A. Siegel, and C.D. Mobley. 2000. Ocean radiant heating: Part I. Optical influences. *Journal of Physical Oceanography* **30**(8):1833-1848.

Siegel, D.A., T.K. Westberry, and J.C. Ohlmann. 1999. Cloud color and ocean radiant heating. *Journal of Climate* **12**(4):1101-1116.

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Ohlmann, J.C., D.A. Siegel, and C. Gautier. 1996. Ocean mixed layer radiant heating and solar penetration: A global analysis. *Journal of Climate* **9**(10):2265-2280.

Siegel, D.A., J.C. Ohlmann, L. Washburn, R.R. Bidigare, C.T. Nosse, E. Fields, and Y.M. Zhou. 1995. Solar-Radiation, Phytoplankton Pigments and the Radiant Heating of the Equatorial Pacific Warm Pool. *Journal of Geophysical Research Oceans* **100**(C3):4885-4891.

HENRY M. PAGE
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Projects: *Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species*
Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products
Ecological Performance and Trophic Links: Comparisons Among Platforms and Natural Reefs for Selected Fishes and their Prey

Education:

B.S.	University of Southern California	1973
M.A.	University of California, Santa Barbara	1977
Ph.D.	University of California, Santa Barbara	1984

Positions:

2004-present	Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
1998-present	California Coastal Commission SONGS mitigation scientist (wetlands)
1985-2004	Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
1984-present	Lecturer in Summer Session, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1994-1997	Instructor, Department of Biological Sciences, Santa Barbara City College
1983-1985	Postgraduate Research Biologist, Marine Science Institute, University of California, Santa Barbara

Selected Publications:

Galindo-Bect, M. S., H.M. Page, R.L. Petty, M. Hernandez-Ayon, E.A. Aragon-Noriega, and H. Bustos-Serrano. Temporal variation in the abundance of postlarval and juvenile blue shrimp (*Litopenaeus stylirostris*) and brown shrimp (*Farfantepenaeus californiensis*) in the Colorado River Estuary. *Fishery Bulletin* (submitted).

Bram, J.B., H.M. Page and J.E. Dugan. 2005. Spatial and temporal variability in early successional patterns of an invertebrate assemblage at an offshore platform. *Journal of Experimental Marine Biology and Ecology* **317**:223-237.

Bomkamp, R.E., H.M. Page and J.E. Dugan. 2004. Role of food subsidies and habitat structure in influencing benthic communities of shell mounds at sites of existing and former offshore oil platforms. *Marine Biology* **146**:201-211.

Page, H.M. and M. Lastra. 2003. Diet of intertidal bivalves in the Ria de Arosa (Galicia, NW Spain): evidence from stable C and N isotope ratio analysis. *Marine Biology* **143**:519-532.

Page, H.M., S. Schroeter, D. Reed, R.F. Ambrose, J. Callaway and J. Dixon. 2003. An inexpensive method to identify the elevation of tidally inundated habitat in coastal wetlands. *Bulletin of the Southern California Academy of Sciences* **102**:130-142.

Galindo-Bect, M.S., E.P. Glenn, H.M. Page, L.A. Galindo-Bect, J.M. Hernandez-Ayon, R.L. Petty, and J. Garcia-Hernandez. 2000. Analysis of peneid shrimp landings in the northern Gulf of California in relation to Colorado River discharge. *Fishery Bulletin - NOAA* **98**(1):222-225.

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Page, H.M. 1997. Importance of vascular plant and algal production to macroinvertebrate consumers in a southern California salt marsh. *Estuarine, Coastal and Shelf Science* **45**:823-834.

Dugan, J.E., D.M. Hubbard, and H.M. Page. 1995. Scaling population density to body size: tests in two soft sediment intertidal communities. *Journal of Coastal Research* **11**:849-857.

Page, H.M. 1995. Variation in the natural abundance of ^{15}N in the halophyte, *Salicornia virginica*, associated with ground water subsidies of nitrogen in a southern California salt marsh. *Oecologia* **104**:181-188.

Page, H.M., R.L. Petty, and D.E. Meade. 1995. Influence of watershed run-off on nutrient dynamics in a southern California salt marsh. *Estuarine, Coastal and Shelf Science* **41**:163-180.

Page, H.M., J.E. Dugan, and D.M. Hubbard. 1992. Comparative effects of infaunal bivalves on an epibenthic microalgal community. *Journal of Experimental Marine Biology and Ecology* **157**:247-262.

Page, H.M., A. Fiala-Medioni, C.R. Fisher, and J.J. Childress. 1990. Experimental evidence for filter-feeding by the hydrothermal vent mussel, *Bathymodiolus thermophilus*. *Deep-Sea Research* **38**:1455-1461.

Page, H.M., C.R. Fisher, and J.J. Childress. 1990. The role of filter-feeding in the nutritional biology of a deep sea mussel with methanotrophic symbionts. *Marine Biology* **104**:251-257.

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Page, H.M. 1986. Differences in population structure and growth rate of the stalked barnacle, *Pollicipes polymerus* between a rocky headland and an offshore oil platform. *Marine Ecology Progress Series* **29**:157-164.

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Projects: *Effects of Produced Water on Complex Behavior Traits of Invertebrate Larvae and Algal Zoospores*
Effects of Temporal and Spatial Separation of Samples on Estimation of Impacts
Shoreline Inventory of Intertidal Resources of San Luis Obispo and Northern Santa Barbara Counties

Education:	B.A.	Philosophy, Northern Arizona University	1976
	Ph.D.	Biology, University of California, Santa Barbara	1988

Positions:	2003-Present	Chair, Department of Ecology and Evolutionary Biology, UC Santa Cruz
	2002-Present	Professor, Department of Ecology and Evolutionary Biology, UC Santa Cruz
	1999-2002	Associate Professor, Department of Biology, University of California, Santa Cruz
	1996-1999	Assistant Professor, Department of Biology, University of California, Santa Cruz
	1992-1996	Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
	1991-1992	Post-doctoral Research Biologist, Marine Science Institute, University of California, Santa Barbara
	1989-1991	Research Fellow, Australian Research Council Fellowship, University of Melbourne, Department of Zoology
	1988-1989	Research Fellow, University of Melbourne Research Fellowship
	1987-1988	Post-doctoral Researcher, University of California, Santa Barbara
	1986-1990	Environmental Consultant, Marine Review Committee

Distinctions:	1976	President's Scholarship for Academic Excellence. Northern Arizona University
	1981-1982	Dean's Award for Academic Excellence, University of Arizona
	1984	Sigma Xi Grant-in-Aid of Research
	1986	University of California Patent Fund
	1987-1988	Office of Naval Research Postdoctoral Fellowship
	1988-1989	University of Melbourne Research Fellowship
	1989-1991	Australian Research Council Fellowship

Selected Publications:

Reed, D.C., P.T. Raimondi, L. Washburn, B. Gaylord, B.P. Kinlan, and P.T. Drake. 2005. A metapopulation perspective on patch dynamics and connectivity in giant kelp. In: P. Sale and J Kritzer eds. Marine metapopulations. *Academic Press* (in press).

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Forde, S.E. and P.T. Raimondi. 2004. An experimental test of the effects of variation in recruitment intensity on intertidal community structure. *Journal of Experimental Marine Biology and Ecology* **301**:1-14.

Luengen, A.C., C.S. Friedman, P.T. Raimondi, and A.R. Flegal. 2004. Evaluation of immune responses as indicators of contamination in San Francisco Bay, CA; Development of a novel phagocytosis and phagocytic index method for mussels. Marine Environmental Research. **57**(3):197-212.

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Raimondi, P.T., C.M. Wilson, R.F. Ambrose, J.M. Engle, and T.E. Minchinton. 2002. Continued declines of black abalone along the coast of California: are mass mortalities related to El Nino events? *Marine Ecology Progress Series* **242**:143-152.

Raimondi, P.T. and A.N.C. Morse. 2000. The consequences of complex larval behavior in a coral. *Ecology* **81**(11):3193-3211.

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Reed, D.C., P.T. Raimondi, M.H. Carr, and L. Goldwasser. 2000. The role of dispersal and disturbance in determining spatial heterogeneity in sedentary organisms. *Ecology* **81**(7):2011-2026.

Carr, M.H. and P.T. Raimondi. 1999. Marine protected areas as a precautionary approach to management. *California Cooperative Oceanic Fisheries Investigations Report* **40**:71-76.

Raimondi, P.T., A.M. Barnett, and P.R. Krause. 1997. The effects of drilling muds on marine invertebrate larvae and adults. *Environmental Toxicology and Chemistry* **16-6**:1218-1228.

Altstatt, J.A., R.F. Ambrose, J.M. Engle, P.L. Haaker, K.D. Lafferty, and P.T. Raimondi. 1996. Recent declines of black abalone *Haliotis cracherodii* on the mainland coast of central California. *Marine Ecology Progress Series* **142**:185-192.

Keough, M.J. and P.T. Raimondi. 1996. Responses of settling invertebrate larvae to bioorganic films: Effects of large-scale variation in films. *Journal of Experimental Marine Biology and Ecology* **207**:59-78.

Raimondi, P.T. and D. Reed. 1996. Determining the spatial extent of ecological impacts caused by local anthropogenic disturbances in coastal marine habitats. Pp. 179-198 in: *Detecting Ecological Impacts: Concepts and Applications in Coastal Habitat*s, R.J. Schmitt and C.W. Osenberg, eds. Academic Press, San Diego, CA.

Keough, M.J. and P.T. Raimondi. 1995. Responses of settling invertebrate larvae to microbial films, II: Effects of different types of films. *Marine Ecology Progress Series* **185**:235-253.

Morse, D.E., A. Morse, N. Hooker, and P.T. Raimondi. 1994. Morphogen-based chemical flypaper for *Agaricia humilis* larvae. *Biological Bulletin* **186**:172-181.

Lively, C.M., P.T. Raimondi, and L.F. Delph. 1993. Intertidal community structure: space-time interactions in the Northern Gulf of California. *Ecology* **74**:162-173.

Keough, M.J. and P.T. Raimondi. 1992. Robustness of estimates of recruitment rates for sessile marine invertebrates. Recruitment Workshop Proceedings. *Australian Society of Fisheries Biologists*.

Raimondi, P.T. 1992. Adult plasticity and rapid larval evolution in a recently isolated barnacle population. *Biological Bulletin* **182**:210-220.

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Department of Zoological Research
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Smithsonian Institution
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Project: *Population Dynamics and Biology of the California Sea Otter at the Southern End of its Range*

Education:	B.A.	Biology, Stanford University	1960
	M.S.	Biology, Radcliffe College	1962
	Ph.D.	Biology, Harvard University	1965

Positions:	2004-Present	Research Associate, University of California, Santa Cruz, CA
	1998-Present	Senior Research Biologist, Smithsonian Institution, Washington, DC
	1976-1998	Research Biologist, Smithsonian Institution, Washington, DC

Selected Publications:

Schwartz, M., K. Ralls, D. Williams, B.L. Cypher, K.L. Pilgrim and R.C. Fleischer. 2005. Gene flow among San Joaquin kit fox populations in a severely changed ecosystem. *Conservation Genetics* **8**:1-13.

Haight, R.G., B. Cypher, P.A. Kelly, S. Phillips, K. Ralls and H.P. Possingham. 2004. Optimizing reserve expansion for disjunct populations of San Joaquin kit fox. *Biological Conservation* **117**:61-72.

Ralls, K. and J. Ballou. 2004. Genetic status and management of the California condors. *The Condor* **106**:215-228.

Moehrenschlager, A., B. Cypher, K. Ralls, R. List and M. Sovada. 2004. Comparative ecology and conservation priorities of swift and kit foxes. Pages 185-198 *in* D. W. Macdonald and C. Sillero-Zubiri, editors. Biology and Conservation of Wild Canids. Oxford University Press, Oxford.

Ralls, K. and D. A. Smith. 2004. Latrine use by San Joaquin kit foxes (*Vulpes macrotis mutica*) and coyotes (*Canis latrans*). *Western North American Naturalist* **64**:544-547.

Ortega, J., M.d.R. Franco, B.A. Adams, K. Ralls, and J.E. Maldonado. 2004. A reliable, noninvasive method for sex determination in the endangered San Joaquin kit fox (*Vulpes macrotis mutica*) and other canids. *Conservation Genetics* **5**:715-718.

Murdoch, J., K. Ralls, and B. Cypher. 2004. Two observations of tree climbing by San Joaquin kit fox. *Southwestern Naturalist* **49**:522-523.

Estes, J.A., B.B. Hatfield, K. Ralls and J. Ames. 2003. Causes of mortality in California sea otters during periods of population growth and decline. *Marine Mammal Science* **19**:198-216.

Ralls, K. and P.J. White. 2003. Diurnal spacing patterns in kit foxes, a monogamous canid. *Southwestern Naturalist* **48**:432-436.

Smith, D.A., K. Ralls, A. Hurt, B. Adams, M. Parker, B. Davenport, M. Smith and J. E. Maldonado. 2003. Detection and accuracy rates of dogs trained to find scats of San Joaquin kit foxes. *Animal Conservation* **6**:339-346.

Murdoch, J., K. Ralls, and B.L. Cypher. 2003. Use of night vision technology to study kit fox behavior. *Transactions of the Western Section of the Wildlife Society* **38/39**:27-28.

Haight, R.G., B. Cypher, P.A. Kelly, S. Phillips, H.P. Possingham, K. Ralls, A.M. Starfield, P.J. White, and D. Williams. 2002. Optimizing habitat protection using demographic models of population viability. *Conservation Biology* **16(5)**:1386-1397.

Ralls, K., K.L. Pilgrim, P.J. White, E.E. Paxinos, M.K. Schwartz, and R.C. Fleischer. 2001. Kinship social relationships, and den sharing in kit foxes. *Journal of Mammalogy* **82(3)**:858-866.

Smith, D.A., K. Ralls, B. Davenport, B. Adams, and J.E. Maldonado. 2001. Canine assistants for conservationists. *Science* **291**(5503):435-435.

Haight, R.G., K. Ralls, and A.M. Starfield. 2000. Designing species translocation strategies when population growth and future funding are uncertain. *Conservation Biology* **14**(5):1298-1307.

Ralls, K. and B.L. Taylor. 2000. Better policy and management decisions through explicit analysis of uncertainty: New approaches from marine conservation - Introduction. *Conservation Biology* **14**(5):1240-1242.

Ralls, K., J.D. Ballou, B.A. Rideout, and R. Frankham. 2000. Genetic management of chondrodystrophy in California condors. *Animal Conservation* **3**:145-153 Part 2.

White, P.J., K. Ralls, and D.B. Siniff. 2000. Nocturnal encounters between kit foxes. *Journal of Mammalogy* **81**(2):456-461.

Frankham, R. and K. Ralls. 1998. Conservation biology - Inbreeding leads to extinction. *Nature* **392**(6675):441-442.

Good, S.V., D.F. Williams, K. Ralls, and R.C. Fleischer. 1997. Population structure of *Dipodomys ingens* (*Heteromyidae*): The role of spatial heterogeneity in maintaining genetic diversity. *Evolution* **51**(4):1296-1310.

Paxinos, E., C. McIntosh, K. Ralls, and R. Fleischer. 1997. A noninvasive method for distinguishing among canid species: Amplification and enzyme restriction of DNA from dung. *Molecular Ecology* **6**(5):483-486.

Ralls, K. and L.L. Eberhardt. 1997. Assessment of abundance of San Joaquin kit foxes by spotlight surveys. *Journal of Mammalogy* **78**(1):65-73.

Brody, A.J., K. Ralls, and D.B. Siniff. 1996. Potential impact of oil spills on California sea otters: Implications of the Exxon Valdez spill in Alaska. *Marine Mammal Sciece* **12**(1):38-53.

Ralls, K., D.P. Demaster, and J.A. Estes. 1996. Developing a criterion for delisting the southern sea otter under the US endangered species act. *Conservation Biology* **10**(6):1528-1537.

Ralls, K., T.C. Eagle, and D.B. Siniff. 1996. Movement and spatial use patterns of California sea otters. *Canadian Journal of Zoology* **74**(10):1841-1849.

DANIEL C. REED
Marine Science Institute
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Projects: *An Experimental Evaluation of Methods of Surfgrass (Phyllospadix torreyi) Restoration Using Early Life History Stages*
Population Genetics of surfgrass (Phyllospadix torreyi) for use in restoration

Education:	B.A.	Moss Landing Marine Laboratories and San Francisco State University	1978
	M.A.	Moss Landing Marine Laboratories and San Francisco State University	1981
	Ph.D.	University of California, Santa Barbara	1989

Positions:	1999-present	Research Biologist, Marine Science Institute, University of California, Santa Barbara
	1994-99	Associate Research Biologist, Marine Science Institute, UCSB
	1989-94	Assistant Research Biologist, Marine Science Institute, UCSB
	1990	Biological Consultant, Woodward-Clyde Consultants
	1987-90	Biological Consultant, Marine Review Committee
	1988-89	Biological Consultant, Michael Brandman Associates
	1986-87	Biological Consultant, Chambers Consultants

Distinctions:	1989	Lancaster Award for Outstanding Dissertation, University of California, Santa Barbara
	1984	Antarctic Service Medal of the United States of America, National Science Foundation

Selected Publications:

Reed, D.C., B.P. Kinlan, P.T. Raimondi, L. Washburn, B. Gaylord and P.T. Drake. A Metapopulation Perspective on Patch Dynamics and Connectivity of Giant Kelp *in* J.P. Kritzer and P.F. Sale, eds. Marine Metapopulations. *Academic Press. San Diego* (in press*).*

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

Education:

B.S.	Toxicology, Northeast Louisiana University	1984
Ph.D.	Toxicology, Oregon State University	1989

Positions:

2000-Present	Professor, Aquatic Ecotoxicology, Department of Environmental Sciences, University of California, Riverside, CA.
1999-2000	Program Coordinator of Environmental Toxicology Program, Environmental and Community Health Research Program, University of Mississippi, University, MS
1998-2000	Coordinator for the Graduate Program in Pharmacology, University of Mississippi
1995-1998	Assistant Professor of Pharmacology and Toxicology, University of Mississippi
1991-1995	Assistant Professor of Toxicology, University of Arkansas for Medical Sciences, Little Rock, AR
1989-1991	Postdoctoral Fellow, Duke University Marine Laboratory, Integrated Toxicology Program, Beaufort, NC

Selected Publications:

Huggett, D.B., B.W. Brooks, B.Peterson, C.M. Foran, and D. Schlenk. Toxicity of Select Beta-Adrenergic Receptor Blocking Pharmaceuticals (b-Blockers) on Aquatic Organisms. *Archives of Environmental Contamination and Toxicology* (in press).

Schlenk, D., W.H. Benson, S. Steinert, R.Handy and M.Depledge. Biomarkers *in* The Toxicology of Fishes, R. Di Giulio and D. Hinton, editors. Taylor and Francis Publishers, Washington DC, USA (submitted).

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Tilton, F., W.H. Benson and D. Schlenk. Evaluation of estrogenic activity from a Municipal Wastewater Treatment Plant with Predominantly Domestic Input. *Aquatic Toxicology* (in press).

Todorov, J.R., A.A. Elskus, D. Schlenk, P.L. Ferguson, B.J. Brownawell and A.E. McElroy. Estrogenic Responses of Larval Sunshine Bass (*Morone saxatilis X M. chrysops*) Exposed to New York City Sewage Effluent. *Marine Environmental Research* (in press).

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Elalfy, A., S. Grisle, and D. Schlenk. 2001. Characterization of Salinity-enhanced toxicity of aldicarb to Japanese medaka: sexual and developmental differences. *Environmental Toxicology and Chemistry* **20**:2093-2098.

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Tilton, F., W.H. Benson, and D. Schlenk. 2001. Elevation of serum 17-b-estradiol in channel catfish following injection of 17-b-estradiol, ethynyl estradiol, estrone, estriol and estradiol-17-b-glucuronide. *Environmental Toxicology and Pharmacology* **9**:169-172.

Debusk, B.C., S. Kumir, J. Rimoldi, and D. Schlenk. 2000. Phase I and II enzyme and activity levels in the gumboot chiton *Cryptochiton stelleri* following exposure to a dietary bromo-phenol, lanosol. *Comparative Biochemistry and Physiology* **127C**:133-142.

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Projects: *Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell us?*
Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products

Education:

B.A.	Environmental Biology, University of Colorado	1972
M.S.	Marine Science, University of the Pacific	1975
Ph.D.	Biology, University of California, Los Angeles	1979

Positions:

1995-present	Professor, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara
1994-present	Program Director, Coastal Marine Institute, University of California, Santa Barbara
1991-present	Program Director, Coastal Toxicology Program, UC Toxic Substances Research and Teaching Program
1989-2005	Program Director, Southern California Educational Initiative, University of California, Santa Barbara
1987-present	Director, Coastal Research Center, Marine Science Institute, University of California, Santa Barbara
1993-1995	Associate Professor, Department of Biology and Environmental Studies Program, University of California, Santa Barbara
1987-1992	Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
1981-1987	Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara

Distinctions: 1989 George Mercer Award for 1989, Ecological Society of America (best published research in field of Ecology by a scientist under age 40; Awarded for "Indirect interactions between prey: apparent competition, predator aggregation and habitat selection," *Ecology* **68**:1887-1897)

Selected Publications:

Holbrook, S.J. and R.J. Schmitt. 2005. Growth, reproduction and survival of a tropical sea anemone (*actiniaria*): benefits of hosting anemonefish. *Coral Reefs* (in press).

Holbrook, S. J. and R. J. Schmitt. 2004. Population dynamics of a damselfish: effects of a competitor that also is an indirect mutualist. *Ecology* **85**:979-985.

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

Education:	B.S.	Fisheries and Wildlife, Michigan State University	1957
	M.S.	Mathematical Statistics, Michigan State University	1958
	Ph.D.	Entomology, Fisheries & Wildlife, University of Minnesota	1967

Positions: 1975-Present Professor, Department of Ecology, Evolution and Behavior, University of Minnesota, St. Paul, MN
Director of the Itasca Biology Program, University of Minnesota, St. Paul, MN
Director of the Conservation Biology Graduate Program, University of Minnesota, St. Paul, MN

Selected Publications:

Gelatt, T.S., D.B. Siniff, and J.A. Estes. 2002. Activity patterns and time budgets of the declining sea otter population at Amchitka Island, Alaska. *Journal of Wildlife Management* **66**(1):29-39.

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White, P.J., K. Ralls, and D.B. Siniff. 2000. Nocturnal encounters between kit foxes. *Journal of Mammalogy* **81**(2):456-461.

Monson, D.H., J.A. Estes, J.L. Bodkin, and D.B. Siniff. 2000. Life history plasticity and population regulation in sea otters. *OIKOS* **90**(3):457-468.

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Project: *Public Perceptions of Risk Associated with Offshore Oil Development*

Education:	A.B.	University of California, Berkeley	1975
	M.A.	University of California, Berkeley	1976
	Ph.D.	University of California, Berkeley	1982

Positions:	2003-Present	Professor, Department of Political Science, University of California, Santa Barbara
	1996-97	Director, University of California, Santa Barbara – Washington Center
	1990-2003	Associate Professor, Department of Political Science, University of California, Santa Barbara
	1986-90	Assistant Professor, Department of Political Science, University of California, Santa Barbara
	1982-86	Assistant Professor, Department of Political Science, Columbia University
	1982	Lecturer in Politics, Brandeis University

Selected Publications:

Smith, E.R.A.N. and J. Carlisle. 2005. Postmaterialism vs. Egalitarianism as Predictors of Energy-related Attitudes. *Environmental Politics* **14**:527-40.

Smith, E.R.A.N. 2004. How Much Knowledge Does Democracy Require? *Phi Kappa Phi Forum* **84**:16-19.

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Fox, R.L. and E.R.A.N. Smith. 1998. The role of candidate sex in voter decision-making. *Political Psychology* **19**:405-419.

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Smith, E.R.A.N. 1996. Book Review: The two majorities - the issue context of modern American politics, by B.E. Shafer and W.J.M. Claggett. *American Political Science Review* **90**:438-439.

Squire, P. and E.R.A.N. Smith. 1996. A further examination of challenger quality in Senate elections. *Legislative Studies Quarterly* **421**:235-248.

Herrera, R., T. Epperlein, and E.R.A.N. Smith. 1995. The stability of congressional roll-call indexes. *Political Research Quarterly* **48**:403-416.

Smith, E.R.A.N. and S.R. Garcia. 1995. Evolving California opinion on offshore oil development. *Ocean and Coastal Management* **26**:41-56.

Squire, P., E.R.A.N. Smith, J. Lindsay, and C. Covington. 1995. *Dynamics of Democracy*. Brown-Bennchmark, Madison, Wisconsin. 596p.

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Tannenbaue, P., L. Kostrich, E.R.A.N. Smith and M. Berg. 1983. *Turned-on television and turned off voters: Policy options for election projections*. Sage Publications, Beverly Hills, CA.

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Project: *Weathering of Aromatic Compounds in the Coastal Marine Environment: Quantifying Rates of Microbial Metabolism*

Education:	B.S.	Chemistry/Biochemistry, Revelle College, U.C. San Diego	1995
	M.S.	Chemistry, University of California, San Diego	1996
	M.S.	Earth System Science, University of California, Irvine	1998
	Ph.D.	Earth System Science, University of California, Irvine	2000

Positions: 2001-Present Assistant Professor, Department of Geological Sciences, University of California, Santa Barbara, California.

Selected Publications:

Adams, C. and D.L. Valentine. Bioenergetics of secondary fermentations involving glycolate, butyrate, and alanine. (in preparation)

Wardlaw G.W. and D.L. Valentine. 2005. Evidence for salt diffusion from sediments contributing to increasing salinity in the Salton Sea, California. *Hydrobiologia* **533**:77-85.

Valentine, D.L., A.L. Sessions, S.C. Tyler and A. Chidthaisong. 2004. Hydrogen isotope fractionation during H2/CO2 acetogenesis: hydrogenase efficiency and the origin of lipid-bound hydrogen. *Geobiology* **2**:179-188.

Valentine, R.C. and D.L. Valentine. 2004. Omega-3 fatty acids in cellular membranes: a unified concept. *Progress in Lipids Research* **43**:383-402.

Hill, T.M., J.P. Kennett and D.L. Valentine. 2004. Isotopic evidence for the incorporation of methane-derived carbon into living foraminifera from modern methane seeps, Hydrate Ridge, OR. *Geochimica et Cosmochimica Acta* **68**(12):4619-4627.

Valentine, D.L., A. Chidthaisong, A. Rice, W.S. Reeburgh and S.C. Tyler. 2004. Carbon and hydrogen isotope fractionation in moderately-thermophilic methanogens. *Geochimica et Cosmochimica Acta* **68**(7):1571-1590. pdf version

Valentine, D. L. 2002. Biogeochemistry and microbial ecology of anaerobic methane oxidation: a review. Antonie van Leewenhoek **81**:271-282.

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Projects: *Observing the Surface Circulation Along the South-Central California Coast Using High Frequency Radar: Consequences for Larval and Pollutant Dispersal*
Application of Coastal Ocean Dynamics Radars for Observation of Near-Surface Currents off the South-Central California Coast

Education:

B.S.	Mechanical Engineering, University of Arizona	1974
M.S.	Engineering Science, University of California, San Diego	1978
Ph.D.	Engineering Science, University of California, San Diego	1982

Positions:

1998-present	Professor, Department of Geography and ICESS, University of California, Santa Barbara, CA
1993-1998	Associate Professor, Department of Geography and ICESS, University of California, Santa Barbara, CA
1991-1993	Assistant Professor, Department of Geography, University of California, Santa Barbara, CA
1985-1990	Research Assistant Professor of Physical Oceanography, Center for Earth Sciences, University of Southern California, Los Angeles, CA
1982-1985	Postgraduate Research Oceanographer, Scripps Institution of Oceanography, San Diego, CA

Selected Publications:

Warrick, J.A., L. Washburn, M.A. Brzezinski and D.A. Siegel. 2005. Nutrient contributions to the Santa Barbara Channel, California, from the ephemeral Santa Clara River. *Estuarine, Coastal and Shelf Science* **62**:559-574.

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

Education:	B.A.	Biology, Douglass College	1976
	M.S.	Physiology, Rutgers University	1979
	Ph.D.	Environmental & Exercise Physiology, Rutgers University	1981
		Certificate Program in Molecular Biotechnology, UC San Diego	1989

Position:	1997-present	Associate Professor of Biology, University of California, Santa Cruz

Selected Publications:

Davis, R.W., L. Polasek, R. Watson, A. Fuson, T.M. Williams and S.B. Kanatous. 2004. The diving paradox: new insights into the role of the dive response in air-breathing vertebrates. *Comparative Biochemistry and Physiology Part* A **138**:263-268.

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

Education:

B.S.	Pharmacy, Massachusetts College of Pharmacy & Allied Health Sciences, Boston, MA	1963
Ph.D.	Pharmacology, School of Medicine, Tufts University, Boston, MA	1967

Positions:

1995-present	Professor of Biochemistry and Pharmacology, Department of Molecular, Cellular, and Developmental Biology, University of California, Santa Barbara, CA
1978-1995	Professor of Biochemistry and Pharmacology, Division of Molecular, Cellular, and Developmental Biology, Department of Biological Sciences, University of Santa Barbara, CA
1987-1991	Chair, Department of Biological Sciences, University of California, Santa Barbara, CA
1976-1978	Associate Professor, Department of Biological Sciences, University of California, Santa Barbara, CA
1969-1975	Assistant Professor, Department of Pharmacology, Stanford University School of Medicine, Stanford, CA

Selected Publications:

Wilson, L. and M.A Jordan. New microtubule / tubulin-targeted anticancer drugs and novel chemotherapeutic strategies. Journal of Chemotherapy (Suppl) (in press).

Feinstein, S.C. and L. Wilson. Inability of Tau to Properly Regulate Neuronal Microtubule Dynamics: A Loss-of-Function Mechanism by which Tau Might Mediate Neuronal Cell Death. *Biochimica et Biophysica Acta* (in press).

Jordan, M.A. and L. Wilson. 2004. Microtubules as a target for anticancer drugs. *Nature Cancer Reviews* **4**:253-265.

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Ngan, V.K., K. Bellman, B.T. Hill, L. Wilson, and M.A. Jordan. 2001. Mechanism of mitotic block and inhibition of cell proliferation by the semisynthetic vinca alkaloids vinorelbine and its newer derivative, vinflunine. *Molecular Pharmacology* **60**:1-8.

Panda, D., S. Feinstein, and L. Wilson. 2001. Differential modulation of microtubule dynamics by 3-repeat and 4-repeat tau isoforms: Implications for neurodegenerative disease. *Molecular Biology of the Cell* **12**:938, Suppl. S.

Pfohl, T., J.H. Kim, M. Yasa, H.P. Miller, G.C.L. Wong, F. Bringezu, Z. Wen, L. Wilson, M.W. Kim, Y. Li, and C.R. Safinya. 2001. Controlled modification of microstructured silicon surfaces for confinement of biological macromolecules and liquid crystals. *Langmuir* **17**(17):5343-5351.

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.