
University of California

Coastal Marine Institute

Annual Report

2003 - 2004

University of California

Coastal Marine Institute

**Annual Report
2003 - 2004**

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 foster 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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TABLE OF CONTENTS

Program Manager's Report	1
Summary of Research Progress	3
Trainees and Staff	68
Research Productivity	74
Curriculum Vitae	86

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 10

July 15, 2004

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 10 (July 1, 2003 - June 30, 2004).

Major programmatic progress achieved during Program Year 10 of the CMI:

- ◆ During 2003 – 2004, 31 regular and research faculty, 181 trainees (6 postdoctoral, 27 graduates, 111 undergraduates, and 1 high school student) and 36 staff from 6 campuses and laboratories participated in CMI research projects;
- ◆ This Program year, CMI-sponsored studies published 25 peer-reviewed papers (with an additional 5 papers in review), and 42 research presentations. In addition, 4 CMI-MMS final reports were completed and 3 draft final reports are currently in review.

SUMMARY OF RESEARCH PROGRESS

Joint UCSB-MMS Pacific OCS Student Internship and Trainee Program	4
Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell Us?.....	6
Habitat Value of Shell Mounds to Ecologically and Commercially Important Benthic Species.....	9
Inventory of Rocky Intertidal Resources in Southern Santa Barbara, Ventura, and Los Angeles Counties	10
Shoreline Inventory of Intertidal Resources of San Luis Obispo and Northern Santa Barbara Counties	11
Population Dynamics and Biology of the California Sea Otter at the Southern End of its Range.....	12
Population Genetics of Surfgrass (<i>Phyllospadix torreyi</i>) for Use in Restoration	13
Public Perceptions of Risk Associated with Offshore Oil Development	14
Observing the Surface Circulation Along the South-Central California Coast Using High Frequency Radar: Consequences for Larval and Pollutant Dispersal and Observations of the surface circulation in the Eastern Santa Barbara Channel using high frequency radar and Lagrangian drifters	16
Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products	20
Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSYS-HYS) and Oil Slicks in the Ocean: Predicting their Release Points Using the Natural Laboratory of the Santa Barbara Channel	40
Transport over the Inner-Shelf of the Santa Barbara Channel	42
Use of Biological Endpoints in Flatfish to Establish Sediment Quality Criteria for Polycyclic Aromatic Hydrocarbon Residue and Assess Remediation Strategies.....	44
Spatial and temporal variation in recruitment to rocky shores: Relationship to recovery rates of intertidal communities	49
Weathering of oil and gas in the coastal marine environment: quantifying rates of microbial metabolism	53
Ecological performance and trophic links: comparisons among platforms and natural reefs for selected fishes and their prey.....	57
Relative importance of POCS oil platforms on the population dynamics of two reef fishes in the Eastern Santa Barbara Channel.....	62

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

Progress during 2003-2004

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, 9 graduate and undergraduate students participated as interns in 6 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 2003 and the 2003-2004 academic year, CMI interns were involved in a project assisting with the development of websites and online data reporting for the MARINE rocky intertidal monitoring program (Jennifer Klaib mentored by Ms. Dunaway of MMS and Dr. Engle of UCSB). A graduate student, Jennifer Lape, developed and implemented a comprehensive compilation of scientific reprints resulting from >15 years of MMS funded research and provided program assistance. In Spring 2004, two new internship positions were advertised and filled for Summer 2004. An undergraduate student, Beth O'Connor was hired in May 2004 to take photographs and develop content for use in updating the CMI website. Beth is being mentored by Dr. Dugan. In June 2004, Kristina Estudillo, a UCSB graduate student, was hired to assist with the development of K-12 educational curricula and materials comparing alternative energy sources for the summer months. She will be mentored by Ms. Dunaway of MMS.

With the remainder of the 2002 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 CMI research projects. The student interns for these projects included Shannon Herrar who assisted with demographic studies of fishes on reefs and oil

platforms mentored by Drs. Brooks and Lenihan, and Sabrina Beyer, Rachelle Fisher, Justin Hoesterey, and Stacie Fejtek who assisted with laboratory sample analyses to compare benthic invertebrates from offshore oil platforms and natural reefs mentored by Drs. Page and Dugan of UCSB.

In Spring 2004, we applied for and received approval for renewal of funding from the UCSB Shoreline Preservation Fund to expand our internship program and support additional undergraduate interns in the CMI program for Summer and Fall of 2004. This funding will be available after July 1st and will be used to support several new undergraduate interns who will directly assist with research on the UCSB campus and at MMS headquarters.

Joint UCSB-MMS Pacific OCS Graduate Trainee Program

Graduate students and post-doctoral researchers 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 and postdoctoral researchers appears in a separate section of this Annual Report.

Information Transfer Seminars (ITS)

No information transfer seminars were presented during this reporting period.

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

Project Background and Rationale:

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°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 reveal 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.

Progress to Date:

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

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

We initially analyzed 8 separate datasets enumerating the flora and fauna of nearshore marine communities in three different ecological systems; subtidal rocky reef, kelp bed, and open ocean pelagic. Trends in population abundances show consistent declines in all three systems over the last 10-15 years. Data were standardized between studies by re-expressing data on population densities as the percent change in initial population density over the time period 1977-2000. Organisms within a given community were assigned to one of four trophic categories, primary producer, primary, secondary, or tertiary consumer, based on published life history information. Most interesting, within each system examined, trends for each component trophic level show approximately the same degree of decline. This pattern holds across spatial scales ranging from a single island within the northern Channel Islands group to the entire Southern California Bight. Also interesting is the fact that data collected using extremely different methodologies, e.g. coastal power plant impingement studies versus diver visual surveys, provide similar estimates of the magnitudes of these declines. Next, we performed various time-series analyses on these data sets to describe temporal trends and explore the timing and magnitude of the observed changes. The species examined were classified as to trophic level, mode of reproduction, extent of geographic range, association with benthic or pelagic food webs, and habitat. In general, the magnitude of decline was similar for all species, regardless of classification. Trends were similar at all locations examined within the Bight, again suggesting regional declines in abundances rather than redistribution of individuals. These patterns are consistent with the explanation that a regional decline in productivity is responsible for regional decline in fish stocks. Most recently, we have analyzed data collected by the National Marine Fisheries Services during their triennial surveys of west coast groundfishes. This dataset covers the same time period as the earlier datasets that we analyzed, 1977-2001, but concentrates on fish species inhabiting the deeper waters of the continental shelf (55-500m). In addition, these surveys are conducted along the west coast of the United States from Monterey Bay, California to Alaska giving us a much broader geographic coverage. While many species present in this dataset (most notably several species of rockfishes) exhibited declines consistent with those observed in our other datasets, certain species (most notably flatfishes) actually increased in abundance during the period 1977-

2001. Categorizing species as to trophic level, reproductive mode, or geographic region did not alter these results. We are analyzing this dataset further using length frequency distributions in an attempt to determine if observed increases occurred before, during, or after periods of declines seen in other species.

We continue to collaborate with John Stephens Jr. and Dan Pondella of the Vantuna Research Group and Kevin Herbinson of SCE in order to update all of our databases through 2001 and to include data on fish larval abundances from 1977 through 2001. We plan to use these data to test hypotheses concerning “top down” versus “bottom up” flow of trophic cascades.

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

We have finished the process of identifying epifaunal invertebrate samples collected during our 2003 surveys. We also have continued with our monitoring of the abundances of surfperches, their invertebrate prey, and the algal cover present in benthic microhabitats at 11 permanent study sites on the south coast of Santa Cruz Island. Sampling of fish (via visual counts along permanent band transects) and algal cover (via random point contact methods) were accomplished in the manner described in our proposal. Epifaunal invertebrates collected from all of these sites have been rough sorted and preserved for later taxonomic identification. We have begun to observe increases in the numbers of young-of-the-year surfperches at many of our sites. These increases are coincident with the return of cooler waters to the Southern California Bight.

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

Graduate Student: Rachel E. Bomkamp

Major Accomplishments, July 1, 2003 – June 30, 2004:

We completed and submitted a draft final report.

One paper was published with the citation:

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* 25 June, 2004. Marine Biology In Press. DOI: 10.1007/s00227-004-1413-8

Future plans:

None

Problems Encountered:

None

MMS Action Required:

Report Study Number must be issued, and the draft report needs to be reviewed with comments sent electronically to johnston@lifesci.ucsb.edu.

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

****This project, though no longer receiving CMI funding, will still submit reporting materials to the Coastal Research Center and the Minerals Management Service. They will also submit a Final Study Report upon completion of the whole project.****

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.

Problems Encountered:

None

MMS Action Required:

None

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

****This project, though no longer receiving CMI funding, will still submit reporting materials to the Coastal Research Center and the Minerals Management Service. They will also submit a Final Study Report upon completion of the whole project.****

This report summarizes the accomplishments of the Inventory of Rocky Intertidal Resources for San Luis Obispo and Northern Santa Barbara Counties from July 2003 to July 2004. 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.

MMS Action Required:

None

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, 2003-2004:

Monitoring of radio-tagged study animals by fieldworkers based at Piedras Blancas field station, San Simeon CA, progresses as before: although the MMS-funded portion of the fieldwork is now complete, field monitoring of study animals will continue so long as there are active VHF radios. Our total sample for both the central (San Simeon) and southern (Pt. Conception) study areas consists of 72 study animals, 45 of which were also equipped with Time-Depth Recorder (TDR) instruments. On October 1-15, 2003 we conducted the final set of re-capture operations at San Simeon, successfully re-capturing all 11 of the TDR-deployed study animals in the area at that time. An additional TDR was recovered from a study animal killed by a shark at Pescadero beach (this animal was from the 2001 Pt. Conception study group, and thus had traveled 300 km from his initial capture location). This brings the total number of TDR instruments retrieved and downloaded at this time to 27.

In the central study area, 12 of 47 study animals are confirmed dead with carcasses recovered, and an additional 3 are missing and assumed to be dead. The remaining animals fall into two categories: 27 are alive and re-sighted regularly, and another 5 animals survived through the expected lifetime of their transmitter batteries (~2 yrs) but now are rarely seen due to suspected transmitter failure. In the southern study area, 2 of 25 animals are confirmed dead, and an additional 6 are missing and assumed to be dead. The remaining animals fall into two categories: 11 are alive and re-sighted regularly, and another 6 animals survived through the expected lifetime of their transmitter batteries but now are rarely seen due to suspected transmitter failure. The estimated net annual survival rate of animals in the central study group is approximately 0.83 (N = 47), as compared to approximately 0.87 in the southern study group (N = 25). More than 15,000 re-sights have been collected on study animals to date, providing data on both fine-scale patterns of habitat use as well as long-distance movement patterns. Data collection on sea otter foraging has resulted in 36,000 recorded feeding dives.

The MMS-funded fieldwork is complete so primary efforts now include data analysis and completion of the final report. The final report will be submitted by September 30, 2004. Publications in scientific journals are also expected and manuscripts are in preparation.

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 Draft Final Study Report and Technical Summary. We will submit the Draft Report after our manuscripts are submitted in August.

Problems Encountered:

None

MMS Action Required:

Report Study Number will need to be issued, and the draft report will need to be reviewed with comments sent electronically to johnston@lifesci.ucsb.edu.

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 is 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 will prepare a set of methods to study the public's reaction to the debate surrounding these proposed projects.

Summary of Research

Major Accomplishments, July 1, 2003 – June 30, 2004

In this period, we conducted a number of analyses of our survey data. We focused on examining NIMBY effects and attitudes toward drilling for oil and gas in national forests.

We first examined the effect of living in the proximity of an oil well on attitudes toward the oil industry and the risks associated with oil drilling. Although we searched for Nimby ("Not in My Backyard") effects in several different ways, using two data sets from 1998 and 2002, we found nothing. Controlling for other causes of attitudes, we found that people who live near oil-drilling sites were not more likely than people living elsewhere to oppose drilling, to believe that drilling is risky, or to distrust the oil industry. To the contrary, despite its anti-oil reputation Santa Barbara residents in 1998 were actually more likely to support oil drilling, to believe that it is safe, and to trust the oil industry than people living elsewhere in the state. These results suggest the previous work on the Nimby syndrome may have mischaracterized it. The results of this work were presented in "Public Opinion about Energy Development: Nimbyism vs. Environmentalism" (with Juliet Carlisle and Kristi Michaud), a paper delivered at the annual meeting of the American Association for Public Opinion Research, Phoenix, Arizona, May 13-16, 2004. We will be submitting a revised version of this paper for publication this summer.

We also examined public attitudes toward drilling for oil and gas in California's parks and public lands. We found that attitudes toward oil development in forest lands are very similar to attitudes toward offshore oil development in almost every respect. These findings suggest that the Bush administration's efforts to open up more national forests to oil development may run into the same sort of political problems that confront attempts to drill off the California coast. We prepared a paper describing these results, "Public Support for Oil and Gas Drilling in California's Forests" (with Juliet Carlisle and Kristi Michaud). The paper has been submitted to the University of California Energy Institute as a working paper, and submitted to a journal for possible publication.

Finally, we completed the final report for this project, *Public Attitudes toward Oil and Gas Drilling among Californians: Support, Risk Perceptions, Trust, and Nimbyism* (with Juliet

Carlisle and Kristy Michaud). The report summarizes results from previous research as well as the results described above.

Problems Encountered: None

MMS Action Required: None

Future Plans:

We intend to seek publication of some of the separate papers coming out of this project. In addition, we have started work on a book manuscript summarizing the bulk of this work and expanding it in some areas. The manuscript is tentatively titled, *The Energy-Crisis Cycle*. We expect to complete a first draft of this book in early 2005.

Estimated Percentage of Budget Expended: 100

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

Progress during 2003-2004

1. Summary

Progress was made in several areas of this project during the past year. Currently four high frequency (HF) radars are operating in the Santa Barbara Channel for observing the surface circulation patterns in the region. In collaboration with Dr. Carter Ohlmann we have conducted experiments which combine observations from drifters and HF radars to assess the accuracy of current velocities derived from HF radar.

Edwin Beckenbach, a former graduate student at UCSB working on this research project, recently completed his Ph.D. which was just conferred during UCSB's June 2004 commencement ceremony. His dissertation work was largely funded by this and a previous MMS grant. The primary focus of his dissertation research is the surface circulation dynamics of the western Santa Barbara Channel. This work builds significantly on oceanographic research in the region conducted by the Center for Coastal Studies at the Scripps Institution of oceanography. A paper was published earlier this year (Beckenbach and Washburn, 2004) which describes a propagating wave-like phenomenon resembling a type of coastal trapped wave. Another focus of Beckenbach's dissertation is the relationship between wind forcing and the two-dimensional surface circulation in the western Channel.

A second HF radar system was installed in the eastern Santa Barbara Channel recently. The first radar system in the eastern Channel was installed last year at Reliant Energy's Mandalay generating station. The new system is on private property in Summerland, CA; the system was installed on 1 May 2004 and will be removed on 1 September 2004 by agreement with the property owner. In addition to providing important data on the circulation of the eastern Channel, observations from this radar are supporting a new juvenile fish recruitment study also funded by MMS (Milton Love is the principal investigator of the new study).

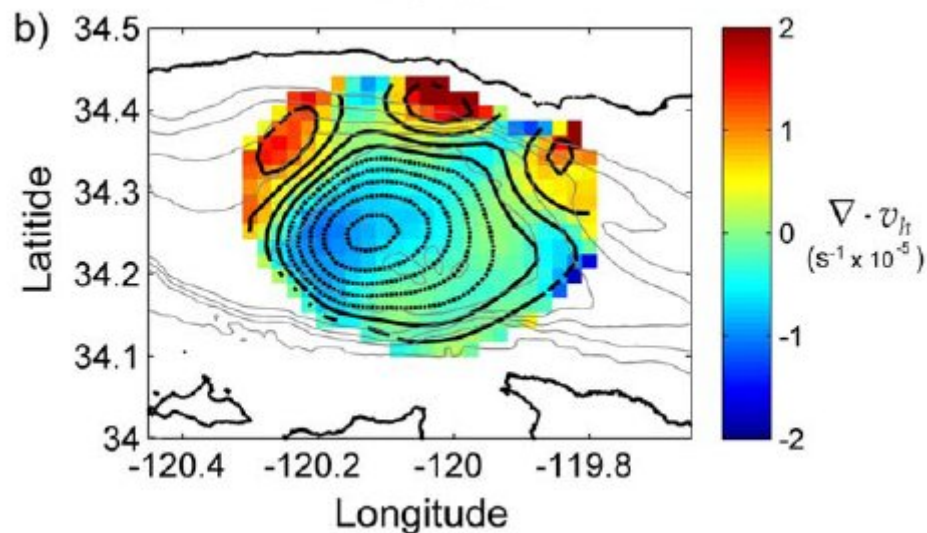
2. Surface Circulation in the Santa Barbara Channel

As described by (Beckenbach and Washburn, 2004), we used a three-year time series of HF radar-derived currents to describe propagating rotary wave-like features in the western Santa Barbara Channel. This was a new discovery and our analysis suggested that the features are topographic Rossby modes, a resonance phenomenon setup by large scale coastal trapped waves

which excite resonant oscillatory flows over the Santa Barbara Basin. Reviewers of our paper commented that this is the best oceanographic evidence to date documenting the existence these modes.

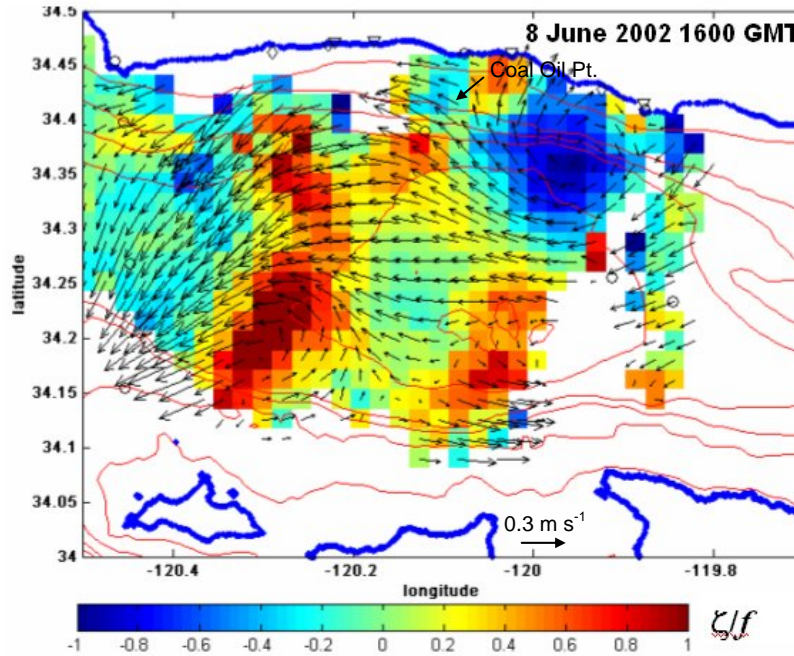
Another focus of our research is the Channel's two-dimensional flow structure and its relationship to wind forcing. We find that the long term mean circulation is characterized by convergence over the Santa Barbara Basin, opposite the flow pattern predicted by the wind field (Fig. 1). This is important because it indicates the convergence is not wind driven. On shorter time scales a clear relationship between wind forcing and the surface flow is evident. Conditional averaging of the surface flow based on modes of the wind field shows that consistent circulation states correspond to the wind modes. This analysis also supports model predictions of (Oey et al., 2001) which relate the strength of the characteristic cyclonic flow to the along-channel wind gradient.

Figure 1. Four-year mean (1998-2001) surface divergence field in the western Santa Barbara Channel. Large blue area near the center of the color contours indicates convergence and downwelling-favorable flow. Smaller red areas along northern boundary of contours shows areas of divergence and upwelling-favorable flow. Color bar at right shows divergence scale where blue indicates convergence and red divergence. Black contours are lines of constant velocity potential such that the divergent part of the velocity field is at right angles to the contours. Dotted contours are negative, solid contours positive. The divergent part of the flow field points from lower to higher contours.



A new aspect of the Channel circulation that we are exploring is the recent discovery of small eddies over the inner shelf and mid-continental shelf. Moored nutrient measurements (funded by the Santa Barbara Channel Long Term Ecological Research program) show that these eddies transport nutrients from deep offshore waters onto the inner shelf. Continuing analysis of this project will further describe these features and their relationship to larval transport and nutrient transport to nearshore waters.

Figure 2. Surface circulation in the western Santa Barbara Channel on 8 June 2002 at 1600 GMT. Dark blue area of clockwise rotating arrows indicates location of small nearshore eddy off of Coal Oil Point, CA. These eddies transport cold, nutrient rich waters from offshore onto the continental shelf. Color scale indicates rotation rate compared with the earth's rotation rate. Red areas indicate counter-clockwise rotation and blue areas indicate clockwise rotation. Arrow at lower right indicates flow speed of 0.3 m s^{-1} .



3. Comparisons between Lagrangian drifters and HF radars

We are also collaborating with Dr. Carter Ohlmann in a comparison study to determine how small scale spatial variability affects the accuracy of HF radar-derived current vectors. Our experimental approach is to repeatedly deploy patterns of drifters in selected radar coverage cells. In situ surface current vectors are computed from sequential drifter positions and compared with simultaneous surface current vectors obtained from the radars. Results from our continuing analysis indicate that differences between the drifter and radar velocity vectors are smallest when small scale spatial variance in the drifter derived velocities is smallest. This suggests that unresolved small scale velocity features are important in determining the accuracy of HF radar-derived currents. This work will progress more rapidly when Dr. Ohlmann returns from his year-long sabbatical at Scripps. This MMS grant also served as “seed funding” for a successful NSF grant which will allow us to expand the scope of this aspect of our research.

4. Larval fish recruitment and oceanographic observations

We currently have two radars deployed in the eastern Santa Barbara Channel. Obtaining permission to occupy sites in the eastern Channel has proven to be extremely difficult for a variety of reasons. Fortunately a private landowner in Summerland has allowed us to erect a radar site on his coastal property for the period 1 May – 1 September 2004. This time period spans the peak recruitment time for bocaccio, an important rock fish species which settles on oil

production platforms. This site, along with our site at Reliant Energy's Mandalay generating station, is providing good coverage over much of the eastern Channel, including coverage over all of the oil production platforms in the area.

Data from the Mandalay and Summerland sites will be used to examine surface circulation features in the area. Inspection of current patterns to date reveals the presence of small scale eddies nearshore. This indicates that features we observed previously in the western Channel may important general features of the nearshore current field.

Our HF radar current data in the eastern channel will complement in situ observations now being obtained on oil production platforms Gina and Gail. Instrumentation now deployed on the platforms include acoustic Doppler current profilers (ADCP's), conductivity-temperature-depth (CTD) sensors, and thermistors. Data from these instruments will be used to interpret data from twice-per-week SCUBA surveys to determine rates of settlement of rockfish species on these two platforms (research supported by MMS; principal investigator is Dr. Milton Love, of the UCSB Marine Science Institute). Our working hypothesis is that settlement of pelagic juvenile rockfish is related to identifiable near-surface current patterns. Our research group is working closely with Milton Love's group in this research.

2. Status of the HF radar array

We are currently operating four HF radars in the Santa Barbara Channel at the following locations: 1) Summerland; 2) Refugio State Beach; 3) Coal Oil Point; and 4) Mandalay generating station near Oxnard. We are also maintaining a fifth site near Pt. Sal on Vandenberg Air Force Base. This site is not presently in operation because we moved its electronics boxes to other sites. However, its antennas, housing, and other equipment have been left in place in anticipation of the site being used in the future Southern California Coastal Current Observing System. Coverage from these radar sites now spans the Santa Barbara Channel and extends approximately from Gaviota to the eastern channel entrance.

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 and 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 and manuscripts are in preparation.

Study Sites

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

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

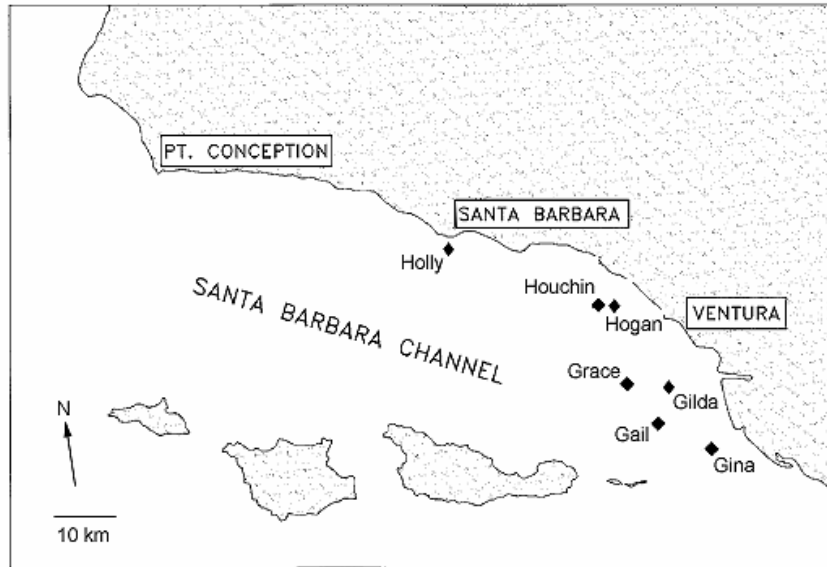


Table 1. Characteristics of study platforms. Key to abbreviations: Gi-Gina, Ga-Gail, Gil-Gilda, Gr-Grace, Hog-Hogan, Hou-Houchin, Hol-Holly.

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
Location along channel (km)	0	12	15	19	33	36	65
Platform size (m ² on bottom)	560	5600	2340	3120	1444	1444	1728

Progress during 2003-2004

Spatial variation in platform invertebrate communities

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 m² 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 photoquadrat 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

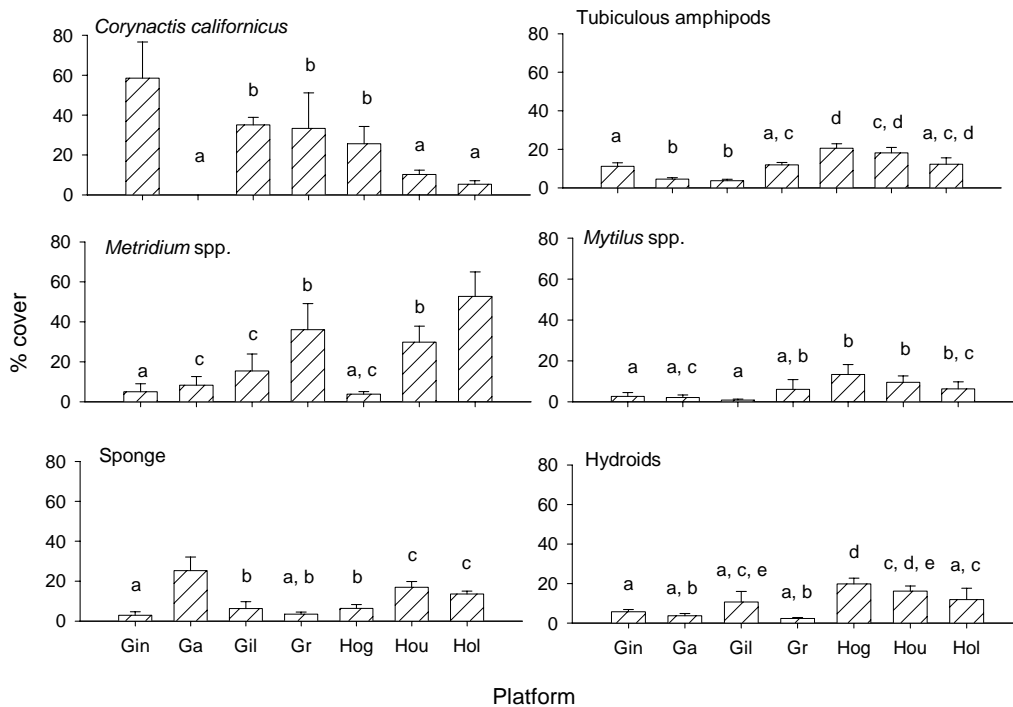
Across all platforms, the most widely distributed and abundant taxa, accounting for 83% of the total cover in our photoquadrats, were anemones (e.g., *Corynactis californicus*, *Metridium* sp.), tubicolous amphipods, (primarily *Erichthonius* sp.), hydroids (*Plumaria*, *Agalophenia*), and sponges (e.g., *Haliclona* spp., *Halichondria panicea*). 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.

The structure of invertebrate communities varied greatly among platforms ($P < 0.001$, $F = 13.729$, $df = 120, 1082.43$, MANOVA: Fig. 2). Anemones occurred in higher cover overall (up to 50 to 60%) than most other invertebrates, but the dominant species varied with location. *Corynactis californicus* was the dominant anemone on platforms at southeast end of the channel (e.g., Gina, $59 \pm 18\%$); cover of this anemone tended to be lower on platforms to the northwest (e.g., $5 \pm 2\%$ at Holly). An exception to this pattern occurred at Gail where mean cover of *C. californicus* was only $2 \pm 1\%$ 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, $51 \pm 13\%$) and lower on platforms to the southeast (Gina, $3 \pm 2\%$). An exception to this pattern was evident at Hogan where cover of *Metridium* was only $2 \pm 1\%$.

Tubicolous amphipods, hydroids, and mussels also generally occurred in higher cover on platforms with increasing distance along the channel from the southeast to the northwest (Fig. 2). For example, tubicolous 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 cullcullata*, occurred only on Gilda with mean cover of 41% (data not shown).

Figure 2. Comparison of the distribution and abundance of the anemones, *Corynactis californicus* and *Metridium senile*, sponges, tubicolous amphipods, mussels (*Mytilus* spp.), and hydroids among study platforms.



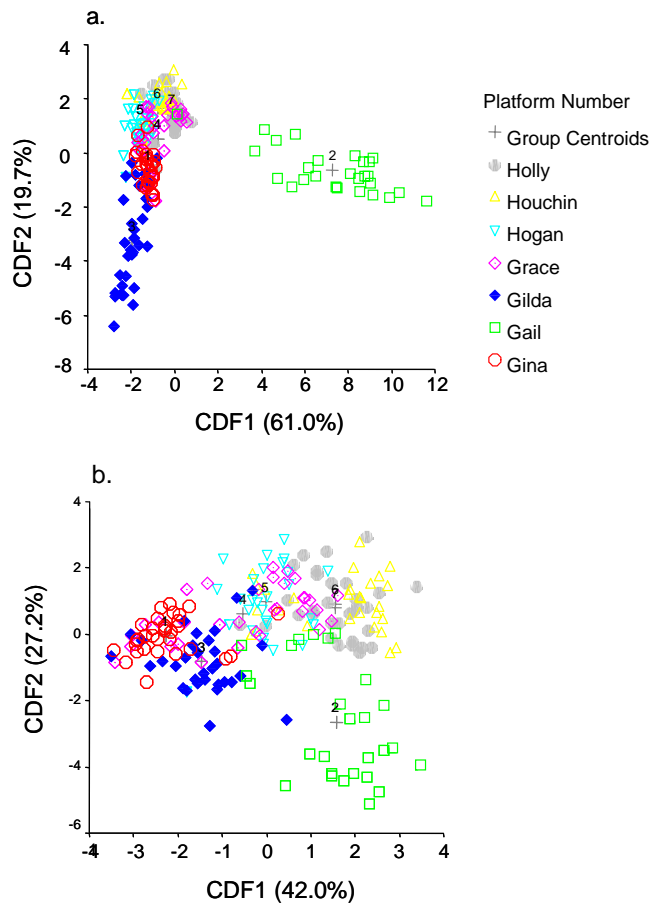
Community patterns

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 (Fig. 3a). 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. The negative correlation of cover of the bryozoan, *Watersipora cucullata*, with CDF2 (-0.379) for Gilda contributed to the separation of this platform from the others (Fig. 3a).

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 (Fig. 3b). 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 CFD1 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 (Fig. 3b).

Figure 3. Results of Canonical Discriminant Function Analysis of invertebrate communities on the seven study platforms: a) all species, b) exotics species excluded.

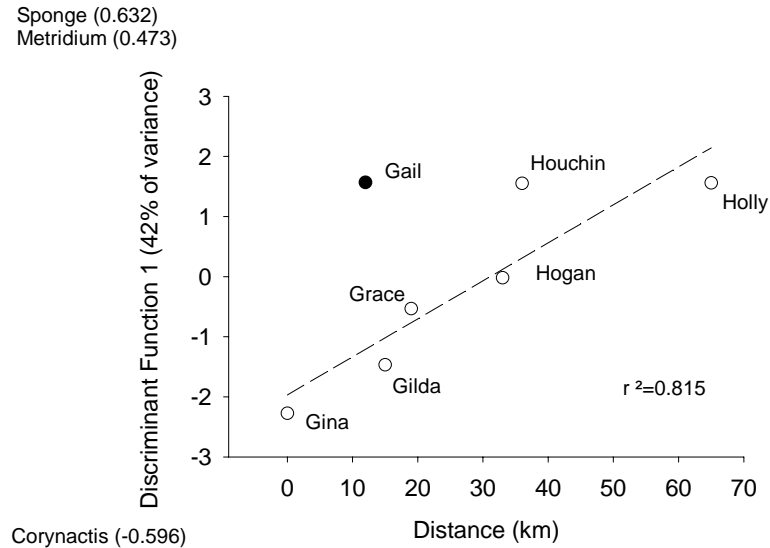


Community patterns and environmental variables

To explore relationships between community patterns and environmental variables, we used the calculated values of CDF1 for each platform (calculated including and excluding *Diadumene* sp. and *Watersipora cullculata*), and the independent variables of location 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 location along the channel ($P=0.014$: Fig.4).

Figure 4. 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.



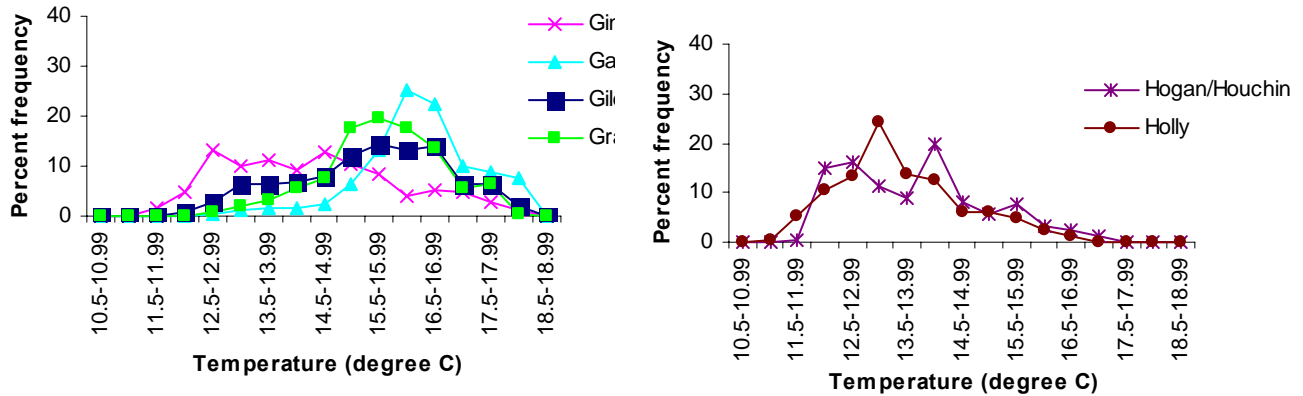
Measurements of water temperature during deployment of experimental modules

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 the end of each experimental period. To compare temperatures among sites we calculated the frequency of the number of hours at each water temperature (Fig. 5).

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 (Fig. 5). Such large temperature ranges were not recorded at the other southern sites.

Figure 4. Water temperature frequencies by degree hours for Summer 2001 at a) southern and b) northern platforms.

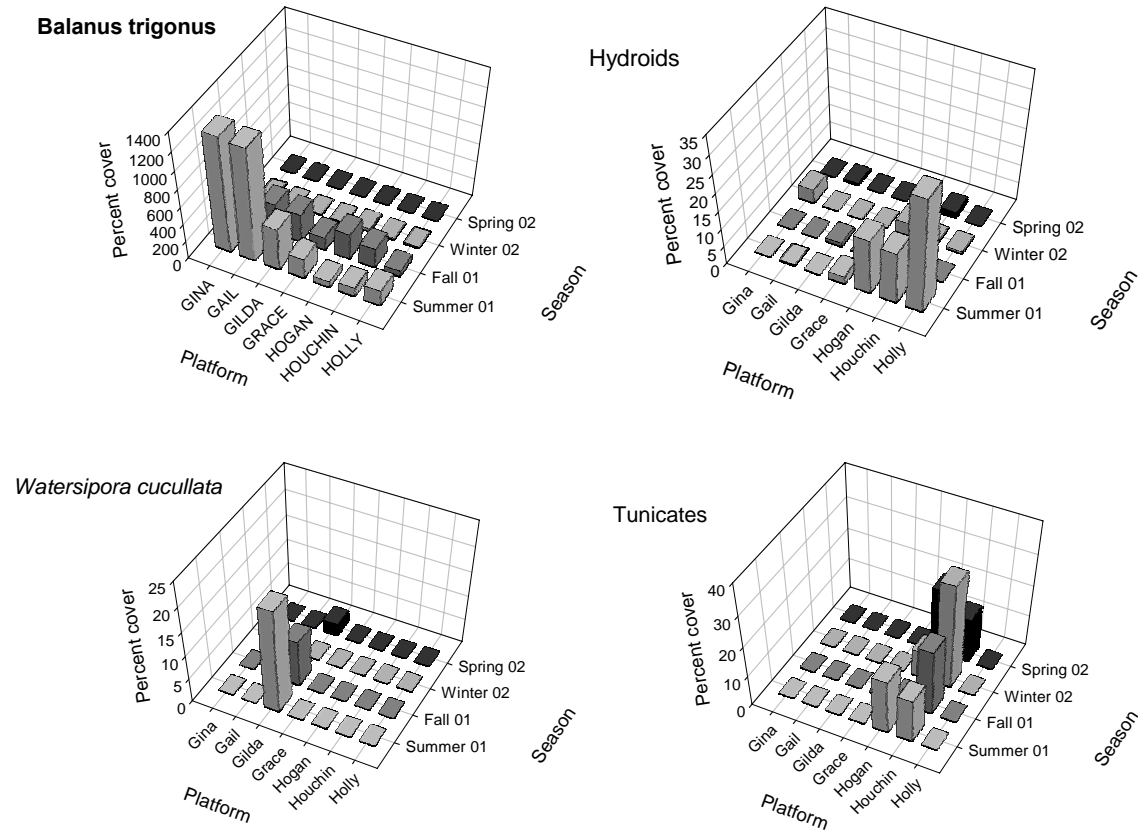
Figure 5. Distribution of water temperature, expressed as percent of total number of hours at a given water temperature, for the study platforms.



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 (Fig. 6). 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 6. 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 (R_s) 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.

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

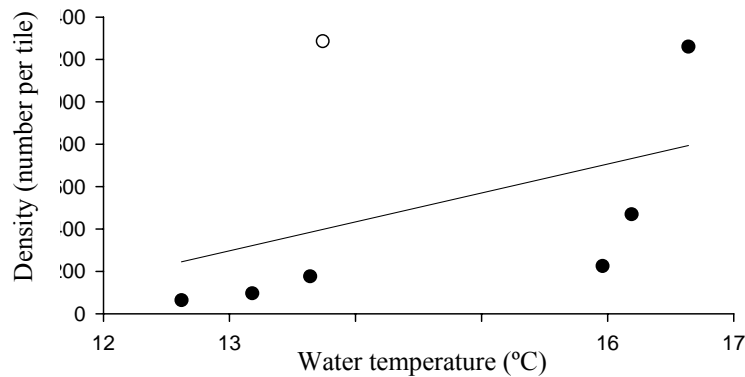
between recruitment and location for hydroids, their limited dispersal ability (crawl away larvae) suggests that oceanographic factors associated with water masses likely had little influence on transport of the hydroid larvae and subsequent recruitment. Instead, biological interactions (predation, competition)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

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

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

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 (Fig. 5). 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 (Fig. 7). This suggests that larvae of warm water species could have been transported in these water masses during the summer.

Figure 7. The relationship between recruitment of *Balanus trigonus* and water temperature (mode) at each location. Open circle = Platform Gina.



Dr. C. Culver was invited to present our project results at a special session on culture of pharmaceutically important species at an international conference, Aquaculture 2004 on March 1-5, 2004 in Honolulu, Hawaii. Her participation was sponsored by National Sea Grant. The title of her talk was "Use of OCS oil platforms as sustainable sources of marine natural products". A summary of our presentation was published in the Global Aquaculture Advocate, a bi-monthly publication of the Global Aquaculture Alliance. Entitled "Use of oil and gas platforms as harvest and culture sites for marine natural products", this article was part of a special issue focusing on culture of pharmaceutically important species.

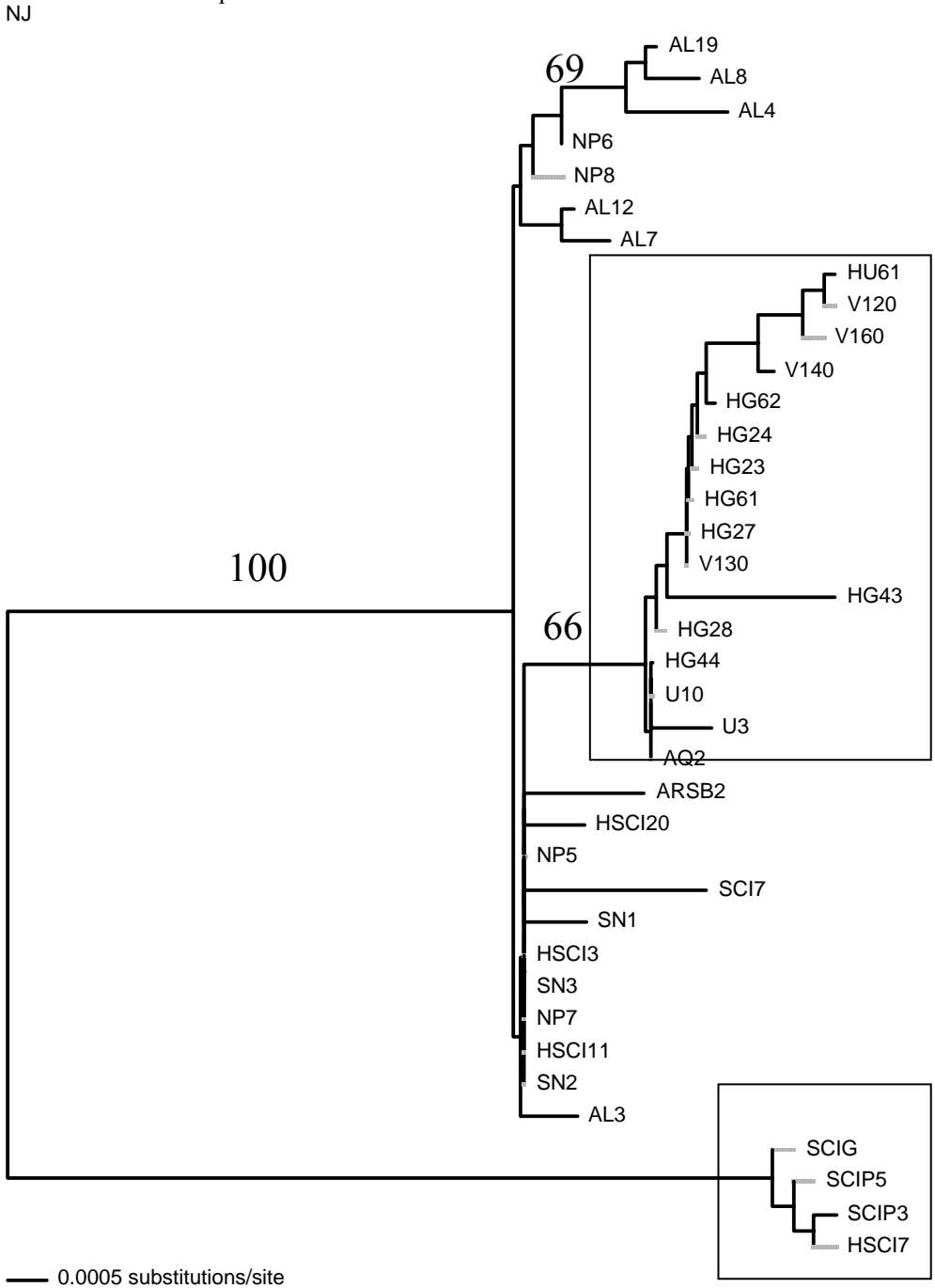
GENETICS:

Progress during 2003-2004

We have continued to make progress on determining the genetic variation among samples of *Bugula neritina* during this last quarter. 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 (Fig. 1). This analysis has two particularly interesting outcomes. First, it strongly supports that we have identified a new cryptic species of *B. neritina*, found, so far, only from Santa Cruz Island. Second, it suggests that all of the samples from two OCS oil platforms are members of a single clade and thus that colonization of platforms may be a relatively rare event. 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, the PI (Hodges) is working to analyze the mtDNA sequence data and to begin conducting the bench-work to amplify and sequence DNA from the bacterial symbiont. We also hope to hire a graduate student research assistant during the Fall quarter to complete the remaining bench work. 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 (Fig. 1). If so, we plan to collect and culture the new *B. neritina* type we have found (and any others our analysis uncovers) here at UCSB. If we are successful, we will then determine if it harbors new types of bryostatin compounds.

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 Hugo (HG) and platform Houchen (HU). The smaller box encompasses the new lineage of *B. neritina* found from samples on Santa Cruz Island.



PHARMACOLOGY:

Progress during 2003-2004

Fall 2003

Daniel Day (Jacobs Lab) spent most of the fall quarter optimizing a number of organic extraction procedures in order to obtain a favorable yield of pure extract from *Waterispora Cucullata* (WC). Once some of the organic extraction techniques were optimized we confirmed that the activity was retained by testing the pure compounds in the Sea Urchin Embryo assay.

Winter 2004

Drugging of HeLa S3 Cells with crude (WC-1) and partially purified (WC-2) marine natural product extracts from *Waterispora Cucullata*.

Fresh samples were extracted from *Waterispora Cucullata* (WC) and assayed on HeLa S3 cells for evaluation on cell proliferation and viability.

Results

Inhibition of Cell Proliferation and Viability

Plots were made of % inhibition of cell proliferation (average of 2 samples) vs. drug concentration. % inhibition data are shown in figures 1 and 2. IC₅₀ values were approximated from plots and determined to be 12 µg/ml for WC1 and 16 µg/ml for WC2. Cell viabilities were determined for each drug concentration by trypan blue dye exclusion and were found to be equal or less than controls in all cases (control viability 98.9%)

Mitotic Index, Spindle and Chromosome Abnormalities

The mitotic index was determined from DAPI-stained coverslips of untreated and drug treated samples. (Table 1 below). A 3 fold increase in mitotic index was seen in the two highest WC1 samples but the mitotic index of the WC2 sample was slightly below that of the control. A high percentage of mitotic cells on the WC1 treated coverslips were noted to have abnormal chromosome distributions (see attached PowerPoint Slide for example). The most common abnormal cell type was a mitotic cell with a distinguishable metaphase chromosome alignment but with 1 or more chromosomes stuck at the pole. Several years ago Mary Ann Jordan developed a classification scheme for these where she grouped the abnormal cells as having either type I, type II or type III spindles. (Jordan et al. 1992 J. Cell Science 102:401-16). Type I spindles have elongated astral microtubules (we suspect most of these were supposed to be kinetochore microtubules but never made the right connections) and a metaphase chromosome distribution with one to 4 chromosomes at the pole. Type II spindles have a shorter than normal interpolar distance (although still with long astral microtubules) and more than 4 chromosomes at the poles but still have recognizable metaphase accumulation of the majority of chromosomes

at the equator. Type III spindles form a ball of chromosomes as a result of a collapse of the spindle into a monoastral configuration in place of the normal bipolar orientation. We have observed these types of cells as a result of treatments with drugs such as the Vinca alkaloids, podophyllotoxin, and taxol type compounds. This morphology is observed when nanomolar concentrations of these drugs are used; concentrations that do not alter microtubule polymer mass. From studies of interphase cells treated with these concentrations of drugs we know that microtubule dynamic instability is being suppressed by these drugs at these concentrations.

Most of the abnormal cells in WC1 treated cells fell into the category of type I and type II spindles. The proportion of type I and type II mitotic spindles to total metaphase cells was determined and is reported in Table 1. The abnormal mitotic cells were rare in control populations and were not observed in WC2-treated cells. Also notable was the lack of increased numbers of multipolar spindles in WC1-treated cells (HeLa cells spontaneously develop 1-2% of these as a proportion of total mitotic cells but no increase in this number was seen in WC1 treated cells-data not shown). Multipolar spindles are common in cells treated with compounds like taxol and epothalone B, but not with Vincas and other drugs that at higher concentrations cause microtubule depolymerization. I think we can safely conclude that the crude extracts contain at least one compound that promotes microtubule stabilization in a manner similar to that of the Vinca alkaloids.

Table 1

Treatment	Mitotic Index	Type I spindles/total metaphase	Number of cells counted
0.2% DMSO	4.4	0.03	606
WC1 (40 µg/ml)	13.5	0.79	572
WC1 (20 µg/ml)	13.3	0.72	563
WC2 (20 µg/ml)	3.4	0	500

Figure 1

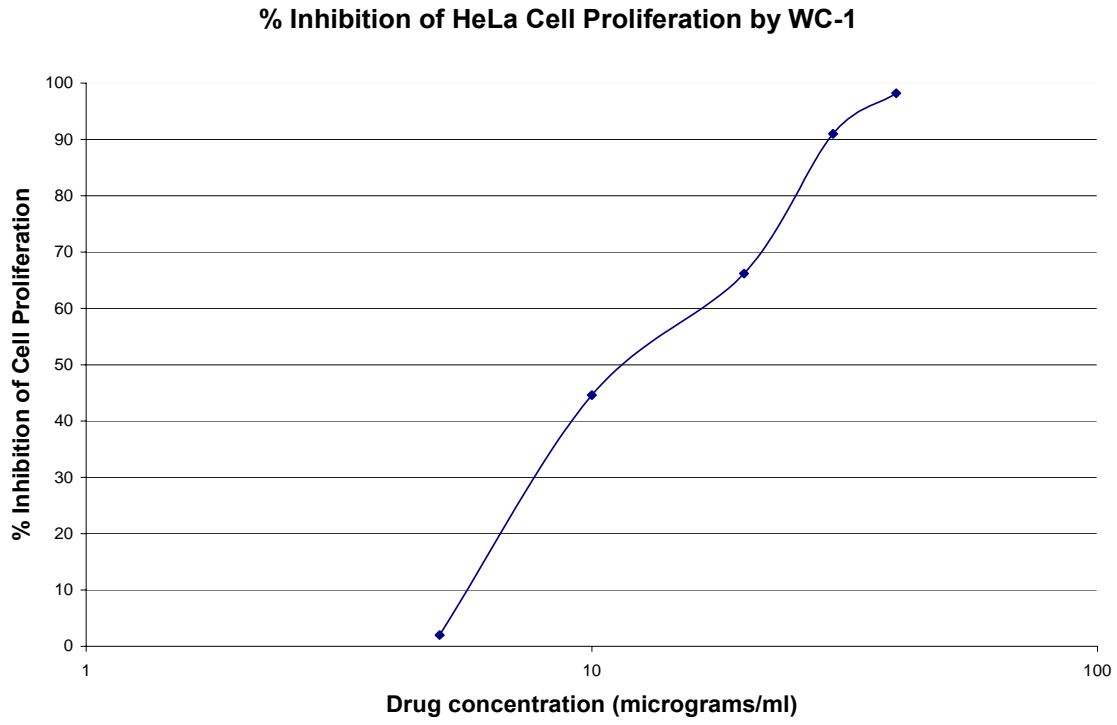
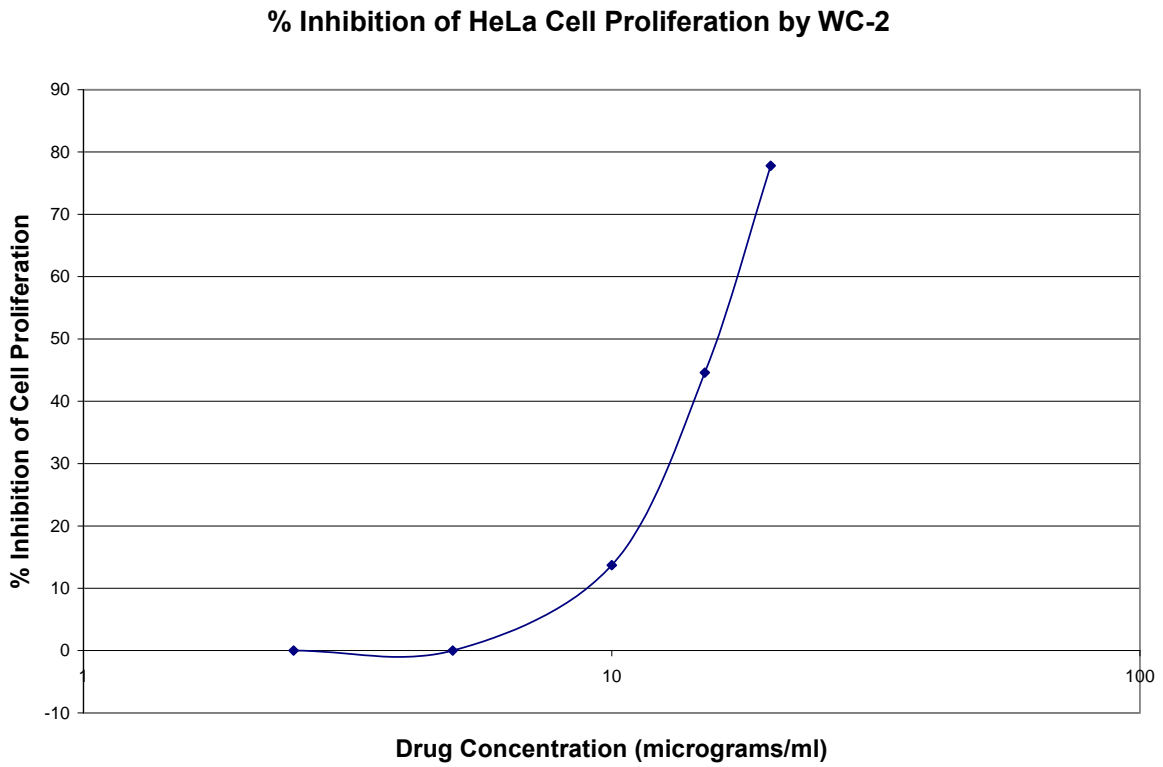


Figure 2



Spring and summer 2004

For the spring quarter and through out this summer Daniel Day has been working in the structure elucidation of the pure compound extracted from *Waterispora cucullata* (WC). After studying a number of established protocols we were able to once again significantly increase the yield of pure compound extracted. The methods and results are described in the following paragraphs and figures.

1. Extraction

After extraction with solvents hexane, methylene chloride, and ethyl acetate from lyophilized organism an excess of ethyl acetate was added to the ground remains. To this stirring mixture 1M HCl was added drop wise until compound is released from the bound substrate (calcium carbonate) and supernatant becomes clear. The acidified ethyl acetate layer was then neutralized and ready for separation procedures.

2. Thin Layer Chromatography

The crude extract was prepared using 500 micrometer preparative silica gel plates with a mobile phase of 100% THF (Fig. 3). A recent experiment on compound stability showed that the compound of interest (red compound) is highly sensitive to temperature and slightly by light (Fig. 4).

Figure 3.

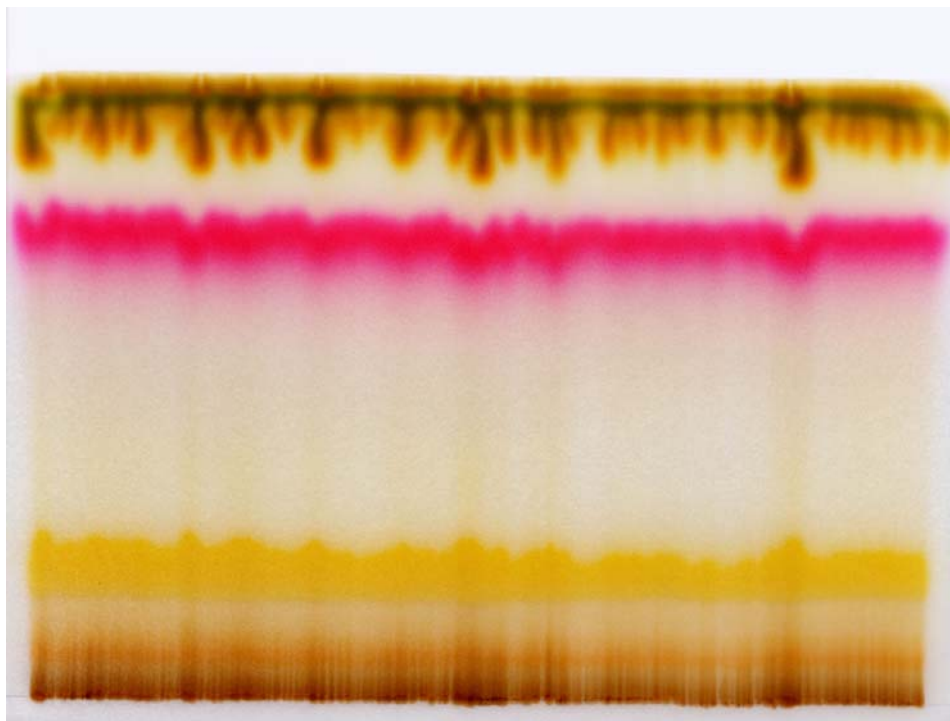
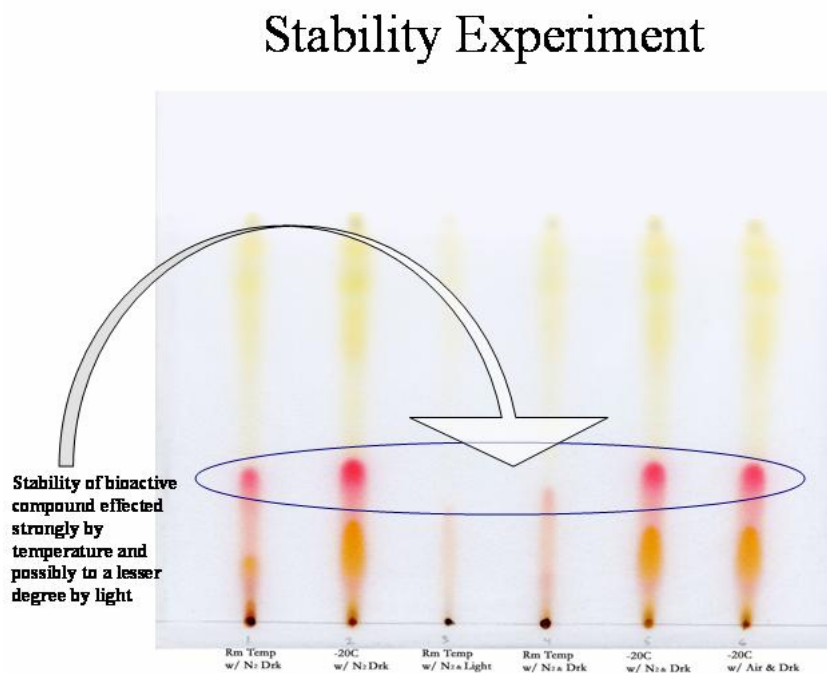


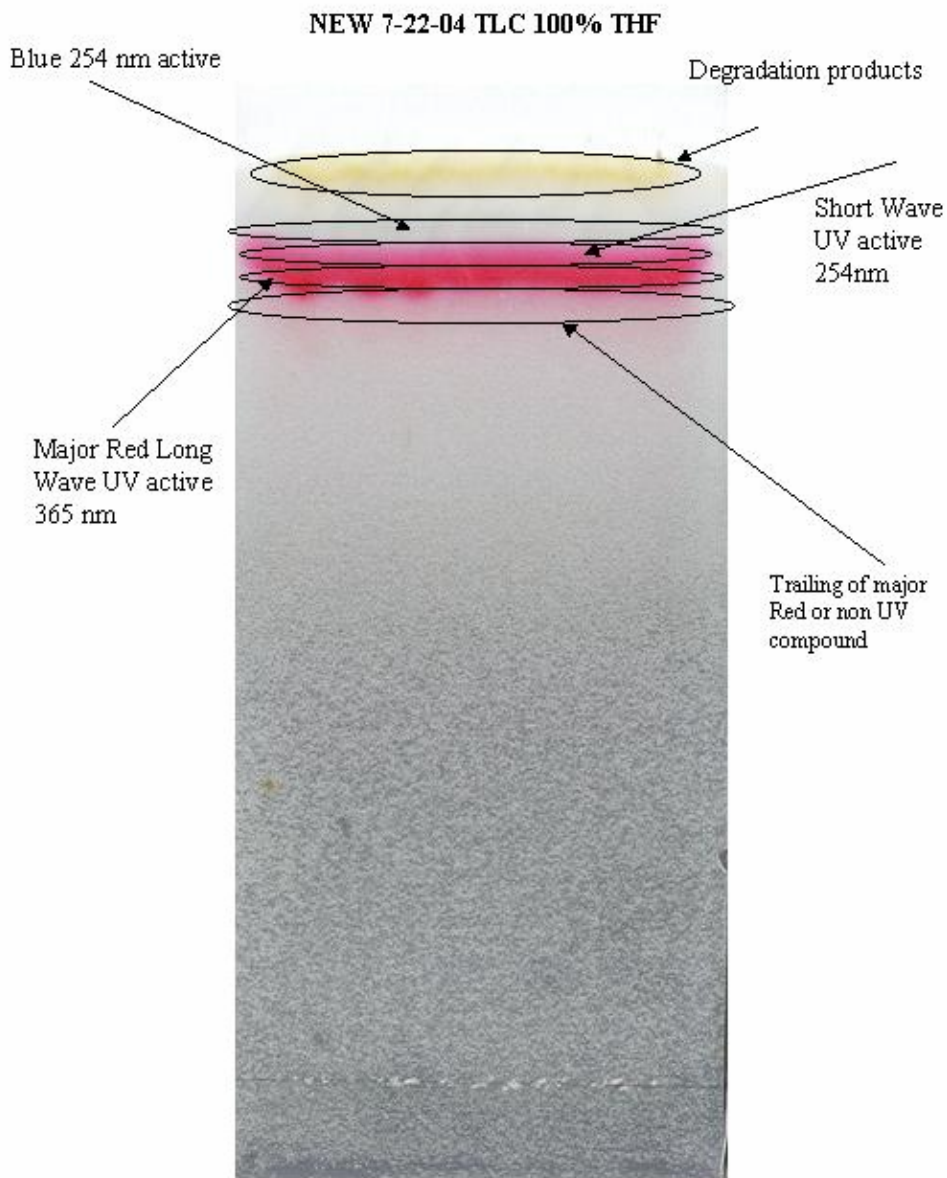
Figure 4.



3. Purification of the red band

After further purification with higher quantities of starting material it was found that the previously described red band was composed of 3 or more individual compounds including a unique blue colored band which is highly unstable (Fig. 5).

Figure 5.



4. Activity assessment of purified bands

In order to verify that the newly purified compounds (purified bands) retained biological activity a sea urchin embryo assay was performed. All bands showed 100% activity in inhibition of cell cleavage in the first cell division. At this point we are focusing our attention on the major red band, which can be seen on the previous TLC plate. Figure 6 shows a UV scan of the red active compound and figure 7 shows a mass spectroscopy analysis with a major peak at 311 m/z.

Figure 6.

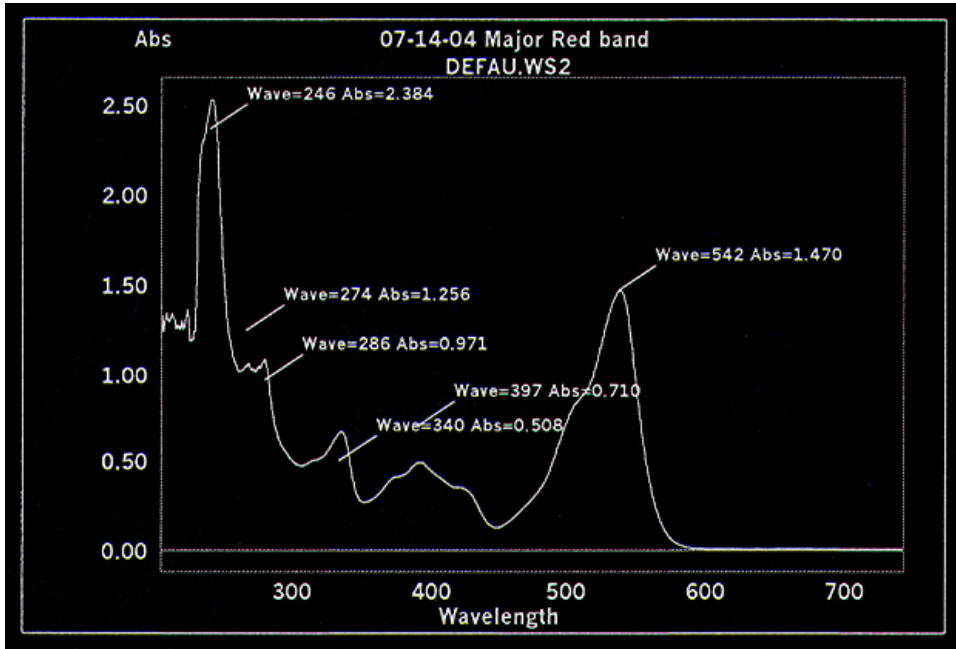
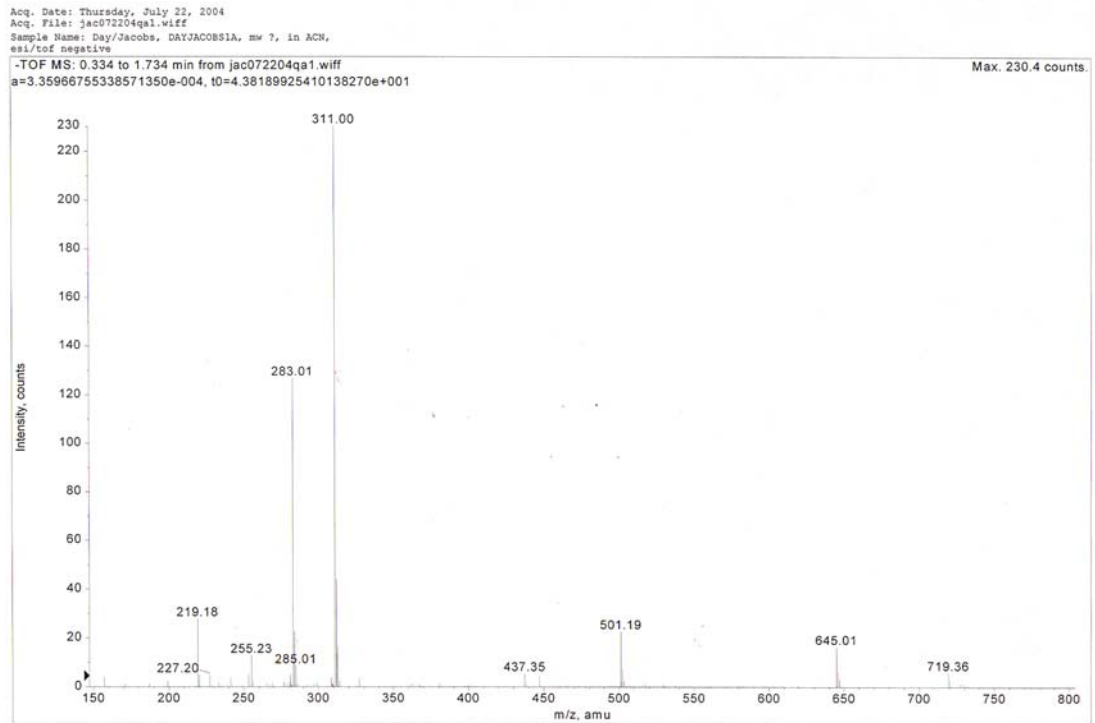


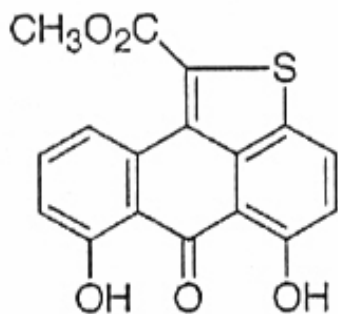
Figure 7.



5. Current work

We are currently in the process of continuing analysis, including more mass spectra, NMR, and elemental analysis in pursuit of a structure for the compound, which we believe, is a novel compound.

After a thorough literature search, we found a compound which may be similar but not identical to our compound of interest, described in a bryozoa of different a genus (*Dakaira subovoidea*). (Shindo, T et al. 6H-anthra[1,9-bc]thiopene derivatives from a bryozoa, *Dakaira subovoidea* Experientia 1993, vol. 49 pp177-178).



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

Summary of Research

Progress during 2003-2004

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 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. The text below outlines our progress during the preceding fiscal year.

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 the seabed at Shane Seep and published in Leifer and Boles (2004). They showed that seeps can be loosely classified into four categories, major, minor, obstructed, and elastic. Elastic vents were observed at Ira Seep, a tar mound that transiently released very large pulses of bubbles, with bubbles up to 20 cm diameter. Obstructed seeps are where a vent is obstructed physically, such as by a log or anemones, and tended to have very large bubbles. Minor vents produce bubble streams at a low enough flow rate that the size distribution 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.

Fluid Motions

Dye release experiments had quantified upwelling velocities in the plume and provided dramatic evidence of the existence of the upwelling flow. From the bubble distributions, upwelling velocities were inferred for different bubble streams and are published in Leifer and Boles (2004). Direct measurements of fluid motions by dye releases are published in Clark et al. (2003) and were ~ 30 cm/s for Shane Seep.

Seabed Morphology

During the last few years, numerous changes were observed in the seabed morphology and in areas of active seepage (i.e., vent activation and deactivation, crater growth and shrinking).

These changes were identified as related to transient seepage events that were observed both directly and through air pollution records. A theory on the effect of tar on gas seepage was developed from these observations. Changes in the seabed features and the theory were published in Leifer et al. (2004a).

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 occasionally 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, occasional 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 (2004).

Geochemistry

Gas samples collected and analyzed have suggested that Shane Seep emissions have an unusually high CO₂ concentration (~12%). Measurements were then made of the CO₂ profile in the first 3 m above the seabed, and showed a rapid exponential decrease. Surface bubble gas composition was measured for deeper (70 m) and shallower (20 m) seeps and showed more air content at the deeper seeps. Water concentrations were also measured in the bubble plumes at the deeper and shallower seeps. Deeper seeps showed super saturations not measured at the shallower seeps. This was interpreted as the bubble stream in water column had not had sufficient time to reach equilibrium with only 20 m water, but did reach saturation in 70 m water. These results were published in Clark et al. (2003).

Dissemination

As indicated above, most of the key results during the last year were also published. The results of the workshop discussing the underlying mechanisms of hydrocarbon migration was published as an article in EOS. These results were then expanded and the conceptual model further developed using an electrical circuit analogue for a venting system, published in Leifer and Boles (2004). Results were also presented during a keynote speech at the 7th International Conference on Gas Geochemistry, Freiberg, Germany.

Major Accomplishments, July 1, 2003 – June 30, 2004:

We are in the process of completing and submitting a draft final report.

MMS Action Required:

Report Study Number must be issued, and the draft report needs to be reviewed with comments sent electronically to johnston@lifesci.ucsb.edu.

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 2003 – 2004:

The primary tasks accomplished during the last year include:

- data collection (final)
- data processing code development (final)
- data analysis

The final set of drifter deployments directly related to the project was carried out on 12, December 2003. This gives a total of nearly 200 high-resolution drifter tracks collected during the project. The data processing codes were rewritten to properly handle parsing of multiple deployments of a single drifter in a day, to eliminate data when drifters are clearly caught in kelp beds, and to eliminate data records recorded during times when drifters were aboard boat. The final processed data are now available via the Web for anyone interested (<http://www.icesb.ucsb.edu/~kirk/drifter/analyses.htm>).

The short drifter tracks collected do not resolve a complete tidal cycle. Therefore, as a first analysis step, high frequency (h.f.) radar data and a tidal model were incorporated to resolve tidal signals. A considerable effort went into modeling tides to demonstrate that the drifters are not just measuring tidal currents.

Drifter data have been used for an improved validation of h.f. radar derived velocities. As the number of drifters sampling within an h.f. radar grid cell increases, so does the rms error in currents from the two sampling platforms. This suggests that up to 50% of the error previously reported in h.f. radar data is due to a discrepancy in sampling scales, and not due to error in h.f. radar or its sampling technique. A comparison between actual drifter trajectories and trajectories derived from h.f. radar fields shows a bias in position of more than 1 km after 3 hours, with the greatest discrepancy in the along-shore component. Such differences must be reconciled if h.f. radar fields are to be used to understand and forecast how passive tracers such as pollutants and objects lost-at-sea move through the coastal ocean.

The combined drifter – h.f. radar analysis is the topic of a manuscript in preparation for *JOAT*. Coastal dynamics, which must be understood for proper transport modeling, are discussed in a manuscript in preparation for *CSR*.

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.

Progress during 2003-2004

Major Accomplishments, June-December 2003 (Funding expired).

Concentrations of selected high molecular weight PAHs ranged from 0.049-38.6 ug/g (Table 1). In this particular study, high molecular weight PAHs were considered compounds with 3 benzene rings or more. The 100% COP treatment was dominated by fluoranthene with an average concentration of 1.4 ug/g, followed by dibenzo(ah)anthracene at 7.2 ug/g, and phenanthrene at 4.4 ug/g. All other PAH compounds were under 0.4 ug/g in the 100% COP sample. All samples from control to 1% appeared to have similar total HMW PAH concentrations. Concentrations of LMW PAHs tended to correspond to dilution profiles with the exception of 67% COP treatment where values were slightly lower than the 33% COP concentrations. In the 0.66 to 66 % COP sediments, Acenaphthene was the dominant PAH with an average concentrations of 30 ug/g in the 100% COP treatment.

Cytochrome P450 1A analysis showed a similar baseline expression pattern from the control to the 33 % COP sediments, with significant induction at the 66 and 100% COP sediments (Figure 1). P-values were 0.05 for the 66% sediment, and 0.01 for the 100% sediment exposure.

FAC accumulation in bile was variable in the 33, 66 and 100% PAH sediment exposures, with a trend towards increasing FACs in the bile at the higher sediment concentrations (figures 2 through 4). Values for BAP ranged from 5 to 30 ug/ml, PHE from 33 to 2,300ug/ml, and NAP from 500 to 14,000ug/ml. The lower concentrations of contaminated sediment (0.33%, 0.66%, and 1%) showed a slight trend for increasing PAHs with increases in sediment exposure. Increases in FACs did not correspond directly to increases in PAHs detected in the sediment particularly in the 33 and 66% COP sediments. Metabolites were highest following exposure to the 33% COP sediment, while PAHs were highest at the 100% sediment exposures. Much greater amounts of PAHs were found in the 100% sediments versus the 33% and 66%, and this did not result in a similar increase in FACs. FACs fluorescing at the PHN and NAP wavelengths were highly correlated, with an r^2 of 0.97. BAP values were less related to PHN and NAP, with r^2 values of 0.72 and 0.71 respectively.

No significant differences in plasma steroid concentrations between treatment groups and controls were observed (Figure 5). However, a trend toward reduction of estradiol levels was observed at the 1% COP treatment. Estradiol concentrations were between 347 to 849 pg/ml from the control to the 0.66% COP sediments, and from the 0.1 to the 100% COP sediments the

values ranged from 21 to 494 pg/ml. Testosterone levels were lower than estradiol at all concentrations (even control). GSI did not show any significant response to treatment.

Figure 1. Hepatic cytochrome P4501A expression from male halibut treated with various concentrations of COP sediments. Each value represents the mean of 4 individuals \pm SD. * $p \leq 0.05$

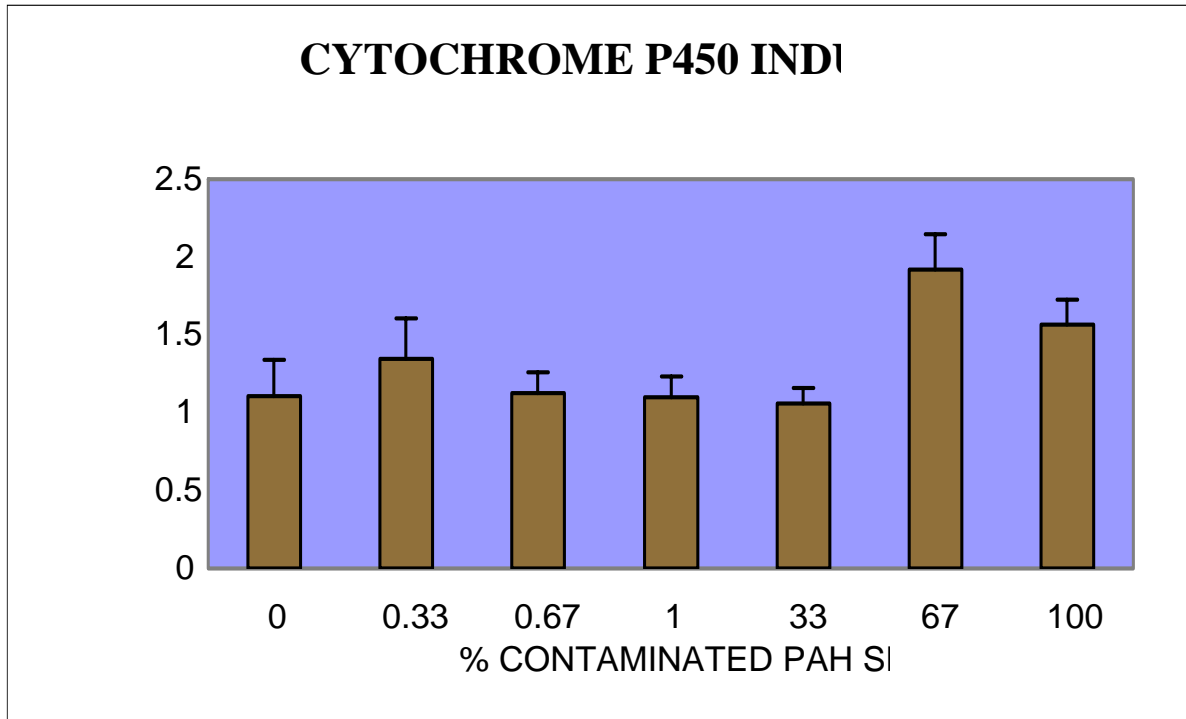


Figure 2. Biliary phenanthrene-like compounds from male halibut treated with various concentrations of COP sediments. Values with error bars represent the average of 3-4 replicates \pm SD.

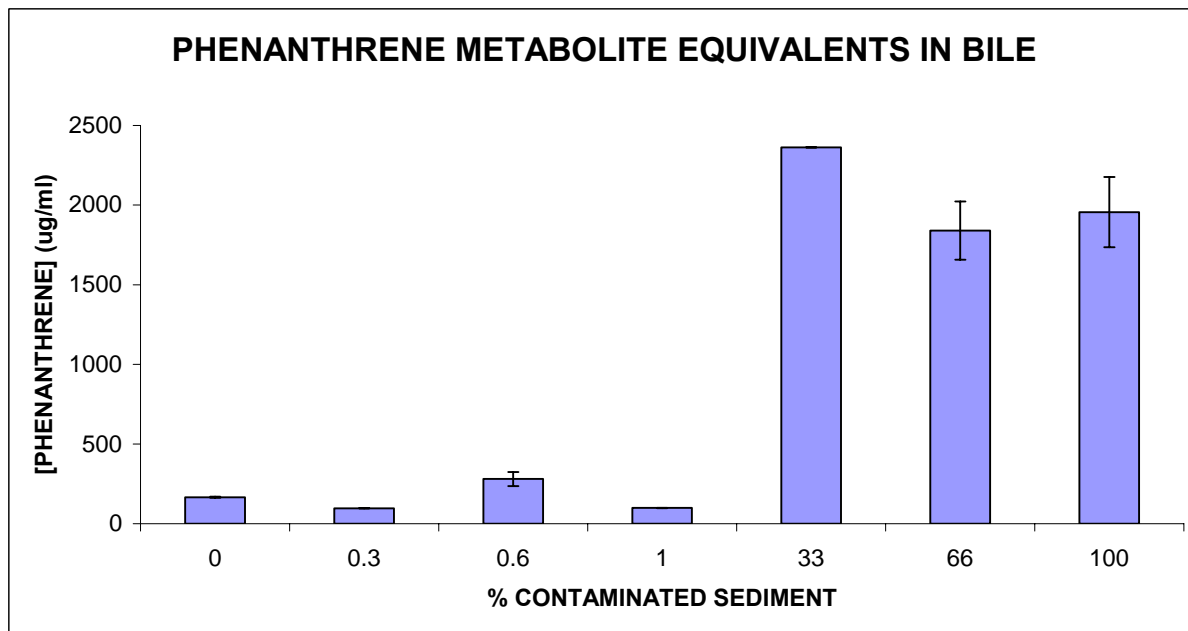


Figure 3. Biliary naphthalene-like compounds from male halibut treated with various concentrations of COP sediments. Values with error bars represent the average of 3-4 replicates \pm SD.

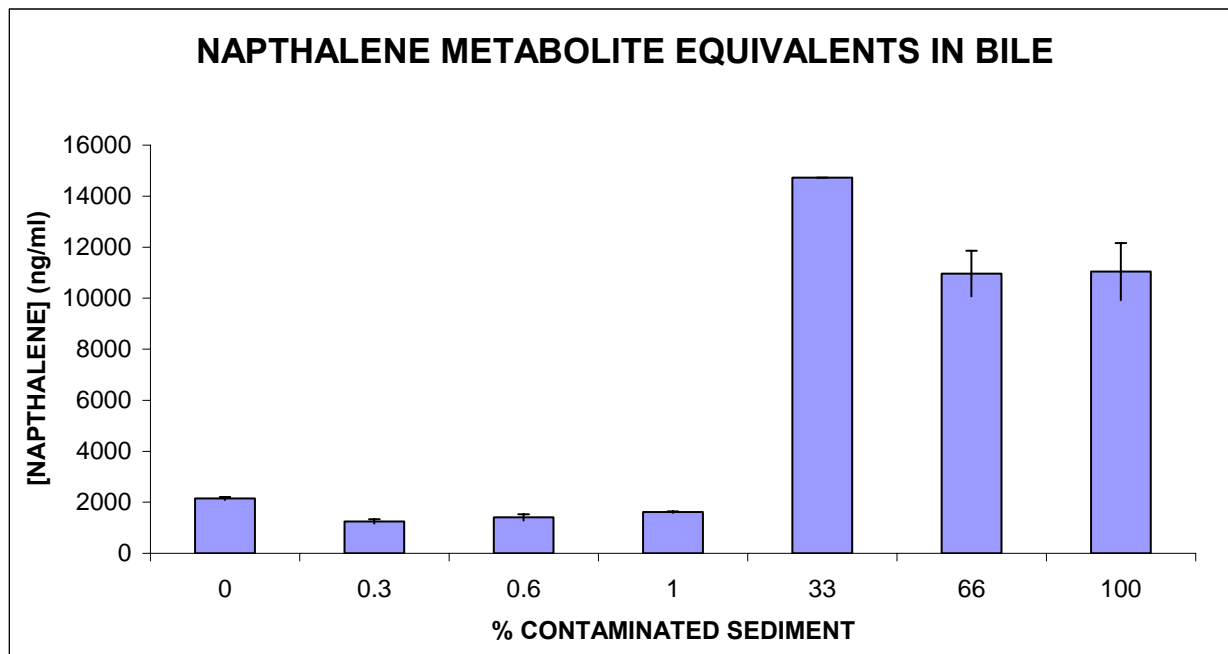


Figure 4. Biliary benzo(a)pyrene-like compounds from male halibut treated with various concentrations of COP sediments. Values represent the average of 2 individuals.

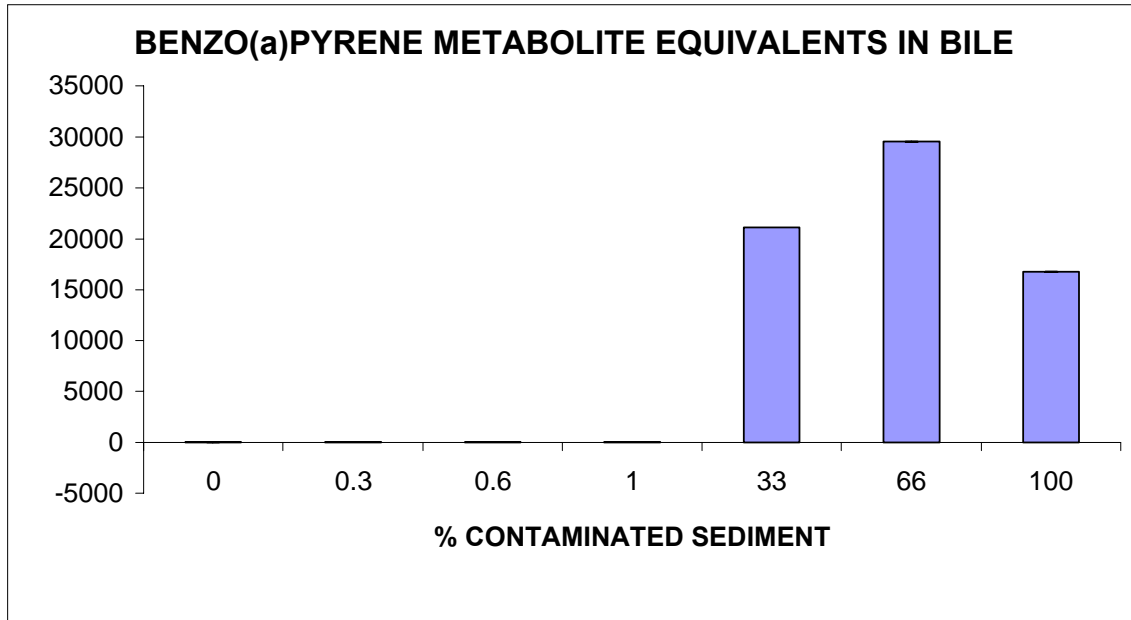
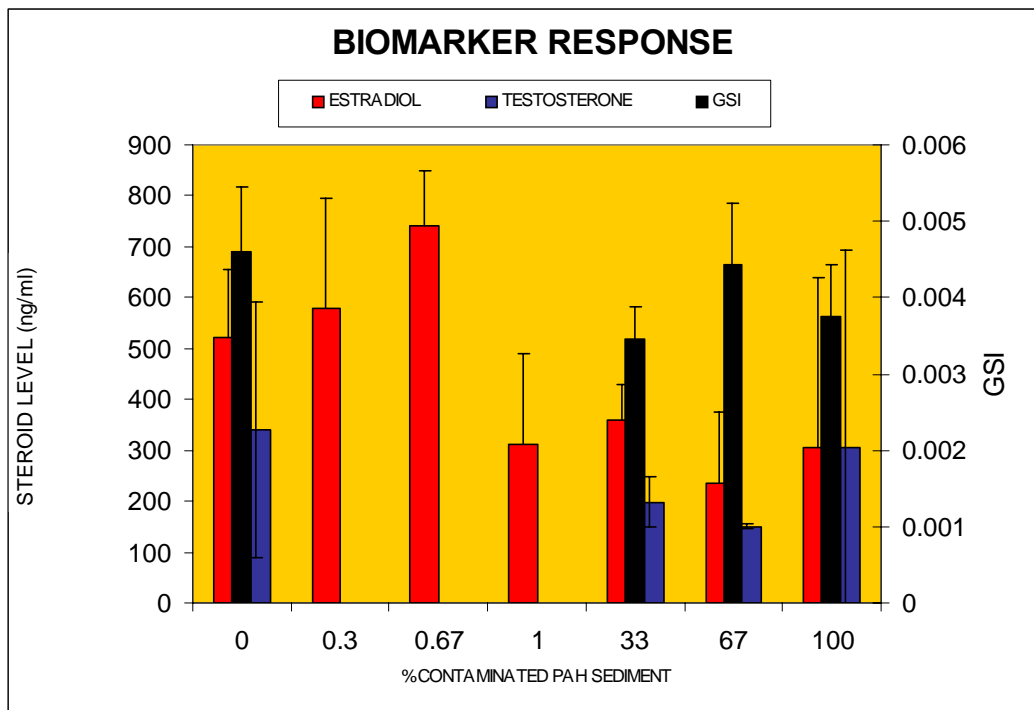


Figure 5. Plasma steroid and GSI values for male halibut treated with various concentrations of COP sediments. Each value represents the mean of 4 individuals \pm SD.



Summary:

Our study found slight induction of CYP1A in response to natural PAH contaminated sediment, and decreased estradiol levels at a lower threshold of exposure than either CYP1A induction or FAC accumulation. In comparison to values seen in other studies, these fish seemed to have particularly variable response in regard to FAC accumulation in bile, which may have been resolved with normalization to biliary protein content. CYP1A induction also seemed low with regard to the amounts of PAHs in naturally contaminated sediment from oil seeps. This may be due to a species specific low induction response, or perhaps natural oil from seeps have different mixture effects than anthropogenically derived PAHs which have previously been shown to cause the response.

Future Plans:

2 publications are in preparation; one evaluating halibut at 28 days of exposure and the second comparing responses between sand dabs and halibut after 7 days of sediment exposures.

Task 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

Progress during 2003-2004

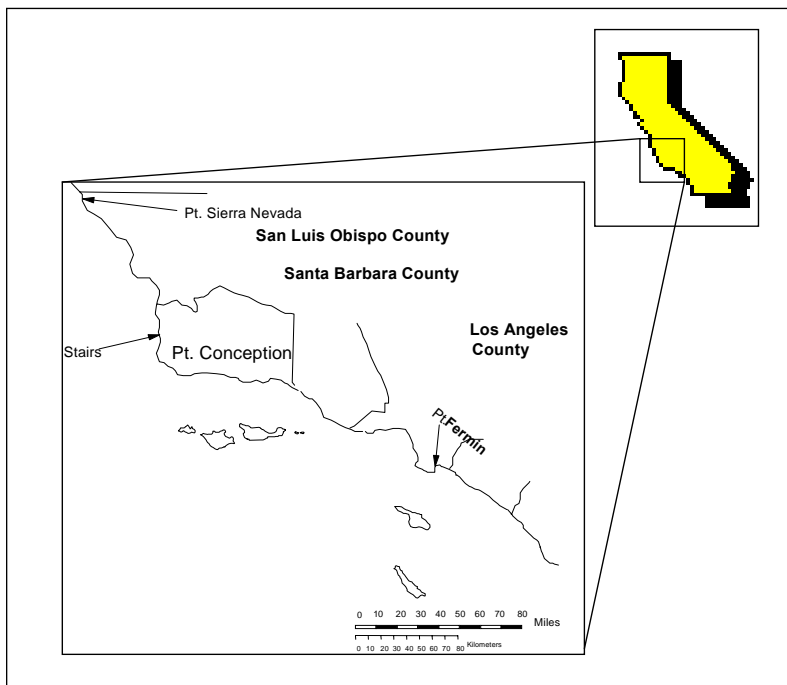
Site Selection

We used the following criteria to select sites for this study:

1. Proximity to existing monitoring plots. Only sites adjacent to MMS monitoring sites were considered as candidates for this recovery study. This will allow placing results in the context of historical species abundances.
2. High abundance of all four target species (*Chthamalus fissus/dalli*, *Endocladia muricata*, *Silvetia compressa* and *Mytilus californianus*.) This was determined qualitatively by assessing each potential site for the target species.
3. Geographic distribution of sites such that one site would fall in each of the three target biogeographic regions (North, near to and South of Point Conception).

Using these criteria, Point Sierra Nevada, Stairs and Point Fermin were selected as sites for this recovery study (see Figure 1.)

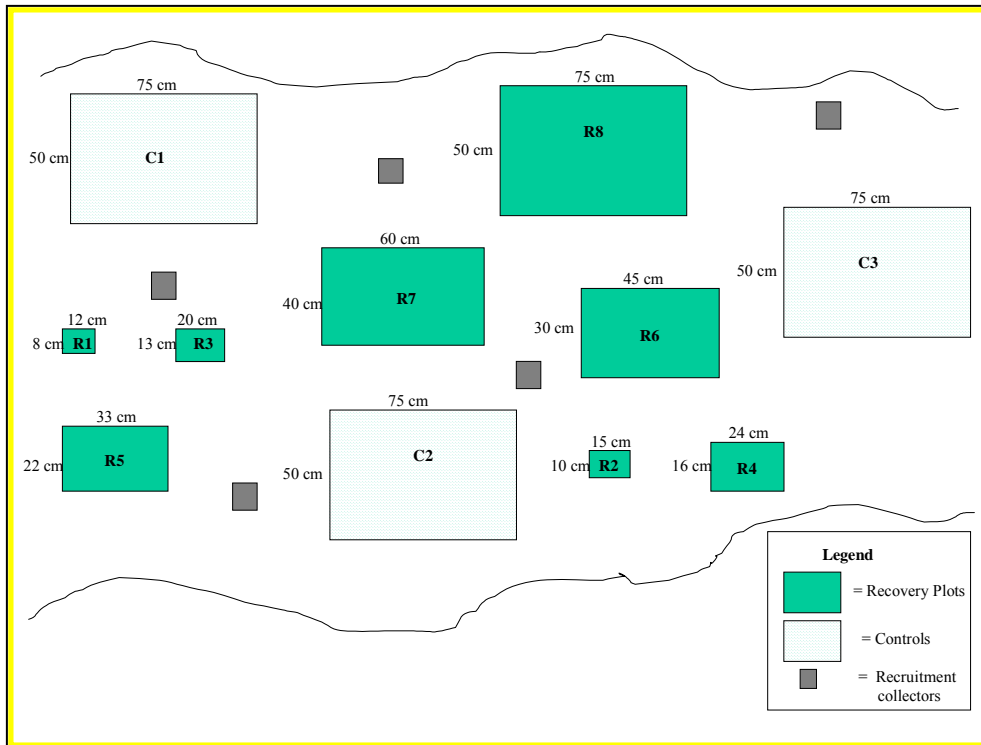
Figure 1. Map of sites where recovery plots were established. Note distribution of one site North, near to, and South of Point Conception.



Site set-up and initial sampling of Recovery and Control plots.

At each site, 8 recovery plots and 3 control plots were established in the *Chthamalus*, *Endocladia*, *Silvetia* and *Mytilus* assemblages (see Figure 2).

Figure 2. Schematic drawing of Recovery and Control plots in each assemblage.



Plots ranged from 8 cm x 12 cm to 50 cm x 75 cm, with one plot of every size. Control plots were the size of the largest clearing size, 50 cm x 75 cm. This is also the same size as the MMS monitoring plots. The total area cleared in each assemblage was approximately 1 square meter. A total of 44 plots were established at each site (8 Recovery plots and 3 Control plots in 4 assemblages). Length to width ratio was held constant for each size (approximately 1:1.5). Prior to clearing, every recovery plot was photographed and sampled in two ways:

1. A Uniform Point-Contact method was employed for each plot. The number of points in each plot reflected the size of the plot to accurately capture the plot: 100 points for the 5 largest sizes, and 50, 40, and 30 points for the three smallest plots. PVC “quadrats” were strung with fishing line to allow for the greatest precision possible when sampling plots. Data were collected by using a CSM 150 bar code scanner attached to a HandSpring handheld. Species were identified to the smallest taxonomic level possible.
2. Mobile critters were counted in each plot. Limpets and littorines were generally subsampled. Species were identified to the smallest taxonomic level possible. Only investigators who were experienced mobile counters (from either Shoreline Inventory or SWAT team) collected the data.

Experimental disturbances

Experimental disturbances were established in Recovery plots of all sites in late November – December of 2003. All biota were removed using chisels, paint scrapers, wire brushes and ice picks. All sites were cleared within 3 weeks of each other. A propane torch was used to sterilize all plots to remove microscope propagules.

All plots were photographed after they were cleared. Mussels, *Silvetia* and mobile invertebrates from Pt. Sierra Nevada and Pt. Fermin were collected and frozen.

Recruitment collectors

Recruitment collectors were deployed at each site. Five safety-walk plates were put amongst the barnacle plots (see Figure 3), 5 barnacle mimics in the *Endocladia* plots (see Figure 4), 5 *Endocladia* mimics in the *Silvetia* plots (see Figure 5), and 4 tuffies in the mussel plots (see Figure 6). In the barnacle zone, a rock area (10 cm x 10 cm) adjacent to the collector was cleared, in the *Endocladia* zone, *Endocladia* was removed from barnacles adjacent to the barnacle mimics, and in the *Silvetia* zone, *Silvetia* was removed from the *Endocladia* adjacent to the *Endocladia* mimics. These plots were also 10 cm x 10 cm, the same size as the collectors. At Pt. Fermin, where there was no *Endocladia* in the *Silvetia* zone, the collectors were placed adjacent to patches of *Caulacanthus ustulatus*, a turfy red alga in which juvenile *Silvetia* plants have been observed.



Figure 3. PVC plate covered with Safety walk and recruitment clearing in *Chthamalus* zone



Figure 4. Barnacle mimic and *Endocladia* recruitment plot in *Endocladia* zone.



Figure 5. *Silvetia* collector and *Silvetia* recruitment plot in *Silvetia* zone.



Figure 6. Mussel recruitment collector (“Tuffy”) in *Mytilus* zone.

Initial trends – Recovery plots

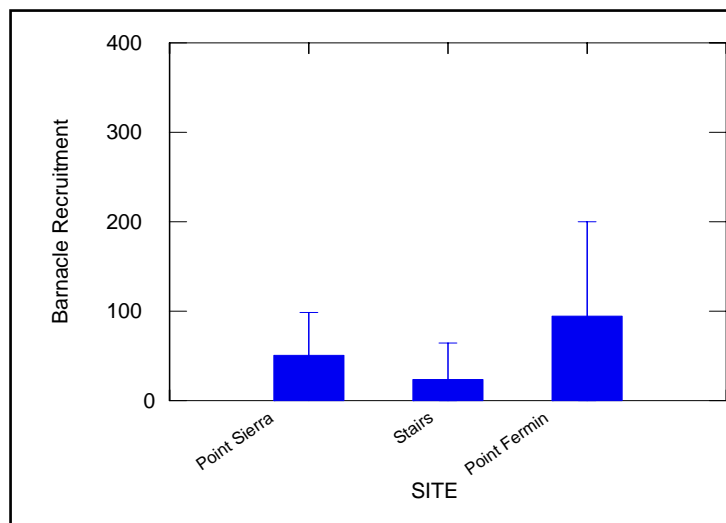
Recovery plots were sampled (Pt. Contacts, Mobiles and Photographs) in March 04 and again in June 04. Because data processing is a somewhat lengthy process, only qualitative trends are included in this report.

Chthamalus recruits are present in all sizes of all *Chthamalus* plots at all three sites. *Endocladia* has shown some vegetative reproduction (encroachment) at all three sites. Barnacles have also recruited into most *Endocladia* plots. Two Recovery plots at Stairs have shown *Endocladia* recruitment into the middle of the plot. As of the March sampling, there were no *Silvetia* or Furoid recruits in any of the plots. However, in the June sampling, Furoid recruits (<2 cm) were detected in some of the Recovery plots at all three sites. Some mussel plots have shown varying degrees of encroachment; no mussels have recruited into the plots.

Initial trends – Monthly recruitment:

Recruitment surfaces have not been processed yet in the lab. As such, only barnacle recruitment data is included. Point Fermin and Point Sierra Nevada have showed higher mean monthly recruitment from January to May than Stairs (see Figure 7).

Figure 7. Mean monthly barnacle recruitment (\pm SD) at Point Sierra Nevada, Stairs and Point Fermin from January 2004 to May 2004.



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 be trained to assist with processing of recruitment surfaces.

Problems Encountered: None

Estimated Percentage of Budget Expended: ~ 35%

Task No. 85338: *Weathering of oil and gas in the coastal marine environment: quantifying rates of microbial metabolism*

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

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

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

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

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

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

We have performed our first experiments designed to assess the rates of hydrocarbon weathering. One experiment involved collecting a time series of surface slick samples at Shane Seep, using the slick sampler developed by other MMS-funded scientists (Liefer et al). Samples were collected at the seep and 'down-slick' and represent a rough time series.

Another experiment began on October 27 when we collected 5 L of sediment from anoxic regions of Shane's seep to be used in a long-term incubation experiment. The sediment was transported back to the lab, while being kept under environmental conditions. The Goal of the project is to meet the objectives described in the above paragraph. Specifically, we intend to

assay the weathering patterns and microbial activity in anoxic, sulfidic sediments. The general approach is to incubate hydrocarbon-contaminated seep sediments under controlled conditions while assaying CO₂/H₂S/CH₄ production, sulfate consumption, and changes in petroleum composition.

Experimental design:

Serum bottles (60 ml) were filled with 10 g of wet anoxic sediment (~9 ml), 30 ml sea water, and a known aliquot (0.1 g) of raw petroleum - leaving ~ 20 ml of head-space volume. The raw petroleum was obtained from platform Holly and should be similar in composition to the petroleum emitted from Shane's seep. We will use a total of 138 bottles, 81 will be analyzed for weathering and 57 bottles will be used as controls. This allows for the analyses, in triplicate, of 27 scheduled time points. Analyses of the samples began at time 0 and will be carried out monthly, or more frequently, depending on microbial activity based on CO₂ production and sulfate consumption.

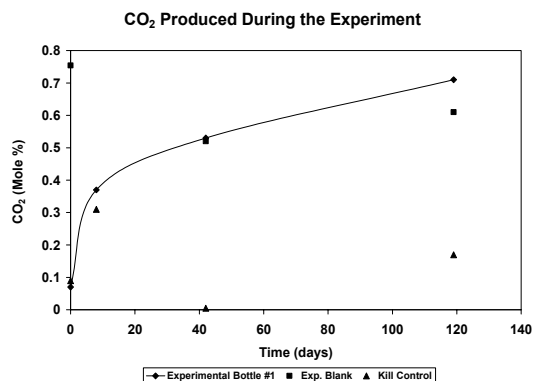
Experimental procedure:

All samples were prepared in a glove bag and transferred to paint cans containing 10-15 ml of a cystiene solution where they will be kept anoxic. In addition to the triplicate samples in the paint cans each one also contains a control. This control contains the same amounts of sediment and seawater but is heat sterilized in an auto-clave. In addition to these controls we will also analyze a blank containing only sediment and seawater at each time point as a reference. A set of oxygen controls was also prepared using serum vials containing reduced resazurin which were sealed in paint cans containing 10-15 ml of cystiene solution. The resazurin can be used as an indicator of oxygen contamination and should alert us in the case of oxygen penetrating the paint cans and serum vials. Serum bottles were capped (with Teflon-lined stoppers), crimped, flushed with Helium and vigorously shaken. Samples are incubating in the dark at near in-situ temperature (17° C). Sample bottles will be harvested in triplicate according to the above schedule. At the time of sampling the headspace will be analyzed for CO₂/H₂S/CH₄, and liquid samples will be taken for sulfate, sulfide, DIC and organic acid analyses. Samples will then be frozen and sent to WHOI for GC × GC analysis.

Analytical procedures:

Gases (CO₂/CH₄/H₂S) are quantified in the headspace using an agilent Micro GC/TCD at UCSB shown in Figure 1. TCO₂ in the aqueous phase will also be quantified using the agilent Micro GC/TCD. Aqueous sulfur (~ sulfate) is quantified by spectrophotometry and ICP-OES from the liquid phase overlying the sediment at UCSB. Organic Acids are to be measured by HPLC at UCSB. DIC will be measured at UCSB. Hydrocarbon composition will be monitored using GC×GC at WHOI.

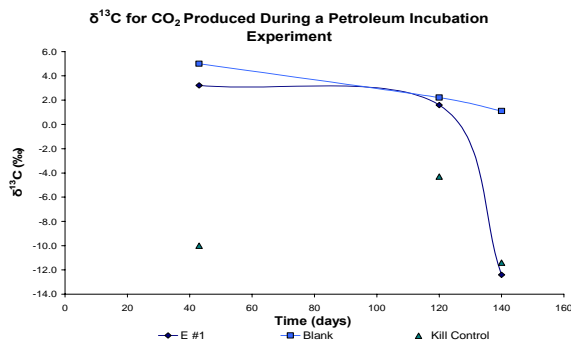
Figure 1. Left panel shows an image of the agilent Micro GC/TCD. Preliminary results are shown in the right panel for CO₂ produced in the experimental, blank and kill control bottles over the first 120 days of the experiment.



Results:

During the first 120 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. These experiments have focused on quantifying CO₂ in the head-space of the incubation bottles, determining the $\delta^{13}\text{C}$ of the CO₂ in the head-space and an assay for the production of sulfide. The isotope ratio mass spectrometer used for this experiment, along with our initial results, are shown in Figure 2. Quantifying CO₂, the end-product of petroleum consumption by microbes, and analyzing the $\delta^{13}\text{C}$ of that CO₂ will aid in determining the extent of microbial activity. The production of sulfide should indicate both that conditions are sufficient for microbial growth and the presence of sulfate reducers which has been postulated to be a necessary condition for microbial hydrocarbon oxidation.

Figure 2. Left panel shows an image of the IR-MS used to determine isotopic values for CO₂ produced during the experiment. Right panel shows initial results for the experimental (E#1), blanks and kill controls during the first 120 days of the experiment.



Analyses performed on the first 4 time series samples show a steady increase in the quantity of the CO₂ in the experimental bottles. Results from experiments using the isotope ratio mass spectrometer (IR-MS) on the CO₂ in the head-space show a decrease in the $\delta^{13}\text{C}$. Analyses performed on December 18, 2003 show a $\delta^{13}\text{C}$ value of approximately +3‰ whereas values from tests performed on experimental bottles on March 24, 2004 showed a decrease in the $\delta^{13}\text{C}$ to approximately -12.5‰. The $\delta^{13}\text{C}$ value determined in the kill controls has been static at approximately - 10‰. Sulfide assays show an increase in sulfide produced in the experimental bottles from T=0 to T=4. Aqueous sulfide concentrations have increased from below detection to slightly less than 300 μM in the first 120 days of incubation. Sulfide concentrations in the kill controls have remained below detection throughout the experiment.

The surface slick samples collected for the 'down slick' time series did not contain enough oil to quantify and will be repeated in the coming year.

Future plans:

We are in the process of analyzing samples from the long-term incubation experiment, designed to broadly assay hydrocarbon weathering patterns, including aromatics. The duration of the experiment is planned for 12-18 months. Samples are sacrificed on a monthly basis and assayed using the methods described above, including the new GC×GC techniques developed at Woods Hole Oceanographic Institution. We have acquired a Spectronic 20 spectrophotometer for use in quantifying aqueous sulfate and to calculate sulfate reduction rates in the experimental bottles. Since microbial activity has been indicated, the first 5 time series will be shipped to WHOI for GC×GC analyses. We will also begin a new set of incubation experiments using butyl rubber stoppers in place of the shallow Teflon coated stoppers used previously.

Problems Encountered:

We have encountered some technical problems with the HP 5890 used for this project, likely related to the FID gas jets. We have not yet been able to acquire the RAGA radioactivity detector. The original detector set for purchase and use on this project has been taken off the market and we are searching for a replacement. In addition, we encountered a problem with the Teflon stoppers used for sealing the incubation bottles. The stopper or part of it that fits into the bottle is shorter than the "Hungate style" stopper. This has lead to a few bottles analyzed being compromised with air which has appeared to have decreased the microbial activity within the bottles. We are currently working to resolve these issues and are beginning a new set of incubation experiments. This set will include approximately the same number of bottles but we will use butyl rubber stoppers (Hungate style) and include a small addition of sulfide in order to scrub oxygen that might seep into the containers over the length of the experiment.

Estimated Percentage of Budget Expended:

Project Year 1: 100 %

Project Year 2: 100 %

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

Progress during 2003-2004

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. The primary goal of this project is to explore whether indices of ecological performance (e.g., nutritional condition, size, individual growth) of a model fish and its invertebrate prey differ between platforms and natural reefs. We selected the painted greenling (*Oxylebius pictus*) as our model fish. It 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 and thus have limited movement among locations. Invertebrate prey of painted greenling consist primarily of small amphipod crustaceans, but may also include small gastropods, polychaetes, and other invertebrates (see below). During the past year, we sampled potential invertebrate prey monthly at two natural reefs (Naples, Mohawk) and two offshore oil platforms (Holly, Houchin). Painted greenling were sampled from these locations in September 2003 and April 2004.

Samples of invertebrates are taken within randomly placed 20 x 20 cm quadrats along transect lines at a depth of ~ 9 m using a combination of scraping and vacuum sampling. On return to the laboratory, prey items are separated from non-prey material that commonly includes turf forming algae and, from the platforms, mussels and other macroinvertebrates. The major non-prey components of the benthic habitat in each sample, such as the benthic algae, are also quantified in terms of weight or volume. Following this coarse processing, prey items are identified, counted and weighed, and for some taxa measured. These data will allow us to compare the standing crop, composition, and perhaps production of potential prey among locations. To date, we have processed 440 samples of invertebrates from a total of 625 samples taken at the four locations. In addition to the field sampling, we are comparing the “instantaneous” molt rate and molt increments of caprellid amphipods, important prey items of painted greenling, among locations. Caprellid amphipods are maintained individually in the laboratory following sampling, and the number of individuals that molt from each location is recorded over three consecutive days. The molted exuvia and newly molted animal are measured to determine the molt increment of each individual that molts. These data may permit a comparison of individual growth, one component of production, of these amphipods among locations.

Our data to date indicate that the total density and taxonomic composition of potential invertebrate prey of painted greenling differ greatly among platform and reef locations (Fig. 1). Total densities of small invertebrates were more than an order of magnitude higher at Platform Holly than the other locations and were frequently the lowest at Mohawk Reef. The invertebrate assemblage at the platforms and Naples Reef is dominated numerically by gammarid and caprellid amphipod crustaceans. The species composition of caprellid amphipods, important prey items of painted greenling, differ among locations with an as yet unidentified large (up to 18 mm) species comprising 61% of the assemblage at Holly, but <10% at the other locations (Table 1).

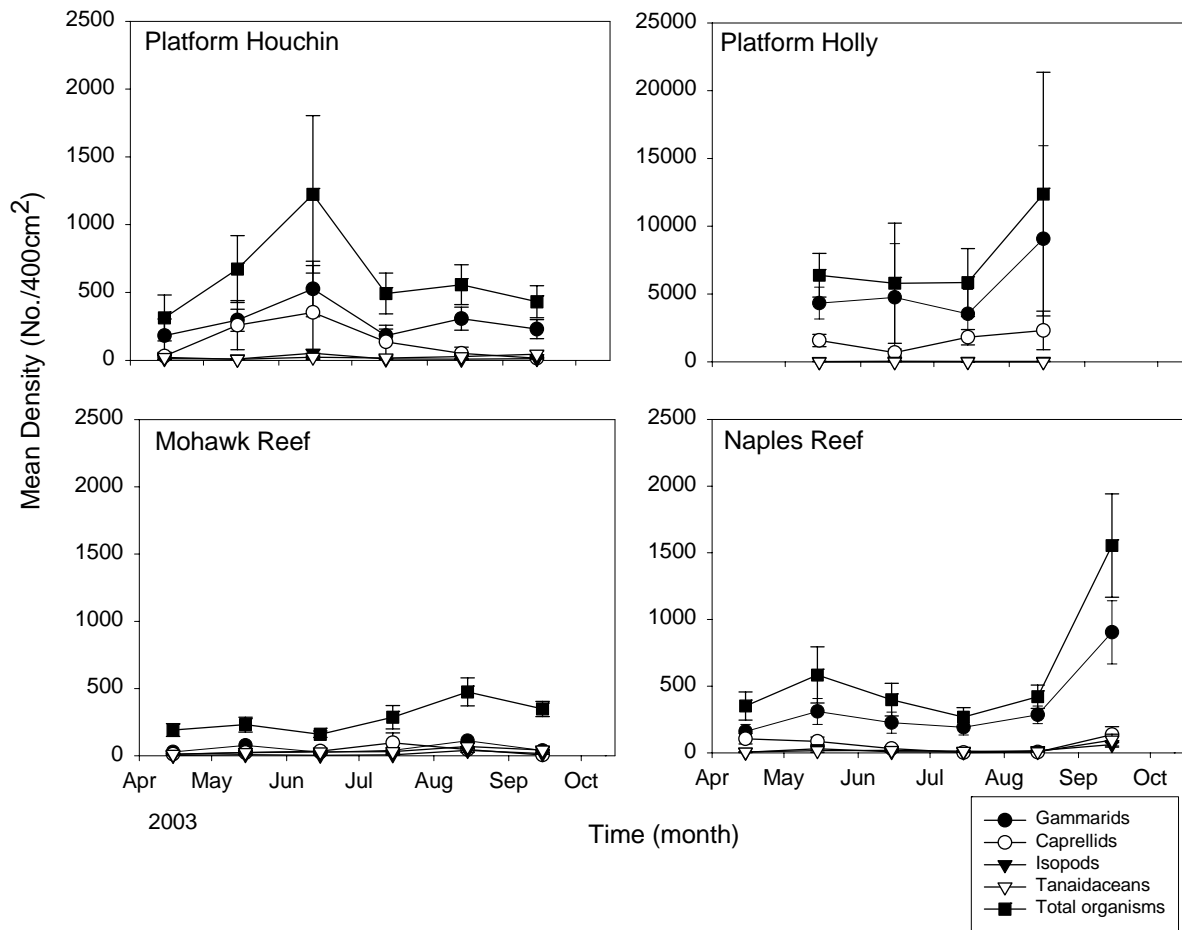


Figure 1. Mean density ($\pm 1SE$) of major groups of organisms over time at platform and natural reef study locations. $n=8$ to 12 quadrats/location in each month. Note variable scales on y-axis.

The ecological performance of painted greenling is being compared across locations through measurements of the quantity and quality of prey items consumed (number and types of prey in the stomach and overall weight of stomach contents) and the nutritional state of the fish (condition factor, K). Painted greenling are collected by hand in the same area that invertebrates were sampled, injected through the mouth with formalin to preserve the stomach contents, and returned to the laboratory for processing. In the laboratory, each fish is measured (standard

length) and weighed. The stomach from each fish is removed and the contents weighed, identified, and counted.

Preliminary data from fish sampled during September 2003 show that painted greenling at all locations were feeding primarily on gammarid and caprellid amphipods (Fig. 2). There also appears to be the selective ingestion of caprellid amphipods over other types of prey; caprellid amphipods were present in stomach contents at disproportionately higher frequencies than their relative abundance at each location. This pattern was particularly evident at Mohawk Reef and Platform Holly. The condition of painted greenling (estimated as K) varied among locations and appeared related, at least in part, to the availability of amphipod prey; values of K were

Table 1. Species composition of caprellid amphipods (*Caprella* spp. as percent of total) at the platform and natural reef locations. Data are the % contributed by each species to the total weight of fish prey sampled on each platform (these data are from samples processed to date).

Location	Caprellid species			
	<i>C. californica</i>	<i>C. verrucosa</i>	<i>C. equilibra</i>	Unk Species A
Naples Reef	28.0	22.2	46.6	2.7
Platform Holly	1.0	<1.0	37.1	61.0
Mohawk Reef	62.7	18.7	17.6	0.5
Platform Houchin	4.2	5.3	81.0	8.1

substantially higher for fish at Platform Holly compared to fish from the other locations (Fig. 3). This site also had the highest abundance of prey species, indicating K may be influenced by food availability for the model fish. However, an unknown “location effect” may be present as well since K is similar at Mohawk and Platform Houchin, but prey availability is higher at the platform. We have initiated a laboratory experiment to directly test the effects of prey abundance, species composition, and microhabitat structure (which also differs among our sites) on fish feeding rates and condition index. This experiment will help us better understand the variation observed in K-value of fish and its relationship to prey population dynamics across POCS platforms and natural reefs.

During the upcoming year we will complete our regular sampling of invertebrate prey at Platforms Holly and Houchin and Naples and Mohawk Reefs, develop estimates of standing crop and production of these 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.

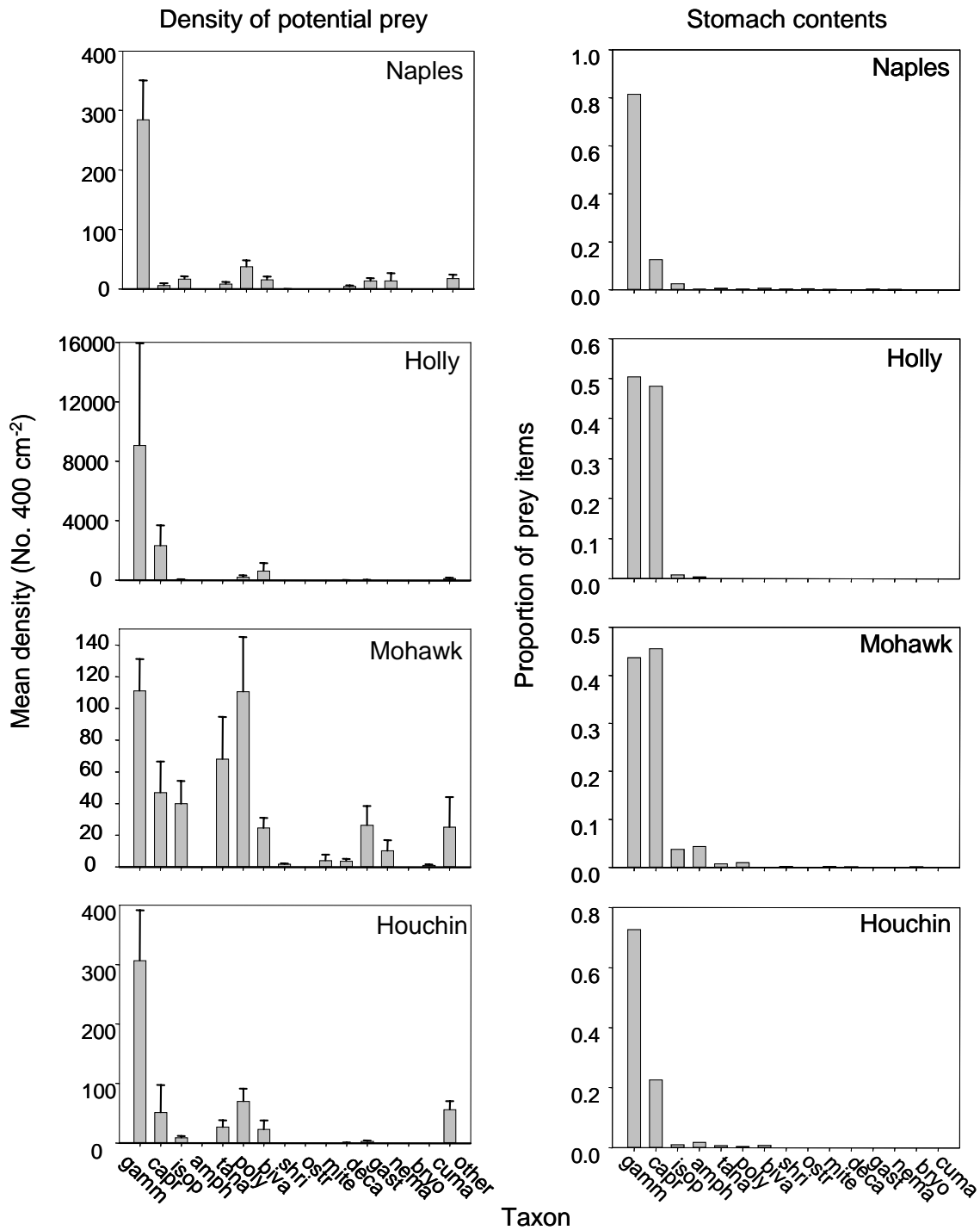
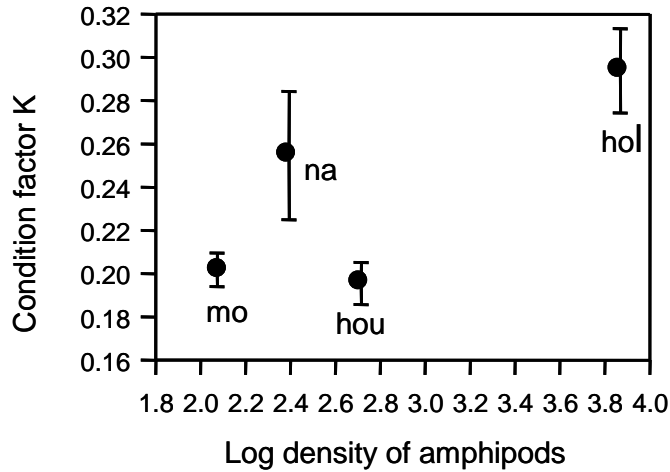


Figure 2. a) Density of invertebrates in August 2004 at Naples and Mohawk Reefs and Platforms Holly and Houchin by taxa and b) proportion of prey items by taxa in the stomach contents of painted greenling sampled at these same locations in September 2004. Key: gamm=gammarid amphipod, capr=caprellid amphipod, isop=isopod, amph=unk amphipod, tana=tanaidacean, poly=polychaete, biva=bivalve, shri=shrimp, ostr=ostracod, deca=decapod, gast=gastropod, nema=nematode, bryo=bryozoan, cuma=cumacean

Figure 3. Condition factor (“K”) of painted greenling versus the log density of gammarid and caprellid prey at Platforms Houchin (hou) and Holly (hol), and Mohawk (mo) and Naples (na) Reefs.



Another objective of our research is to estimate the total possible production of fish and invertebrate prey on each POCS platform and rocky reef using the ecosystem-trophic interaction software provided by ECOPATH/ECOSIM. The general goal of our modeling is to estimate how much fish biomass can be produced on POCS oil platforms versus natural rocky reefs through predation on populations of common fish prey species. We will use in our models the fish and prey species abundance data collected in our monthly surveys, growth rates of painted greenling approximated from our field sampling data, growth rates of prey species determined in our laboratory experiments, and feeding rates recorded from our laboratory experiments now in progress. This modeling component of our research will be undertaken and completed when we have all the results from fish stomach content analysis, prey growth and production estimates, and feeding rates estimates of fishes.

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

Technician: **Matt Kay**, Bren School of Environmental Science & Management, University of California, Santa Barbara, California 93106-5131

Progress during 2002-2003

Overview

Accomplishments during the FY 2003-2004 were to complete laboratory and field preparations, to design and conduct fish population surveys at POCS Platform Gina and three reference sites on Santa Cruz Island, to tag and recapture fishes at each site over multiple months, to estimate egg production during the late winter-spring nesting season, and to measure recruitment in late spring-early summer. This work covers a large proportion of the field component of our study, although we are in the process of finishing recruitment sampling, conducting a final population survey, and designing and deploying a prey tethering study that will estimate site specific predation rates on our model fish, *Coryphopterus nicholsii* (blackeye goby). Data collected this year and those to be collected during July-September 2004 will provide the information necessary to model population and source-sink dynamics of our model species at POCS oil platform Gina and three natural rocky reefs in the Santa Barbara Channel.

Population abundance

We completed population surveys at all sites to provide a time series of population abundance of our model species, *Coryphopterus nicholsii* (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). We are currently conducting our final population survey at all sites. Coupled with our tagging studies, our population censuses of gobies provide information on immigration, emigration, and mortality rates.

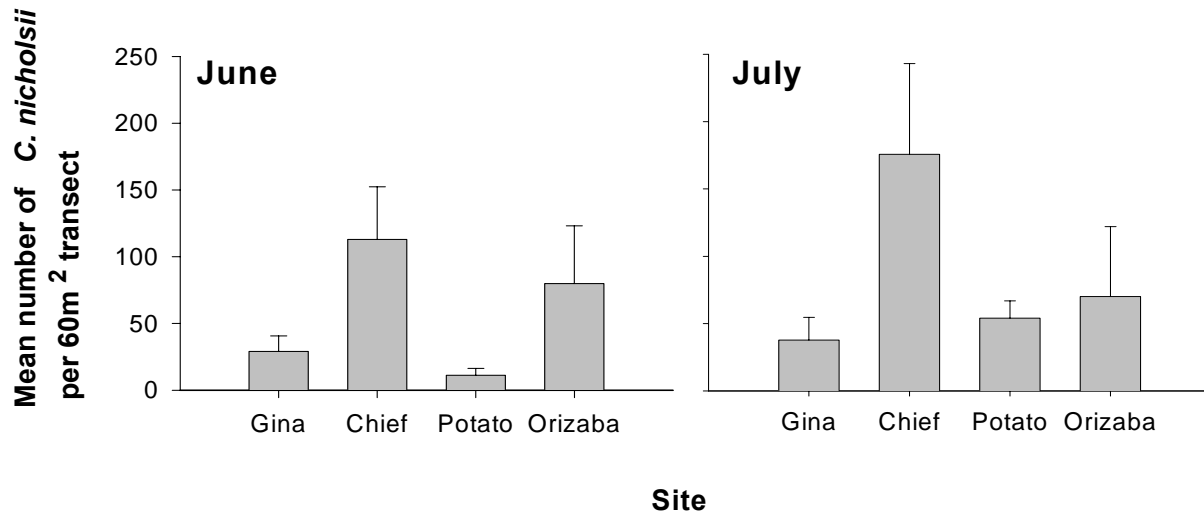


Figure 1: Results of population censuses of *C. nicholsii* at POCS Gina and three reference sites on Santa Cruz Island (Chief Reef, Potato Rock, Orizaba). Error bars are 95% confidence intervals.

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 feasibility 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.

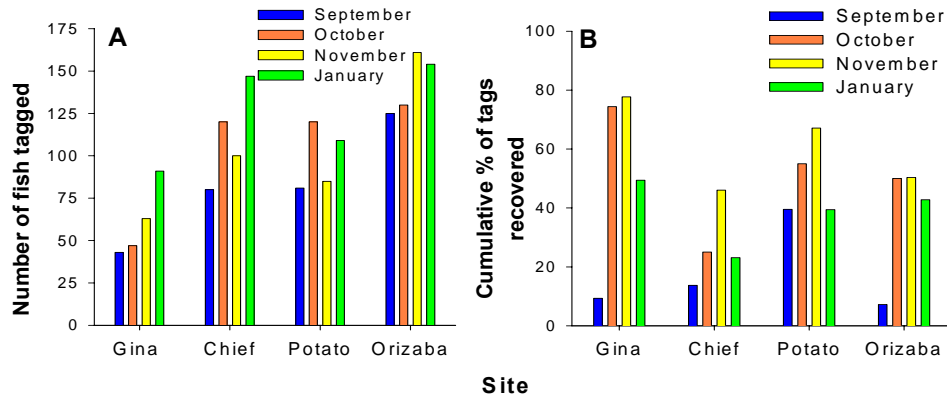


Figure 2: A) The total number of fish tagged at each site during all tagging events; B) the cumulative percent recovery of tags from each tagging event.

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.

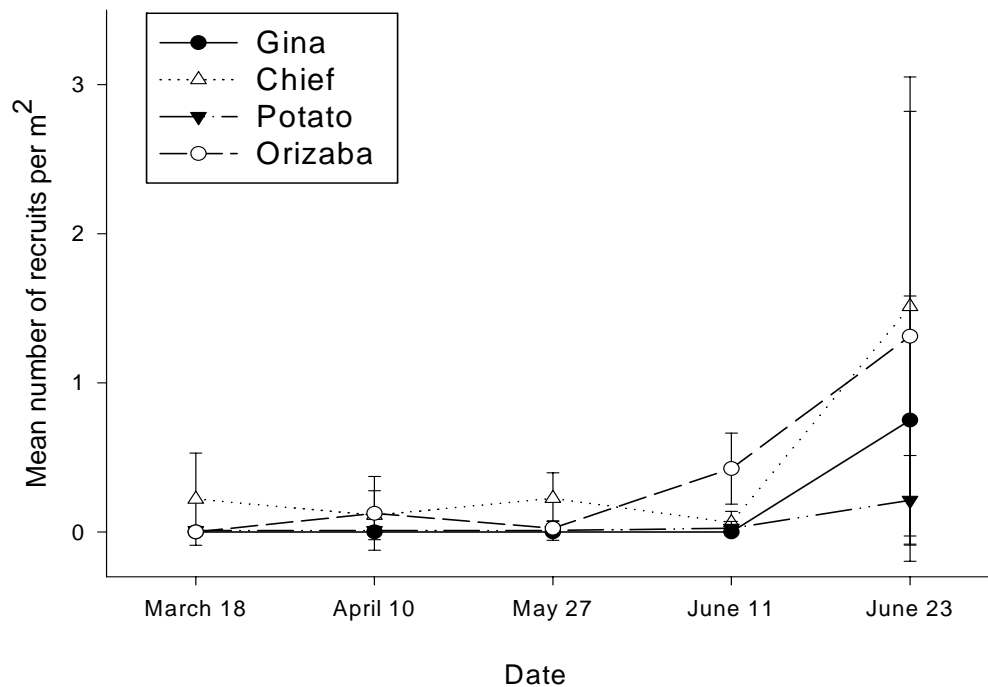
Figure 3: Mean number of eggs per clutch for egg masses of *C. nicholsii*, which were collected from POCS Gina and the three reference sites on Santa Cruz Island. Error Bars are 95% confidence intervals. Note that the Potato Rock site was divided into a deep and midwater sampling scheme. For all Santa 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 m²) at each site. We found very few recruits in March – May, but we found an increasing trend in recruitment in June (Figure 4). We will also quantify 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 are 95% confidence intervals.



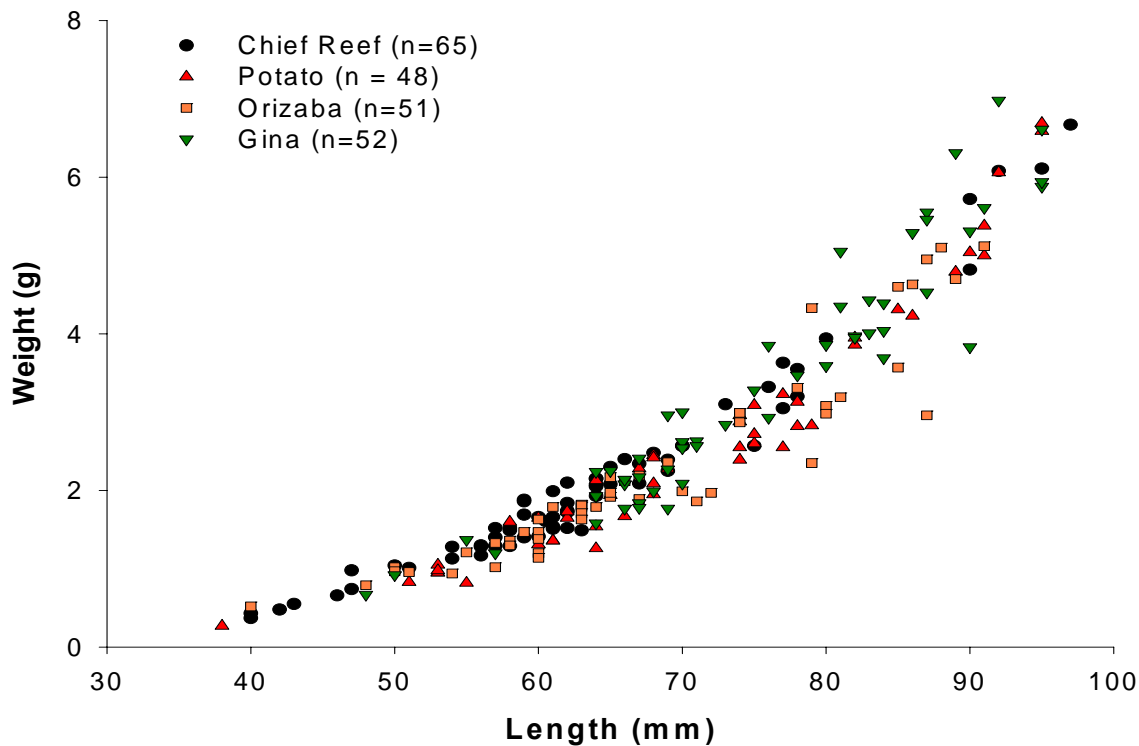
Biotic interactions

The rate of predation on *Coryphopterus* by other fishes will be estimated in July and August 2004 by tethering gobies at each site and examining their survival over 24 hr periods. Gobies will be 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 in 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 will provide the first age and growth characterization for this species. In addition, we are working 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 will potentially provide information regarding the origin of individuals within populations at each site. This study will examine 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.

Educational 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

Plans for summer and fall 2004 include finishing our population and recruitment surveys, and designing and erecting a predation study. We are also working in the laboratory on identifying and counting annual growth rings in otoliths, as well as preparing samples for our microchemistry-connectivity study. We will soon begin to organize our data so that they are ready to be integrated into the population dynamic models we will be constructing this fall and winter. We are in the process of applying for a one-year no cost extension.

Problems encountered

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

Estimated Percentage of Budget Expended:

Project: ~81%



TRAINEES AND STAFF



TRAINEES AND STAFF FUNDED BY THE COASTAL MARINE INSTITUTE

2002-2003 (note changes: xx)

Name	Status	Task
Alfano, Christine	Graduate Student	Sea Otter Population Dynamics
Amend, Anthony	Undergraduate Student	Sea Otter Population Dynamics
Anghera, Michele	Post-Graduate Researcher	Population Trends
Anghera, Mike	Staff	Surfgrass Population Genetics
Arkema, Katie	Graduate Student	S. Shoreline Inventory
Arnold, Christine	Undergraduate Student	Sea Otter Population Dynamics
Ashley, Erin	Undergraduate Student	Habitat Value of Shell Mounds
Baglivio, Eileen	Undergraduate Student	Sea Otter Population Dynamics
Bassin, Corrine	Graduate Student	Surface Circulation
Batres, Erica	Undergraduate Student	Habitat Value of Shell Mounds
Bayer, Pam	Staff	UCSB-MMS Internship
Bean, Jessica	Undergraduate Student	UCSB-MMS Internship
Beckenbach, Edwin	Graduate Student	Surface Circulation
Bentall, Gena	Staff Research Technician	Sea Otter Population Dynamics
Bergquist, Sean	Staff	S. Shoreline Inventory
Beyer, Sabrina	Undergraduate Student	Ecological Performance/Internship
Bomkamp, Erin	Graduate Student	Habitat Value of Shell Mounds
Bostic, Kadie	Undergraduate Student	Ecological Performance
Bram, Jason	Graduate Student	Habitat Value of Shell Mounds
Bramhall, Justin	Undergraduate Student	Ecological Performance
Bricker-Shanahan, Tania	Staff Research Technician	Surfgrass Population Genetics
Brinkman, Mark	Undergraduate Student	Habitat Value of Shell Mounds
Brownstein, Debbie	Undergraduate Student	Sea Otter Population Dynamics
Bull, Scott	Staff	Surfgrass Population Genetics
Burnett, Julie	Undergraduate Student	Habitat Value of Shell Mounds
Byer, Sabrina	Undergraduate Student	UCSB-MMS Internship
Calhoun, Kim	Undergraduate Student	Ecological Performance
Carlisle, Juliet	Graduate Student	Public Perceptions of Risk
Carnahan-Briggs, Katie	Undergraduate Student	Ecological Performance
Carr, Lindsey	Undergraduate Student	Ecological Performance
Campbell, Kelly	Undergraduate Student	UCSB-MMS Internship
Campbell, Susan	Undergraduate Student	Sea Otter Population Dynamics
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Chambers, Jeanne	Staff	UCSB-MMS Internship
Chau, Jason	Undergraduate Student	UCSB-MMS Internship
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Chen, Jerry	Undergraduate Student	Ecological Performance
Chinn, Brian	Undergraduate Student	Transport over the Inner-Shelf
Cline, Xoco	High School Student	Ecological Performance
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Desjardins, Chris	Undergraduate Student	Sea Otter Population Dynamics
Dodd, Erin	Undergraduate Student	Sea Otter Population Dynamics
Doucher, Greg	Undergraduate Student	Surfgrass Population Genetics

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Griffith, Conni Undergraduate Student Ecological Performance
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Kinnaman, Frank Undergraduate Student Rates of Microbial Metabolism
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Loflin, Grace Undergraduate Student Ecological Performance
Luu, Christine Undergraduate Student UCSB-MMS Internship
Malone, Tim Undergraduate Student UCSB-MMS Internship

Annual Report – 2003-2004

Mangiardi, Catrina Graduate Student UCSB-MMS Internship
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Wright, Matt Undergraduate Student Ecological Performance
Yeates, Laura Graduate Student Sea Otter Population Dynamics
Zimmerman, Eric Staff UCSB-MMS Internship

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
Platform Abandonment—Task # 12387, PIs Carr, Forrester, McGinnis
Population Trends—Task # 14181, PIs Schmitt & Brooks
Public Perceptions of Risk—Task # 17607, PI Smith
Rates of Microbial Metabolism—Task # 85338, PI Valentine
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	74
In Press	77
MMS Reports	77
Research Presentations	79

PAPERS PUBLISHED

- Beckenbach, E.H., and L. Washburn. 2004. Low frequency waves in the Santa Barbara Channel observed by high frequency radar. *J. Geophys. Res.* **109** DOI: 10.1029/2003JC001999.
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Carr, M.H., M.V. McGinnis, G.E. Forrester, J. Harding, and P.T. Raimondi. Consequences of Alternative Decommissioning Options to Reef Fish Assemblages and Implications for Decommissioning Policy. MMS OCS Study 2003-053. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, CA. MMS Cooperative Agreement No. 14-35-0001-30758. 104 pages.

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CURRICULUM VITAE

Richard F. Ambrose.....	85
Andrew J. Brooks.....	87
Douglas S. Bush.....	89
James J. Childress.....	92
Jordan Clark.....	95
Daniel P. Costa.....	98
Jenifer E. Dugan.....	100
James A. Estes.....	104
Steven D. Gaines.....	110
W. Michael Hanemann.....	113
Scott A. Hodges.....	115
Sally J. Holbrook.....	117
Robert Jacobs.....	120
Edward A. Keller.....	122
Jon A. Krosnick.....	124
Ira Leifer.....	127
Hunter S. Lenihan.....	129
Milton Love.....	132
Bruce P. Luyendyk.....	133
J. Carter Ohlmann.....	136
Henry M. Page.....	138
Peter T. Raimondi.....	140
Katherine Ralls.....	143
Daniel C. Reed.....	145
Daniel Schlenk.....	148
Russell J. Schmitt.....	150
Donald B. Siniff.....	153
Eric R.A.N. Smith.....	155
David L. Valentine.....	158
Libe Washburn.....	161
Terrie M. Williams.....	164
Leslie Wilson.....	166

Coastal Marine Institute

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1998-present Director, Environmental Science and Engineering Program, UCLA
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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
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Research Interests:

Restoration ecology, especially for coastal marine and estuarine environments, development and
Scientific evaluation of mitigation techniques, long-term ecological monitoring, development of
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estuaries, marine ecology, and interface between environmental biology and resource management
policy.

Selected Publications:

Page, H. M., Schroeter, S., Reed, D. C., Ambrose, R. F., Callaway, J., and J. Dixon. Variation in the distribution and abundance of salt marsh vegetation associated with elevation and height of tidal inundation. *Bulletin of the Southern California Academy of Sciences* (in press).

Vance, R.R., R.F. Ambrose, S.S. Anderson, S. MacNeil, T. McPherson, I. Beers and T.W. Keeney. Effects of sewage sludge on the growth of potted salt marsh plants exposed to natural tidal inundation. *Restoration Ecology* (in press)

Shuman, C. S. and R. F. Ambrose. A comparison of remote sensing and ground-based methods for monitoring wetland restoration success. *Restoration Ecology* (in press).

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Certificate Aquatic Biology and Fisheries Management,
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M.A. Biological Sciences, University of California, Santa Barbara 1993
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Positions: 2001-Present Director, Carpinteria Salt Marsh Reserve, University of California
1999-Present Assistant Research Biologist, Marine Science Institute, University of
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1998-Present Lecturer, Dept. of Ecology, Evolution and Marine Biology, University of
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1998 Teaching Associate, Department of Ecology, Evolution and Marine
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1990-1998: Research Assistant, Department of Ecology, Evolution and Marine
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1987-89 Marine Ecologist and Project Leader, Vantuna Research Group, Occidental
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Population and community dynamics of marine and estuarine fishes.

Grants: 2002-2005 W.M. Keck Foundation
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1997 University Award of Distinction, University of California, Santa Barbara
1995-1999 UC TSR&TP Fellowship, University of California, Santa Barbara
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Publications:

Swearer, S. E., Forrester, G.E., Steele, M.A., Brooks, A.J., and D.W. Lea. 2003. Spatio-temporal and interspecific variation in otolith trace-elemental fingerprints in a temperate estuarine fish assemblage. *Estuarine, Coastal and Shelf Science* (in press).

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- 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., Axell, B., Morris, P., Collins, R., 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.

Coastal Marine Institute

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
	Postdoctoral	Botany, UC Berkeley	1989

Positions:	1998-Present	Associate Research Biologist, Marine Science Institute, UC Santa Barbara
	1998-Present	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.

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

Selected Publications:

- Rodriguez, M.T. and D.S. Bush. 1999. Gibberellin-induced cell death in the wheat aleurone. *Plant Physiology* (submitted).
- Silverman, P., Assiahmah, A., and D.S. Bush. 1998. Cytokinin action in root hairs of *Medicago sativa*. *Planta* **205**: 25-31.
- Subbaiah, C., Bush, D.S., and M. Sachs. 1998. Mitochondria contribution to the anoxic Ca²⁺ signal in maize suspension-cultured cells. *Plant Physiology* **118**: 759-771.
- Thompson, M.D., Bush, D.S., and L.E. Bello. 1997. Possible Wilson's disease: A case presentation. *Arch Clin Neuropsych* **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., Cappellutti, S., Cervantes-Cervantes, M., Rodriguez, M., 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.
- Rodriguez, M.T. and D.S. Bush. 1996. Programmed cell death and hormonal responses in wheat aleurone cells. *Mol Biol Cell* **7**: 2015-2015 Suppl. S.

Annual Report – 2003-2004

- Silverman, F.P. and D.S. Bush. 1996. Membrane transport and cytokinin action in alfalfa root hairs. *Mol Biol Cell* **7**: 1761-1761 Suppl. S.
- Bush, D.S. 1995. Calcium regulation in plant cells and its role in signaling. *Annu. Rev. Plant Physiology. Plant Molecular Biology* **46**: 95-122.
- Bush, D.S. and T. Wang. 1995. Diversity of calcium efflux transporters in wheat aleurone cells. *Planta* **197**:19-30.
- Cervantes-Cervantes, M., Cappelluti, S.J., and D.S. Bush. 1995. Identification of Plant Ca²⁺ Transport Proteins by Complementation in Yeast. *Plant Physiol* **108**(2): 37-37 Suppl. S.
- Silverman, P., Assiamah, A.A., and D.S. Bush. 1995. Cytokinin Action in Medicago-Sativa Root Hairs. *Plant Physiol* **108**(2): 46-46 Suppl. S.
- Subbaiah, C., Bush, D.S., and M. Sachs. 1994. Elevation of cytosolic calcium precedes anoxic gene expression in maize suspension-cultured cells. *The Plant Cell* **6**:1747-1762.
- Bush, D.S. 1993. Regulation of cytosolic calcium in plants. *Plant Physiology* **103**: 7-13.
- Bush, D.S., Biswas, A.K., and R.L. Jones. 1993. Hormonal regulation of Ca²⁺-transport in the endomembrane system of the barley aleurone. *Planta* **189**: 507-515.
- Bush, D.S. 1992. The role of Ca²⁺ in the action of GA in the barley aleurone. In: CM Karssen, LC Van Loon, and D Vreugdenhil, eds. "Progress in plant growth regulation: Proceedings of the 14th International conference on plant growth substances, Amsterdam, 21-26 July, 1991." pp. 96-104. Kluwer Academic Pub., Dordrecht, The Netherlands.
- Drøbak, B.K., Bush, D.S., Jones, R.L., Dawson, A.P., 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., Cornejo, M.J., Bush, D.S., 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., Sticher, L., 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.
- Jones, R.L. and D.S. Bush. 1991. Gibberellic acid and abscisic acid regulate the level of a BiP cognate in the endoplasmic reticulum of barley aleurone cells. *Plant Physiology* **97**: 456-459.
- Jones, R.L., Sticher, L., and D.S. Bush. 1991. Secretion of hydrolases from cereal aleurone cells. In: Hawes, C., J. Coleman and D. Evans, eds. "Endocytosis, Exocytosis and Vesicle Traffic in Plants", Cambridge University Press, Cambridge.
- Bush, D.S. and R.L. Jones. 1990. Hormonal Regulation of Ca²⁺ transport in microsomal vesicles isolated from barley aleurone layers. Calcium in plant growth and development. Leonard and Hepler eds. *American Society of Plant Physiologists* **4**: 60-65.
- Bush, D.S. and R.L. Jones. 1990. Measuring intracellular Ca²⁺ levels in plant cells using the fluorescent probes, indo-1 and fura-2: progress and prospects. *Plant Physiology* **93**: 841-845.
- DuPont, F.M., Bush, D.S., Windle, J.J., and R.L. Jones. 1990. Calcium and proton transport in membrane vesicles from barley roots. *Plant Physiol.* **94**: 179-188.
- Hillmer, S., Bush, D.S., Robinson, D.G., Zingen-Sell, I., and R.L. Jones. 1990. Endomembrane structure and function in barley aleurone protoplasts. *Eur. J. Cell Biol.* **52**: 169-173.

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

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Department of Ecology, Evolution and Marine Biology
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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:

- Girguis, P.R., Childress, J.J., Freytag, J.K., Klose, K., 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. luymesii*: proton elimination is a necessary adaptation to sulfide-oxidizing chemoautotrophic symbionts. *J Exp. Biol.* **205**(19): 3055-3066.
- Freytag, J.K., Girguis, P.R., Bergquist, D.C., Andras, J.P., Childress, J.J., and C.R. Fisher. 2001. A paradox resolved: Sulfide acquisition by roots of seep tubeworms sustains net chemoautotrophy. *P Natl. Acad. Sci. 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. *Mar. Biol.* **138**(2): 259-265.
- Chevaldonne, P., Fisher, C.R., Childress, J.J., Desbruyeres, D., Jollivet, D., Zal, F., and A. Toulmond. 2000. Thermotolerance and the 'Pompeii worms'. *Mar. Ecol. Prog. Ser.* **208**: 293-295.
- Girguis, P.R., Lee, R.W., Desaulniers, N., Childress, J.J., Pospesel, M., Felbeck, H., and F. Zal. 2000. Fate of nitrate acquired by the tubeworm *Riftia pachyptila*. *Applied and Environmental Microbiology* **66**: 2783-2790.
- Janssens, B.J., Childress, J.J., Baguet, F., Rees, J.F. 2000. Reduced enzymatic antioxidative defense in deep-sea fish. *J Exp. Biol.* **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 Res. PT I* **47**(7): 1247-1260.
- Seibel, B.A., Thuesen, E.V., and J.J. Childress. 2000. Light-limitation on predator-prey interactions: Consequences for metabolism and locomotion of deep-sea cephalopods. *Biol. Bull.* **198**(2): 284-298.
- Zal, F., Green, B.N., Martineu, P., Lallier, F.H., Toulmond, A., Vinogradov, S.N., and J.J. Childress. 2000. Polypeptide chain composition diversity of hexagonal-bilayer haemoglobins within a single family of annelids, the Alvinellidae. *Eur. J. Biochem.* **267**(16): 5227-5236.
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- Girguis, P.R. and J.J. Childress. 1998. H⁺ equivalent elimination by the tube-worm *Riftia pachyptila*. *Cah Biol Mar* **39**(3-4): 295-296.
- Goffredi, S.K., Childress, J.J., Lallier, F.H., and N.T. Desaulniers. 1998. How to be the perfect host: CO₂ and HS⁻ accumulation and H⁺ elimination in the hydrothermal vent tube-worm *Riftia pachyptila*. *Cah Biol Mar* **39**(3-4): 297-300.
- Ravaux, J., Shillito, B., Gaill, F., Gay, L., Voss-Foucart, M.F., and J.J. Childress. 1998. Tube synthesis and growth processes in the hydrothermal vent tube-worm *Riftia pachyptila*. *Cah Biol Mar* **39**(3-4): 325-326.
- Thuesen, E.V., Miller, C.B., 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., Leize, E., Lallier, F.H., Toulmond, A., Dorsselaer, A.V., and J.J. Childress. 1998. S-sulfohemoglobin and disulfide-exchange: The mechanisms of sulfide-binding by *Riftia pachyptila* hemoglobins. *P.N.A.S.* **95**: 8997-9002.
- Goffredi, S.K., Childress, J.J., Desaulniers, N.T., and F.H. Lallier. 1997. Sulfide uptake by the hydrothermal vent tubeworm *Riftia* is via diffusion of HS⁻, rather than H₂S. *J. Exp. Biol.* **200**: 2609-2616.
- Goffredi, S.K., Childress, J.J., Desaulniers, N.T., Lee, R.W., Lallier, F.H., and D. Hammond. 1997. Inorganic carbon acquisition by hydrothermal vent tubeworm *Riftia pachyptila* depends upon high external PCO₂ and on proton equivalent ion transport by the worm. *J. Exp. Biology* **200**: 883-896.
- Seibel, B.A., Thuesen, E.V., Childress, J.J., and L.A. Gorodezky. 1997. Decline in pelagic cephalopod metabolism with habitat depth reflects changes in locomotory efficiency. *Bio Bull.* **192**: 262-278.
- Childress, J.J. 1995. Are there physiological and biochemical adaptations of metabolism in deep-sea animals? *Trends in Ecology and Evolution* **10**: 30-36.
- 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., Fisher, C.R., Favuzzi, J.A., Arp, A.J., 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*. *J. exp. Biology* **179**: 131-158.
- Childress, J.J., Lee, R.W., Sanders, N.K., Felbeck, H., Oros, D., Toulmond, A., Desbruyères, D., Brooks, J., and M.C. Kennicutt II. 1993. Inorganic carbon uptake in hydrothermal vent tubeworms facilitated by high environmental pCO₂. *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.

Annual Report – 2003-2004

- Childress, J.J., Fisher, C.R., Favuzzi, J.A., Kochevar, R., Sanders, N.K., and A.M. Alayse. 1991. Sulfide-driven autotrophic balance in the bacterial symbiont-containing hydrothermal vent tubeworm *Riftia pachyptila*, Jones. *Biological Bulletin* **180**: 135-153.
- Sanders, N.K. and J.J. Childress. 1990. Adaptations to the deep-sea oxygen minimum layer: Oxygen binding by the hemocyanin of the bathypelagic mysid, *Gnathophausia ingens* Dohrn. *Biol. Bull.* **178**: 286-294.

Coastal Marine Institute

JORDAN CLARK

Department of Geological Sciences
Program of Environmental Studies
University of California
Santa Barbara, CA

Project: *Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSOS-HYS).
Oil Slicks in the Ocean: Predicting their Release Points Using 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: 1996-Present 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:

- Aeschbach-Hertig, W., Stute, M., Clark, J.F., Reuter, R., and P. Schlosser. 2002. A paleotemperature record derived from dissolved noble gases in groundwater of the Aquia Aquifer (Maryland, USA). *Geochimica et Cosmochimica Acta* **66**: 797-817.
- Boles, J.R., Clark, J.F., Leifer, I., and L. Washburn. 2002. Temporal variation in natural methane seep rate due to tides, Coal Oil Point area, California. *Journal of Geophysical Research* **106**: 27,077-27,086.
- Rademacher, L.K., Clark, J.F., and G.B. Hudson. 2002. Temporal changes in stable isotope composition of spring waters: Implications for recent changes in climate and atmospheric circulation. *Geology* **20**: 139-142.
- Clark, J.F. and G.B. Hudson. 2001. Tracing hydrothermal fluids in hypersaline Mono Lake using helium isotopes. *Limnology and Oceanography* **46**: 189-196.
- Gamlin, J.D., Clark, J.F., Woodside, G., and R. Herndon. 2001. Tracing groundwater flow patterns in an area of artificial recharge using sulfur hexafluoride. *Journal of Environmental Engineering ASCE* **127**: 171-174.
- Rademacher, L.K., Clark, J.F., Hudson, G.B., Erman, D.C., and N.A. Erman. 2001. Chemical evolution of shallow groundwater as recorded by springs, Sagehen basin, Nevada County California. *Chemical Geology* **179**: 37-51.
- Clark, J.F., Washburn, L., Hornafius, J.S., and B.P. Luyendyk. 2000. Dissolved hydrocarbon flux from natural marine seeps to the southern California Bight. *Journal of Geophysical Research* **105** (11): 509-11,522.
- Leifer, I., Clark, J.F., and R.F. Chen. 2000. Modifications of the local environment by natural marine hydrocarbon seeps. *Geophysical Research Letters* **27**: 3711-3714.
- Macfarlane, P.A., Clark, J.F., Davisson, M.L., Hudson, G.B., and D.O. Whittemore. 2000. Late Quaternary ground water recharge in the central Great Plains from geochemical tracers in shallow ground water. *Quaternary Research* **53**: 167-174.

Annual Report – 2003-2004

- Quigley, D.C., Hornafius, J.S., Luyendyk, B.P., Francis, R.D., Clark, J.F., and L. Washburn. 1999. Decrease in natural marine hydrocarbon seepage near Coal Oil Point, California associated with offshore oil production. *Geology* **27**: 1047-1050.
- Aeschbach-Hertig, W., Schlosser, P., Stute, M., Simpson, H.J., Ludin, A., and J.F. Clark. 1998. A $^3\text{H}/^3\text{He}$ study of groundwater flow in a fractured bedrock aquifer. *Ground Water* **36**: 661-670.
- Clark, J.F., Davisson, M.L., Hudson, G.B., and P.A. Macfarlane. 1998. Noble gases, stable isotopes, and radiocarbon as tracers of flow in the Dakota aquifer, Colorado and Kansas. *Journal of Hydrology* **211**: 151-167.
- Clark, J.F., Stute, M., Schlosser, P., Drenkard, S., and G. Bonani. 1997. An isotope study of the Floridan aquifer in Southeastern Georgia: Implications for groundwater flow and paleoclimate. *Water Resources Research* **33**: 281-289.
- Macfarlane, P.A., Clark, J.F., Whittemore, D.O., Davisson, M.L., and G.B. Hudson. 1997. Holocene and late Pleistocene climate conditions in the central Great Plains deduced from noble gases, stable isotopes, Cl, and ^{36}Cl in shallow groundwater. Kansas Geological Survey Open-File-Report #97-77, 28 p.
- Clark, J.F., Schlosser, P., Stute, M., and H.J. Simpson. 1996. SF_6 - ^3He tracer release experiment: A new method of determining longitudinal dispersion coefficients in large rivers. *Environmental Science and Technology* **30**: 1527-1532.
- Clark, J.F., Schlosser, P., Simpson, H.J., Stute, M., Wanninkhof, R., and D.T. Ho. 1995. Relationship between gas transfer velocities and wind speeds in the tidal Hudson River determined by the dual tracer technique. In: *Air-Water Gas Transfer*, eds. Jähne, B. and E. Monahan, Aeon Verlag, Hanau, 785-800.
- Clark, J.F., Schlosser, P., Wanninkhof, R., Simpson, H.J., Schuster, W.S.F., and D.T. Ho. 1995. Gas transfer velocities for SF_6 and ^3He in a small pond at low wind speeds. *Geophysical Research Letters* **22**: 93-97.
- Clark, J.F., Simpson, H.J., Bopp, R.F., and B. Deck. 1995. Dissolved oxygen in lower Hudson estuary: 1978-93. *Journal of Environmental Engineering, ASCE*. **121**: 760-763.
- Clark, J.F., Smethie Jr., W.M., and H.J. Simpson. 1995. Chlorofluorocarbons in the Hudson estuary during summer months. *Water Resources Research* **31**: 2553-2560.
- Stute, M., Clark, J.F., Schlosser, P., Broecker, W.S., and G. Bonani. 1995. A high altitude continental paleotemperature record derived from noble gases dissolved in groundwater from the San Juan Basin, New Mexico. *Quaternary Research* **43**: 209-220.
- Stute, M., Forster, M., Frischkorn, H., Serejo, A., Clark, J.F., Schlosser, P., Broecker, W.S., and G. Bonani. 1995. 5°C cooling of tropical Brazil during the last glacial maximum. *Science* **269**: 379-383.
- Clark, J.F., Wanninkhof, R., Schlosser, P., and H.J. Simpson. 1994. Gas exchange in the tidal Hudson River using a dual tracer technique. *Tellus* **46B**: 274-285.
- Stute, M., Clark, J.F., Phillips, F.M., and D. Elmore. 1993. Reconstruction of late glacial climates from the groundwater archive: Cl and ^{36}Cl in the Carrizo aquifer, Texas. *Applications of Isotope Techniques in Studying Past and Current Environmental Changes in the Hydrosphere and the Atmosphere*, IAEA, Vienna, 259-270.
- Clark, J.F., Simpson, H.J., Bopp, R.F., and B. Deck. 1992. Geochemistry and loading history of phosphate and silicate in the Hudson estuary. *Estuarine, Coastal and Shelf Science* **34**: 213-233.

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Clark, J.F., Simpson, H.J., Smethie Jr., W.M., and C. Toles. 1992. Gas exchange in a contaminated estuary inferred from chlorofluorocarbons. *Geophysical Research Letters* **19**: 1133-1136.

Stute, M., Schlosser, P., Clark, J.F., and W.S. Broecker. 1992. Paleotemperatures in the southwestern United States derived from noble gas measurements in groundwater. *Science* **256**: 1000-1003.

DANIEL P. COSTA

Department of Ecology and Evolutionary Biology
University of California
Santa Cruz, CA

- 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:

- Shaffer, S.A., Costa, D.P., and H. Weimerskirch. 2001. Behavioural factors affecting foraging effort of breeding wandering albatrosses. *J. of Animal Ecology* **70**: 864-874.
- Shaffer, S.A., Costa, D.P., and H. Weimerskirch. 2001. Comparison of methods for evaluating energy expenditure of incubating wandering albatrosses. *Physiological and Biochemical Zoology* **74**: 823-831.
- Shaffer, S.A., Weimerskirch, H., and D.P. Costa. 2001. Functional significance of sexual dimorphism in wandering albatrosses. *Functional Ecology* **15**: 203-210. (including Cover Photo)
- Weimerskirch, H., Guionnet, T., Martin, J., Shaffer, S.A., 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.
- Costa, D.P. and T.E. Williams. 1999. Marine mammal energetics. In: *The Biology of Marine Mammals*, ed. J. Reynolds and J. Twiss. *Smithsonian Institution Press*. Washington, DC.
- Crocker, D.E., Gales, N.J. and D.P. Costa. 1999. Swimming speed and foraging strategies of New Zealand sea lions, *Phocarcos hookeri*. *Journal of Zoology* **254**: 267-277.
- Le Boeuf, B.J., Crocker, D.E., Costa, D.P., Blackwell, S.B., Webb, P.M. and D.S. Houser. 1999. Foraging ecology of northern elephant seals. *Ecol Monogr* **70**(3): 353-382.
- Burgess, W., Tyack, P., Le Boeuf, B.J., and D.P. Costa. 1998. An intelligent acoustic recording tag first results from free-ranging northern elephant seals. *Deep Sea Research II* **45**: 1327-1351.
- Costa, D.P. 1998. The ATOC Consortium. Ocean Climate Change: Comparison of Acoustic Thermography, Satellite Altimetry and Modeling. *Science* **281**: 1327-1332.
- Costa, D.P., Gales, N.J. and D.E. Crocker. 1998. Blood volume and diving ability of the New Zealand sea lion, *Phocarcos hookeri*. *Physiological Zoology* **71**: 208-213.

Coastal Marine Institute

- Crocker, D.E., Webb, P.M., Costa, D.P., and B.J. Le Boeuf. 1998. Protein catabolism and renal function in lactating northern elephant seals. *Physiological Zoology* **71**: 485-491.
- Mattlin, R.H., Gales, N.J., and D.P. Costa. 1998. Seasonal dive behaviour of lactating New Zealand fur seals (*Arctocephalus forsteri*). *Canadian Journal Zoology* **76**: 350-360.
- Shaffer, S.A., Costa, D.P., and T.M. Williams. 1998. Diving and performance of White Whales, *Delphinapterus leucas*. *Journal Exp. Biology* **200**: 3091-3099.
- Gales, N.J. and D.P. Costa. 1997. The Australian sea lion: a review of an unusual life history. Pages 78-87. *Marine Mammal Research in the Southern Hemisphere Volume 1: Status, Ecology and Medicine*. Eds. M. Hindell and C. Kemper. Surrey and Sons Chipping Norton.
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JENIFER E. DUGAN

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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
Utilization of Sandy Beaches by Shorebirds Relationships to Population Characteristic of Macrofauna Prey Species and Beach Morphodynamics

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
2002-Present Science and Outreach Coordinator, Santa Barbara Coastal LTER, Marine Science Institute, University of California, Santa Barbara
2000-Present Deputy Director, Coastal Marine Institute, University of California, Santa Barbara
1995-2003 Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
1996 Consulting Biologist, Unocal oil spill at Guadalupe, Econometrics, Encinitas, CA
1990-95 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
1992 National Marine Sanctuary, Marine Science Institute, University of California, Santa Barbara
1988-93 Marine Biologist, Cooperative Park Science Unit, University of California, Davis, Channel Islands National Park, Ventura, CA

Distinctions: 2002 Travel Fellowship, Junta de Galicia, University of Vigo, Vigo, Spain
2001 Concurso Especial de Incentivo a la Cooperacion International, FONDECYT, Research Travel award to Universidad Austral de Chile, Valdivia, Chile
1999 Concurso Especial de Incentivo a la Cooperacion International, FONDECYT, Research Travel award to Universidad Austral de Chile, Valdivia, Chile
1994 University of Otago, Dunedin, New Zealand, Postdoctoral Fellowship
1993 Foundation for Research Development, Republic of South Africa, Postdoctoral Fellowship

Selected Publications:

Bram, J.B., Page, H. M. and J. E. Dugan. Spatial and temporal variability in early successional patterns of an invertebrate assemblage at an offshore oil platform. *J. Exp. Mar. Biol. Ecol.* (submitted).

- Bomkamp, R. Page, H. M. and J. E. Dugan. Role of food subsidies and habitat structure in influencing benthic communities of shell mounds at sites of existing and former offshore oil platforms. *Mar. Biol.* (in press).
- Page, H. M., J. E. Dugan. 2004. Spatial and temporal variability in early successional patterns of an invertebrate assemblage at an offshore oil platform. Draft Final Report to Minerals Management Service and the UC Coastal Marine Institute.
- Page, H. M., J. E. Dugan and J. Childress. 2004. Role of food subsidies and habitat structure in influencing benthic communities of shell mounds at sites of existing and former offshore oil platforms.
- Dugan, J. E., Ichikawa, G., Stephenson, M., Crane, D. B., McCall, J. and K. Regalado. 2004. Monitoring of coastal contaminants using sand crabs. Draft Final Report to Central Coast Regional Water Quality Control Board.
- Dugan, J. E. and D. M. Hubbard. 2004. Effects of beach grooming on coastal strand and dune habitats at San Buenaventura State Beach. Draft Final Report to California Resources Agency, Department of Parks and Recreation, Channel Coast District.
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- Dugan, J.E., Hubbard, D.M., McCrary, M., and M. Pierson. 2003. The response of macrofauna communities and shorebirds to macrophyte wrack subsidies on exposed sandy beaches of southern California. *Estuar. Coastl. Shelf Sci.* 58S: 133-148.
- Hubbard, D.M., and J.E. Dugan. 2003. Shorebird use of an exposed sandy beach in southern California. *Estuar. Coastl. Shelf Sci.* 58S: 169-182.
- C. Roberts, S. Andelman, G. Branch, R. Bustamante, J. Carlos-Castilla, J. Dugan, B. Halpern, H. Leslie, K. Lafferty, J. Lubchenco, D. McArdle, H. Possingham, M. Ruckelshaus, and R. Warner. 2003. Ecological criteria for evaluating candidate sites for marine reserves. *Ecol. Appl.* 13(1): S199-S214
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- Dugan, J.E., Hubbard, D.M., Engle, J.M., Martin, D.L., Richards, D.M., Davis, G.E., Lafferty, K.D., and R.F. Ambrose. 2000. Macrofauna communities of exposed sandy beaches on the Southern California mainland and Channel Islands. Fifth California Islands Symposium, OCS Study, MMS 99-0038: 339-346.

Annual Report – 2003-2004

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- Barron, M.G., Podrabsky, T., Ogle, R.S., Dugan, J.E., *et al.* 1999. Sensitivity of the sand crab *Emerita analoga* to a weathered oil. *Bull. Environmental Contamination & Toxicology* **62**: 469-475.
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Coastal Marine Institute

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Published Abstracts

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- Dugan, J.E., Hubbard, D.M., and H.M. Page. 2001. Ecological effects of grooming on exposed sandy beaches in southern California. Abstract submitted to: International Workshop, Beaches - What Future? An Integrated Approach to the Ecology and Evolution of Beaches and Sand Dunes. Florence, Italy Oct. 2001.
- Gonzalez-Guzman, L, Gaines, S., and J. Dugan. 2001. Environmental suitability across the geographic distribution of marine intertidal invertebrates. *Bull. Ecol. Soc. Amer.* **82**.

Annual Report – 2003-2004

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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 Minnesota	1967
	M.S.	Zoology, Washington State University	1969
	Ph.D.	Biological Sciences/Statistics, University of Arizona	1974

Positions:	1984-Present	Wildlife Biologist, GM-486/15, Western Ecological Research Center, Biological Resources Division, U.S. Geological Survey
	1978-Present	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

Research Interests:

Population and community ecology, conservation, evolution, natural history, population dynamics, and experimental design.

Grants:	1970-1972	Energy Research and Development Administration
	1984-1985	National Geographic Society
	1985-1986	The Banbury Foundation
	1985-1987	National Science Foundation
	1986-1987	National Science Foundation
	1987-1988	City of Santa Cruz
	1990-1992	National Science Foundation
	1991-1993	National Science Foundation
	1995	Legacy Program, U.S. Navy
	1995-1997	Legacy Program, U.S. Air Force
	1996-2003	U.S. Navy
	2000-2005	National Science Foundation

Distinctions:	1964-1965	National Defense and Education Association, Graduate Research Fellowship
	1978	American Men and Women of Science
	1978	Award for outstanding publication, National Fish and Wildlife Laboratory, Fish and Wildlife Service
	1981	Award for outstanding publication, Denver Wildlife Research Center, Fish and Wildlife Service
	1987	Betty S. Davis Conservation Award, Friends of the Sea Otter
	1990	Distinguished alumnus, School of Renewable Resources, University of Arizona
	1990	United States Department of Interior, Natural Resources Response Award for Exceptional Service
	1999-2002	Pew Fellowship in Marine Conservation

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Selected Publications:

- Estes, J.A. and M.J. Paddack. No-take marine reserves in central California kelp forests: metrics of human take or the tip of the iceberg? Marine Reserves in Central California, California Sea Grant Publication.
- Gelatt, J., D.B. Siniff, and J.A. Estes. In press. Activity budgets of sea otters at Amchitka Island, Alaska. *J Wildl. Manage.*
- Miller, M.A., I.A. Gardner, A. Packham, J.K. Mazet, K.D. Hanni, D. Jessup, J.A. Estes, R. Jameson, E. Dodd, B.C. Barr, L.J. Lowenstine, F.M. Gulland and P.A. Conrad. In press. Evaluation of an indirect fluorescent antibody test (ifat) for demonstration of antibodies to *Toxoplasma gondii* in the sea otter (*Enhydra lutris*). *Journal of Parasitology*
- Konar, B., and J.A. Estes. In press. The stability of boundary regions between kelp beds and deforested areas. *Ecology*
- Estes, J.A. In press. Then and Now. In, R. Knight ed., Aldo Leopold. Oxford University Press
- Carr, M., J. Neigel, S. Andelman, J. Estes, R. Warner, J. Largier, and J. Lubchenco. In Press. Comparing marine and terrestrial ecosystems: implications for principles or reserve design in marine systems. *Ecological applications*
- Estes, J.A. In press. Using focal species to conserve ecosystems: sea otters and kelp forests. In P. Kelly, P. Foster-Turley. *Single species approaches to ecosystem conservation*. Island Press
- Estes, J.A., Hatfield, B.B., Ralls, K., et al. 2003. Causes of mortality in California sea otters during periods of population growth and decline. *Mar. Mammal Sci.* **19**(1): 198-216.
- Gelatt, T.S., Siniff, D.B., and J.A. Estes. 2002. Activity patterns and time budgets of the declining sea otter population at Amchitka Island, Alaska. *J. Wildlife Manage.* **66**(1): 29-39.
- Schroeter, S.C., Reed, D.C., Kushner, D.J., et al. 2001. The use of marine reserves in evaluating the dive fishery for the warty sea cucumber (*Parastichopus parvimensis*) in California, USA. *Can. J. Fish. Aquat. Sci.* **58**(9): 1773-1781.
- Jackson, J.B.C., Kirby, M.X., Berger, W.H., et al. 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* **293**(5530): 629-638.
- Monson, D.H., Estes, J.A., Bodkin, J.L., et al. 2000. Life history plasticity and population regulation in sea otters. *Oikos* **90**(3): 457-468.
- Watt, J., Siniff, D.B., and J.A. Estes. 2000. Inter-decadal patterns of population and dietary change in sea otters at Amchitka Island, Alaska. *Oecologia* **124**(2): 289-298.
- 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.
- Anthony, R.G., Miles, A.K., Estes, J.A., et al. 1999. Productivity, diets, and environmental contaminants in nesting bald eagles from the Aleutian Archipelago. *Environ. Toxic. Chem.* **18**(9): 2054-2062.

Annual Report – 2003-2004

- Williams, T.M., Noren, D., Berry, P., Estes, J.A., Allison, C., and J. Kirtland. 1999. The diving physiology of bottlenose dolphins (*Tursiops truncatus*). III. Thermoregulation at depth. *J. of Experimental Biology* **202**: 2763-2769.
- Dobson, A., Ralls, K., Foster, M., Soulé, M.E., Simberloff, D., Doak, D., Estes, J.A., Mills, L.S., Mattson, D., Dirzo, R., Arita, H., Ryan, S., Norse, E.A., Noss, R.F., and D. Johns. 1999. Connectivity: maintaining flows in fragmented landscapes. Pp. 129-170 in, M. E. Soulé and J. Terborgh, eds., *Continental Conservation*, Island Press, Washington, D.C.
- Scott, J.M., Norse, E.A., Arita, H., Dobson, A., Estes, J.A., Foster, M., Gilbert, B., Jensen, D.B., Knight, R.L., Mattson, D. and M.E. Soulé. 1999. The issue of scale in selecting and designing biological reserves. Pp. 19-38 in, M. E. Soulé and J. Terborgh, eds., *Continental Conservation*, Island Press, Washington, D.C.
- Terborgh, J., Estes, J.A., Paquet, P., Ralls, K., Boyd-Herger, D., Miller, B.J., and R.F. Noss. 1999. The role of top carnivores in regulating terrestrial ecosystems. Pp. 39-64 in, M. E. Soulé and J. Terborgh, eds., *Continental Conservation*, Island Press, Washington, D.C.
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- Estes, J.A. 1999. Otter-eating orcas-Response to Garshelis and Johnson. *Science* **283**(5399): 177.
- Golet, G.H., Irons, D.B., and J.A. Estes. 1998. Survival costs of chick rearing in black-legged kittiwakes. *J. Animal Ecology* **61**(5): 827-841.
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- Estes, J.A., Tinker, M.T., Williams, T.M., and D.F. Doak. 1998. Killer whale predation on sea otters linking oceanic and nearshore ecosystems. *Science* **282**: 473-476.
- Estes, J.A. 1998. Concerns about the rehabilitation of oiled wildlife. *Conservation Biology* **12**: 1156-1157.
- Estes, J.A. 1997. Wild Otters--Predation and Populations. (Book Review). *J. Wildlife Manage.* **61**: 984-987.
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- Estes, J.A. 1996. Predators and ecosystem management. *Wildlife Soc. Bull.* **24**: 390-396.
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- Ralls, K., DeMaster, D., 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.
- Stern, J.L., Hagerman, A.E., Steinberg, P.D., Winter, F.C., and J.A. Estes. 1996. A new assay for quantifying brown algal phlorotannins and comparisons to previous methods. *J. Chem. Ecol.* **22**: 1273-1293.

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- Estes, J.A. 1994. Conservation of Marine Otters. *Aquatic Mammals* **20** (3): 125-128.
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- Estes, J.A., G.B. Rathbun, and G.R. VanBlaricom. 1993. Paradigms for managing carnivores: the case of the sea otter. *Symp. Zool. Soc. Lond.* **65**: 307-320.
- Estes, J.A. 1992. Behavior, ecology, and life history of New World otters. pp. 107-117 in C. Reuther and R. Rochert (eds.), Proceedings of the V. International Otter Colloquium, Hankensbuttel. Habitat 6.
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- Estes, J.A. 1991. Catastrophes and conservation: Lessons from sea otters and the Exxon Valdez. *Science* **254**: 1596.
- Riedman, M.L., and J.A. Estes. 1990. The sea otter (*Enhydra lutris*): behavior, ecology, and natural history. Biological Report 90(14), U.S. Fish and Wildlife Service. 126pp.
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- Smith, D.R., S. Niemeyer, J.A. Estes, and A.R. Flegal. 1990. Stable lead isotopes evidence anthropogenic contamination in Alaskan sea otters. *Environ. Sci. Tech.* **24**: 1517-1521.
- Estes, J.A. 1990. Assessment of sea otter population status: a reply. *J. Wildl. Manage.* **54**: 270-272.

Annual Report – 2003-2004

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Project: *Application of Coastal Ocean Dynamics Radars for Observation of Near-Surface Currents off the South-Central California Coast*
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 Associate Professor, Brown University, Providence, RI
1986-1987 Research Associate, Brown University, Providence, RI
1982-1986 Postdoctoral Fellow, Stanford University, Stanford, CA

Selected Publications:

Blanchette, C.A., Miner, B.G., and S.D. Gaines. 2002. Geographic variability in form, size and survival of *Egria menziesii* around Point Conception, California. *Mar. Ecol. Prog. Ser.* **239**: 69-82.

Phillips, N.E. and S.D. Gaines. 2002. Spatial and temporal variability in size at settlement of intertidal mytilid mussels from around Pt. Conception, California. *Invertebr. Reprod. Dev.* **41**(1-3): 171-177.

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Sax, D.F., Gaines, S.D., and J.H. Brown. 2002. Species invasions exceed extinctions on islands worldwide: A comparative study of plants and birds. *American Naturalist* **160**(6): 766-783.

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

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- Denny, M. and S.D. Gaines. 1990. On the prediction of maximum intertidal wave forces. *Limnology and Oceanography* **35**: 1-15.

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Gaines, S.D. and W.R. Rice. 1990. Analysis of biological data with ordered expectations. *American Naturalist* **135**: 310-317.

Coastal Marine Institute

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Project: *Testing and Calibrating the Measurement of Nonmarket Values for Oil Spills Via the Contingent Valuation Method*

Education:	B.S.	Philosophy, Politics, and Economics, Oxford University, England	1965
	M.S.	Development Economics, London, School of Economics	1967
	M.A.	Public Finance and Decision Theory, Harvard University	1973
	Ph.D.	Economics, Harvard University	1978

Positions:	1995-Present	Professor, Department of Agricultural and Resource Economics, University of California, Berkeley, CA
	1984-95	Associate Professor, Department of Agricultural and Resource Economics, University of California, Berkeley, CA
	1978-84	Assistant Professor, Department of Agricultural and Resource Economics, University of California, Berkeley, CA
	1976-78	Acting Assistant Professor, Department of Agricultural and Resource Economics, University of California, Berkeley, CA
	1976	Lecturer, Department of Economics, Northeastern University, Boston, Massachusetts
	1970-75	Staff Economist/Consultant, Urban Systems Research & Engineering, Inc., Cambridge, Massachusetts
	1970-75	Teaching Fellow, Department of Economics, Harvard University
	1967-68	Assistant to the Director, Unit for Economic and Statistical Studies on Higher Education, London School of Economics

Selected Publications:

Hanemann, W.M. The economic theory of WTP and WTA. In: Valuing the Environment Preferences: Theory and Practice of the Contingent Valuation Method in the US, EC and Developing Countries, I. Bateman and K. Willis, eds. Oxford University Press.

Hanemann, W.M. and B. Kanninen. The statistical analysis of discrete-response. In: Valuing the Environment Preferences: Theory and Practice of the Contingent Valuation Method in the US, EC and Developing Countries, I. Bateman and K. Willis, eds. Oxford University Press.

Krosnick, J.A., Holbrook, A.L., Berent, M.K., Carson, R.T., Hanemann, W.M., Kopp, R.J., Mitchell, R.C., Presser, S., Ruud, P.A., Smith, V.K., Moody, W.R., Green, M.C., and M. Conaway. 2002. The impact of "no opinion" response options on data quality - Non-attitude reduction or an invitation to satisfice? *Public Opin Quart* **66**(3): 371-403.

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Fisher, A.C. and W.M. Hanemann. 1993. Assessing climate change risks: Valuation of effects. In: *Assessing Climate Change Risks*, J. Darmstadter, ed. Resources for the Future, DC.

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Project: *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: 1995 - Present Assistant/Associate Professor, Dept. of Ecology, Evolution and Marine Biology, UCSB
1993 - 1995 Postdoctoral Associate, Depts. of Botany and Genetics, Univ. of Georgia, Athens, GA
1992 Research Associate, Dept. of Genetics, University of Georgia, Athens, GA
1991 Visiting Assistant Professor of Biology, Barnard College, Columbia Univ. New York, NY
1983-1990 Research Associate, Research Associate, Teaching Assistantship at UC Berkeley

Distinctions: 1998 UCSB nominee for Packard Fellowship
1997 Regents' Junior Faculty Fellowship
1996 Regents' Junior 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:

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

Hodges, S.A., Whittall, J.B., Fulton, M., 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., Hodges, S.A., Cooper, J.B., 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., Baker, I., 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.

Hodges, SA. 1997. A rapid adaptive radiation via a key innovation in *Aquilegia*. Molecular evolution and adaptive radiations. pg. 391-405. Eds. T. Givinish and K. Sytsma. Cambridge University Press, Cambridge.

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- Emms, S.K., Hodges, S.A., and M.L. Arnold. 1996. Pollen-tube competition, siring success and consistent asymmetric hybridization in the Louisiana irises. *Evolution* **50**: 2201-2206.
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- Hodges, S.A. and M.L. Arnold 1994. Columbines: a geographically wide-spread species flock. *Proceedings of the National Academy of Sciences, USA* **91**: 5129-5132.
- Hodges, S.A. and M.L. Arnold. 1994. Floral and ecological isolation between *Aquilegia formosa* and *A. pubescens*. *Proceedings of the National Academy of Sciences, USA* **91**: 2493-2496.
- Hodges, S.A. 1993. Consistent interplant variation in nectar characteristics of *Mirabilis multiflora*. *Ecology* **74**: 542-548.
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Department of Ecology, Evolution and Marine Biology
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Project: *An Experimental Evaluation of Methods of Surfgrass (Phyllospadix torreyi) Restoration Using Early Life History Stages*

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:

- Bernardi, G., Holbrook, S.J., Schmitt, R.J., Crane, N.L., and E. DeMartini. 2002. Species boundaries, populations, and color morphs in the coral reef three-spot damselfish (*Dascyllus trimaculatus*) species-complex. *Proceedings of the Royal Society of London B* **269**(1491): 599-605.
- Bolker, B.M., St.Mary, C.M., Osenberg, C.W., Schmitt, R.J., and S.J. Holbrook. 2002. Management at a different scale: marine ornamentals and local processes. *Bulletin of Marine Science* **70**:733-748.
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- Schmitt, R.J. and S.J. Holbrook. 2000. Habitat-limited recruitment of coral reef damselfish. *Ecology* **81**(12): 3479-3494.
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- Holbrook, S.J. and R.J. Schmitt. 1999. *In situ* nocturnal observations of reef fishes using infrared video. In: Proc. 5th Indo-Pac. Fish Conf., Nouméa, 1997 (Séret B. & J.-Y. Sire, eds), pp. 805-812. Paris: Soc. Fr. Ichtyol.
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- Holbrook, S.J. and R.J. Schmitt. 1998. Have field experiments aided in the understanding of abundance and dynamics of reef fishes? Pp. 152-169 in: *Issues and Perspectives in Experimental Ecology*, W.J. Resetarits and J. Bernado eds. Oxford University Press.
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Annual Report – 2003-2004

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Coastal Marine Institute

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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:

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

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

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

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

Annual Report – 2003-2004

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- 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.
- Potts, B.C.M., Faulkner, D.J., and R.S. Jacobs. 1992. Phospholipase A₂ inhibitors from marine organisms. *J. Natural Products* **55**: 1701-1717.

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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 Peer-reviewed 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., Johnson, D.L., Laduzinsky, D.L., Seaver, D.B., 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.
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- Trecker, M.A., Gurrola, L.D., and E.A. Keller. 1998. Oxygen - isotope correlation of marine terraces and uplift of the Mesa hills, Santa Barbara, CA, USA. In: Stewart I.S. & Vita-Finzi, C.(eds) Coastal Tectonics. Geological Society, London, Special Publications 146:57-69 (invited contribution).
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Education: B.A. Psychology, Harvard University, Cambridge, MA 1980
M.A. Social Psychology, University of Michigan 1983
Ph.D. Social Psychology, University of Michigan 1986

Positions: 1986-Present Assistant to Associate to Full Professor, Departments of Psychology and Political Science, Ohio State University, Columbus, OH
1987-1989 Lecturer, Survey Research Center Summer Program in Survey Research Techniques, University of Michigan
1986-1987 Visiting Scholar, Survey Research Center, Institute for Social Research, University of Michigan

Selected Publications:

Holbrook, A.L., Bizer, G.Y., and J.A. Krosnick. Political behavior of the individual. In: Encyclopedia of Psychology, A.E. Kazdin, ed. Washington, DC, and New York, NY: American Psychological Association and Oxford University Press. In press.

Krosnick, J.A. Is political psychology sufficiently psychological? Distinguishing political psychology from psychological political science. In: Thinking about political psychology. J. Kuklinski, ed. New York: Cambridge University Press. In press.

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Krosnick, J.A. The challenges of psychological political science: A review of research on the projection hypothesis. In: Thinking about political psychology. J. Kuklinshi, ed. New York: Cambridge University Press. In press.

Visser, P.S., Krosnick, J.A., and P. Lavrakas. Survey research methods. In: Handbook of research methods in social psychology, H. T. Reis and C. M. Judd, eds. New York: Cambridge University Press. In press.

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Krosnick, J.A., Godek, L., and D.B. Glasser. 2002. Sexual attitudes and self-esteem among female partners of men with and without erectile dysfunction: a US population-based study. *J Women Health Gen-B* **11**(3): P13.

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Annual Report – 2003-2004

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- Visser, P.S. and J.A. Krosnick. 1998. Development of attitude strength over the life cycle: Surge and decline. *J Pers Soc Psychol* **75**(6): 1389-1410.
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- Fabrigar, L.R. and J.A. Krosnick. 1995. Attitude importance and the false consensus effect. *Personality and Social Psychology Bulletin* **21**: 468-479.
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Project: *Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSOS-HYS)
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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: 2001-Present 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:

Clark, J.F., Leifer, I., Washburn, L., and B.P. Luyendyk. 2003. Compositional changes in natural gas bubble plumes: Observations from the Coal Oil Point Seep Field. *Geo. Mar Lett.* (submitted).

Leifer, I. and I. MacDonald. 2003. Dynamics of the gas flux from shallow gas hydrate deposits: Interaction between oily hydrate bubbles and the oceanic environment. *Earth Plan. Sci. Lett.* (in press).

Leifer, I., De Leeuw, G., and L. Cohen. 2003. Calibrating optical bubble size by the displaced mass method. *Chem. Eng. Sci.* (submitted).

Leifer, I. and J. Clark. 2002. Modeling trace gases in hydrocarbon seep bubbles. Application to marine hydrocarbon seeps in the Santa Barbara Channel. *Russian Geology and Geophysics* **43**(7): 613-621.

Leifer, I. and R. Patro. 2002. The bubble mechanism for transport of methane from the shallow sea bed to the surface: A review and sensitivity study. *Cont. Shelf Res.* **22**: 2409-2428.

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HUNTER LENIHAN

Bren School of Environmental Science and Management
Marine Science Institute
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Project: *Relative Importance of POCS Oil Platforms on the Population Dynamics of Two Reef Fishes in the Eastern Santa Barbara Channel*
Ecological Performance and Trophic Links: Comparisons Among Platforms and Natural Reefs for Selected Fishes and Their Prey

Education:

B.S.	Conservation of Natural Resources, UC Berkeley	1986
M.S.	Marine Sciences, 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
2002	Santa Barbara Coastal Ecosystem Long Term Ecological Research, UCSB
2001-2002	Assistant Research Biologist II, UCSB
2000	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

Distinctions:

2004	Association of Pacific Rim Universities Fellow, UCSB
1996-1997	US National Research Council Post-doctoral Associate
1991	ARCS Foundation Achievement Award for College Scientist
1991	Research grant from the David Packard Foundation
1990	Dr Earl and Ethel Meyers Oceanography and Marine Biology Trust Scholarship

Selected Publications:

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

Kirby, M.X. and H.S. Lenihan. *Submitted*. Environmental deterioration and historical exploitation of oyster reefs in western Atlantic estuaries. *Ambio*.

Lenihan, H.S. and C.H. Peterson. 2004. Conserving oyster reef habitat by switching from dredging and tonging to diver hand-harvesting. *Fishery Bulletin* 102: 298-305.

Lenihan, H.S., C.H. Peterson, S.L. Kim, K.E. Conlan, R. Fairey, C. McDonald, J.H. Grabowski, and J.S. Oliver. 2003. How variation in marine benthic community composition allows discrimination of multiple stressors. *Marine Ecology Progress Series* 206: 63-73.

- K.E. Conlan, S.L. Kim, H.S. Lenihan, and J.S. Oliver. 2003. Benthic community changes at McMurdo Station, a response to sewage abatement? *In* A. H.L. Huiskes, W.W.C. Gieskes, J. Rozema, R. M. L. Schorno, S. M. van der Vies & W. J. Wolff (editors) *Antarctic biology in a global context*. Leiden, The Netherlands: Backhuys Publishers.
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Annual Report – 2003-2004

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- Lenihan, H. S., Oliver, J. S., and M. Stephenson. 1990b. Changes in hard-bottom communities related to boat-mooring and Tributyltin (TBT) in San Diego Bay: a natural experiment. *Marine Ecology Progress Series* 60: 147-159.

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MILTON LOVE

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Projects: *Ecological Performance and Trophic Links: Comparisons Among Platforms and Natural Reefs for Selected Fishes and their Prey*

Education: B.A. Environmental Biology (Honors), University of California Santa Barbara 1970
M.A. Zoology, University of California, Santa Barbara 1974
Ph.D. Zoology, University of California, Santa Barbara 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: 2002-2003 Packard Foundation
2002 Sea Grant
2001-2002 California Artificial Reef Enhancement Program and Biological Resources Division, U.S Geological Service
2000-2001 National Marine Fisheries Service

Selected Publications:

Caselle J.E., Love M.S., Fusaro C., et al. 2002. Trash or habitat? Fish assemblages on offshore oilfield seafloor debris in the Santa Barbara Channel, California. ICES J Mar. Sci. 59: S258-S265 Suppl. S.

Schroeder, D.M. and M.S. Love. 2002. Recreational fishing and marine fish populations in California. Calif. Coop. Ocean Fish, 43: 182-190.

Love, M. S., Caselle, J. E., and L. Snook. 2000. Fish assemblages around seven oil platforms in the Santa Barbara Channel. Fish. Bull. 98: 96-117.

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Love, M. S., Caselle, J. E., and W. Van Buskirk. 1998. A severe decline in the commercial passenger fishing vessel rockfish (*Sebastes* spp.) catch in the southern California Bight, 1980-1996. CalCOFI Rept. 39: 180-195.

Love, M., Hyland, J., Ebeling, A., Herrlinger, T., Brooks, A., 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. Bull. Mar. Sci. 55: 1062-1085.

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Love, M. and W. Westphal. 1990. A comparison of fishes taken by a sportfishing party vessel around oil platforms and adjacent natural reefs near Santa Barbara, California. Fish. Bull. 88:599-605.

BRUCE P. LUYENDYK

Department of Geological Sciences
University of California
Santa Barbara, CA

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

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

Positions: 1997-Present Chair, Department of Geological Sciences, University of California, Santa
Barbara
1988-1997 Directory, Institute for Crustal Studies, University of California, Santa
Barbara
1987-1988 Acting Director for Institute of Crustal Studies, UC Santa Barbara
1981-Present Professor, Department of Geological Sciences, University of California,
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:

Luyendyk, B.P., Smith, C.H., and G. Druivenga. Gravity measurements on King Edward VII Peninsula,
Marie Byrd Land, West Antarctica, during GANOVEX VII, *Geolog. Jahrb.* (in press).

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).

Larson, R.L., Pockalny, R.A., Viso, R.F., Erba, E., Abrams, L.J., Luyendyk, B.P., Stock, J.M., and R.W.
Clayton. 2002. Mid-Cretaceous tectonic evolution of the Tongareva triple junction in the
southwestern Pacific basin. *Geology* **30**: 67-70.

Hamilton, Rhea, Luyendyk, B.P., Sorlien, C.C., and L.R. Bartek. 2001. Cenozoic Tectonics of the Cape
Roberts Rift Basin, and Transantarctic Mountains Front, Southwestern Ross Sea, Antarctica.
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Luyendyk, B.P. and E.T. Eglund. 2001. Variation in discharge from marine hydrocarbon seeps at Coal Oil
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Luyendyk, B.P., Sorlien, C.C., Wilson, D., Bartek, L., and C.H. Siddoway. 2001. Structural and tectonic
evolution of the Ross Sea rift in the Cape Colbeck region, Eastern Ross Sea, Antarctica. *Tectonics*
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Source of Dissolved Methane to California Coastal Waters. *J. Geophys. Res. - Oceans* **105**(11):
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Sorlien, C.C., Gratier, J.P., Luyendyk, B.P., Hornafius, J.S., and T.E. Hopps. 2000. Map restoration of
folded and faulted late Cenozoic strata across the Oak Ridge fault, onshore and offshore Ventura
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- Luyendyk, B.P. 1997. Slab capture versus ridge collision as an explanation for Cretaceous extension and rifting of east Gondwana. in Ricci, C. A., ed., The Antarctic Region: Geological Evolution and Processes, Proceed. VII Symp. on Antarctic Earth Sci., Siena, 467-474.
- Luyendyk, B.P., Cisowski, S., Smith, C.H., Richard, S. and D.L. Kimbrough. 1996. Paleomagnetic study of the northern Ford Ranges, western Marie Byrd Land, West Antarctica: A middle Cretaceous pole, and motion between West and East Antarctica. *Tectonics* **15**: 122-141.
- Schermer, E., Luyendyk, B.P., and S. Cisowski. 1996. Late Cenozoic structure and tectonics of the northern Mojave Desert. *Tectonics* **15**: 905-932.
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- Steritz, J. and B.P. Luyendyk. 1994. Hosgri fault zone, offshore Santa Maria basin, California. In Alterman, I. B., McMullen, R.B., Cluff, L.S., and D.B. Slemmons eds., Seismotectonics of the central California Coast Ranges. *Geol. Soc. Amer. Spec. Paper.* **292**: 191-210.

Annual Report – 2003-2004

Wateren, F.M. van der, Luyendyk, B.P., Verbers, A.L.L.M., and C.H. Smith. 1994. Landscape evolution model of the West Antarctic Rift system relating tectonic and climatic evolutions of the rift margins. *Terra Antarctica* **1**(2): 453-456.

Coastal Marine Institute

J. CARTER OHLMANN

Institute for Computational Earth System Science
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Santa Barbara, CA

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 Obispo, CA 1991
M.S. Mechanical Engineering, University of California, Santa Barbara, CA 1995
Ph.D. Geography (Oceanography), University of California, Santa Barbara, CA 1997

Positions: 2003-Present Visiting Researcher Oceanographer, Physical Oceanography Research Division, Scripps Institute 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

Research Interests:

Ocean circulation over the continental shelf, interactions between basin scale and coastal flows, Lagrangian techniques, development of drifting buoys for the coastal region, and the role of radiant heating on upper ocean dynamics and air-sea interactions.

Selected Publications:

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

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

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, Potential feedbacks between Pacific Ocean ecosystems and interdecadal climate variations, *Bulletin of the American Meteorological Society*, **84**, 617-633, 2003.

Ohlmann, J.C., A.L. Sybrandy, and P.P. Niiler, GPS-cellular drifter technology for coastal ocean observing systems, *Journal of Atmospheric and Oceanic Technology*, in prep.

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

Ohlmann, J. C., and A.L. Sybrandy. 2002. A catch-and-release Lagrangian drifter for near-shore ocean circulation research. *Proceedings, California and the World Ocean* (in press).

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

Ohlmann, J.C., Niiler, P.P., Fox, C.A., and R.R. Leben. 2001. Eddy energy and shelf interactions in the Gulf of Mexico. *J Geophys Res-Oceans* **106**(C2): 2605-2620.

Annual Report – 2003-2004

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Coastal Marine Institute

HENRY M. PAGE

Marine Science Institute
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Santa Barbara, CA

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

Positions: 1998-Present California Coastal Commission SONGS mitigation scientist (wetlands)
1985-Present Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
1984-Present Summer Lecturer, 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

Research Interests:

Benthic ecology, artificial reefs, wetland and estuarine biology, nutrient cycling.

Selected Publications:

- 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*, in press. Online 6/25/04
- 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., Glenn, E.P., Page, H.M., Galindo-Bect, L.A., Hernandez-Ayon, J.M., Petty, R.L., 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.
- Page, H.M., Dugan, J.E., Dugan, D., and J. Richards. 1999. Effects of an offshore oil platform on the distribution and abundance of commercially important crab species. *Marine Ecology Progress Series* **185**: 47-57.
- 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., Hubbard, D.M., 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 ¹⁵N in the halophyte, *Salicornia virginica*, associated with ground water subsidies of nitrogen in a southern California salt marsh. *Oecologia* **104**: 181-188.

Annual Report – 2003-2004

- Page, H.M., Petty, R.L., 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., Dugan, J.E., 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., Fiala-Medioni, A., Fisher, C.R., 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., Fisher, C.R., 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.
- Page, H.M. and D.M. Hubbard. 1987. Temporal and spatial patterns of growth in mussels, *Mytilus edulis*, on an offshore platform: relationships to water temperature and food availability. *Journal of Experimental Marine Biology and Ecology* **111**: 159-179.
- 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.

Coastal Marine Institute

PETER T. RAIMONDI

Department of Biology- Ecology and Evolution
University of California
Santa Cruz, CA

Projects: *Effects of Temporal and Spatial Separation of Samples on Estimation of Impacts*
Effects of Produced Water on Complex Behavior Traits of Invertebrate Larvae and Algal
Zoospores
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: 1996-present 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
1981-82 Dean's Award for Academic Excellence, University of Arizona
1984 Sigma Xi Grant-in-Aid of Research
1986 University of California Patent Fund
1987-88 Office of Naval Research Postdoctoral Fellowship
1988-89 University of Melbourne Research Fellowship
1989-91 Australian Research Council Fellowship

Selected Publications:

- Forde, S.E. and P.T. Raimondi. Recruitment intensity and intertidal community structure: comparing observations and experiments. *Oecologia* (in review)
- Gaylord, B., Reed, D.C., Raimondi, P.T., Washburn, L., and S.R. McLean. 2002. A physically based model of macroalgal spore dispersal in the wave and current-dominated nearshore. *Ecology* **83**(5): 1239-1251.
- Raimondi, P.T., Wilson, C.M., Ambrose, R.F., Engle, J.M., 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.
- Carr, M.H. and P.T. Raimondi. 2000. Concepts relevant to the design and evaluation of harvest reserves. Proceedings of workshop on rockfish refugia.
- Raimondi, P.T. and A.N.C. Morse. 2000. The consequences of complex larval behavior in a coral. *Ecology* **81**(11): 3193-3211.
- Raimondi, P.T., Forde, S.E., Delph, L.F., and C.M. Lively. 2000. Processes structuring communities: evidence for trait-mediated indirect effects through induced polymorphisms. *Oikos* **91**(2): 353-361.

Annual Report – 2003-2004

- Reed, D.C., Raimondi, P.T., Carr, M.H., 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. *Cal. Coop. Ocean Fish.* **40**: 71-76.
- Raimondi, P.T., Barnett, A.M., 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., Ambrose, R.F., Engle, J.M., Haaker, P.L., Lafferty, K.D., 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. *J. Exp. Mar. Biol. 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 Habitats*, 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., Morse, A., Hooker, N., and P.T. Raimondi. 1994. Morphogen-based chemical flypaper for *Agaricia humilis* larvae. *Biological Bulletin* **186**: 172-181.
- Lively, C.M., Raimondi, P.T., 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.
- Raimondi, P.T. and R.J. Schmitt. 1992. Effects of produced water on settlement of larvae: field tests using red abalone. Pp. 415-430 in: *Produced Water: Technological/Environmental Issues and Solutions*. J.P. Ray and F.R. Engelhardt, eds. Plenum Press, NY.
- Raimondi, P.T. 1991. The settlement of *Chthamalus anisopoma* largely determines its adult distribution. *Oecologia* **85**: 349-360.
- Raimondi, P.T. and J.E. Martin. 1991. Evidence that mating group size affects allocation of reproductive resources in a simultaneous hermaphrodite. *American Naturalist* **138**: 1206-1217.
- Raimondi, P.T. 1990. Patterns, mechanisms, and consequences of variability in settlement and recruitment in an intertidal barnacle. *Ecological Monographs* **60**:283-309.
- Raimondi, P.T. and M.J. Keough. 1990. Behavioral variability in marine larvae. *Aust. J. Ecology* **15**: 427-437.
- Raimondi, P.T. 1988. Rock type affects settlement, recruitment, and zonation of the barnacle *Chthamalus anisopoma* (Pilsbry). *Journal of Experimental Marine Biology and Ecology* **123**: 253-267.
- Raimondi, P.T. 1988. Settlement cues and determination of the vertical limit of an intertidal barnacle. *Ecology* **69**: 400-407.
- Lively, C.M. and P.T. Raimondi. 1987. Desiccation, predation, and mussel-barnacle interactions in the Northern Gulf of California. *Oecologia* **74**(2): 304-309.

Coastal Marine Institute

KATHERINE RALLS

Department of Zoological Research
National Zoological Park
Smithsonian Institution
Washington, D.C.

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: 1998-Present Senior Research Biologist, Smithsonian Institution, Washington, DC
1976-1998 Research Biologist, Smithsonian Institution, Washington, DC

Selected Publications:

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

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

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

Haight, R.G., Ralls, K., and A.M. Starfield. 2000. Designing species translocation strategies when population growth and future funding are uncertain. *Conserv Biol* **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. *Conserv Biol* **14**(5): 1240-1242.

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

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

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

Good, S.V., Williams, D.F., Ralls, K., 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., McIntosh, C., Ralls, K., and R. Fleischer. 1997. A noninvasive method for distinguishing among canid species: Amplification and enzyme restriction of DNA from dung. *Mol Ecol* **6**(5): 483-486.

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

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

Annual Report – 2003-2004

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

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

Coastal Marine Institute

DANIEL C. REED

Marine Science Institute
University of California
Santa Barbara, CA

- Project:** *An Experimental Evaluation of Methods of Surfgrass (Phyllospadix torreyi) Restoration Using Early Life History Stages*
- 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:** 1994-present Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
1989-94 Assistant Research Biologist, Marine Science Institute, University of California, Santa Barbara
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:

- Gaylord, B., Reed, D.C., Raimondi, P.T., Washburn, L., and S.R. McLean. 2002. A physically based model of macroalgal spore dispersal in the wave and current-dominated nearshore. *Ecology* **83**(5): 1239-1251.
- Holbrook, S.J., Reed, D.C., and J.S. Bull. 2002. Survival experiments with outplanted seedlings of surfgrass (*Phyllospadix torreyi*) to enhance establishment on artificial structures. *Ices J Mar Sci* **59**: S350-S355 Suppl. S.
- Schroeter, S.C., Reed, D.C., Kushner, D.J., Estes, J.A., 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. *Can J Fish Aquat Sci* **58**(9): 1773-1781.
- Holbrook, S.J., Reed, D.C., Hansen, K., and C.A. Blanchette. 2000. Spatial and temporal patterns of predation on seeds of surfgrass, *Phyllospadix torreyi*. *Mar Biol* **136**(4): 739-747.
- Reed, D.C., Raimondi, P.T., Carr, M.H., and L. Goldwasser. 2000. The role of dispersal and disturbance in determining spatial heterogeneity in sedentary kelp-forest organisms. *Ecology* **81**(7): 2011-2026.
- Blanchette, C.A., Worcester, S., Reed, D., and S.J. Holbrook. 1999. Algal morphology, flow and spatially variable recruitment of surfgrass, *Phyllospadix torreyi*. *Marine Ecology Progress Series* **184**: 119-128.
- Reed, D.C., Brzezinski, M.A., Coury, D.A., Graham, W.M., and R.L. Petty. 1999. Neutral lipids in macroalgal spores and their role in swimming. *Marine Biology* **133**: 737-744
- Reed, D.C., Holbrook, S.J., Solomon, E., and M. Anghera. 1998. Studies on germination and root development in the surfgrass *Phyllospadix torreyi*: Implications for habitat restoration. *Aquatic Botany* **62**: 71-80.

Annual Report – 2003-2004

- Reed, D.C., Anderson, T.W., Ebeling, A.W., and M. Anghera. 1997. Role of reproductive synchrony in the colonization potential of kelp. *Ecology* **78**: 2443-2457.
- Canestro, D., Raimondi, P.T., Reed, D.C., Schmitt, R.J., and S.J. Holbrook. 1996. A study of methods and techniques for detecting ecological impacts. Pp. 53-67 in: *Methods and techniques of underwater research, Proceedings of the American Academy of Underwater Scientists symposium*. AAUS, Nahant, MA.
- 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: Conceptual Issues and Applications in Coastal Marine Habitat*, R.J. Schmitt and C.W. Osenberg, eds. Academic Press, San Diego, CA.
- Reed, D.C., Ebeling, A.W., Anderson, T.W., and M. Anghera. 1996. Differential reproductive responses to fluctuating resources in two seaweeds with different reproductive strategies. *Ecology* **77**: 300-316.
- Ambrose, R.F., Boland, J., Murdoch, W.W., Raimondi, P.T., and D.C. Reed. 1995. The San Onofre nuclear generating station mitigation reef: monitoring issues. Pp. 587-592 in: *Proceedings from the International Conference on Ecological System Enhancement Technology for Aquatic Environments*. Japan International Marine Science and Technology Federation, Tokyo.
- Reed, D.C. 1994. Giant forests of the sea. *The World and I* **July**: 202-207.
- Reed, D.C. and R.J. Lewis. 1994. Effects of an oil and gas production effluent on the colonization potential of giant kelp (*Macrocystis pyrifera*) zoospores. *Marine Biology* **119**: 277-283.
- Reed, D.C., Lewis, R.J., and M. Anghera. 1994. Effects of an open coast oil production outfall on patterns of giant kelp (*Macrocystis pyrifera*) recruitment. *Marine Biology* **120**: 26-31.
- Brzezinski, M., Reed, D.C., and C.D. Amsler. 1993. Neutral lipids as major storage products in *Macrocystis pyrifera*. *J. Phycology* **29**: 16-23.
- Carr, M.H. and D.C. Reed. 1993. Conceptual issues relevant to marine harvest refuges: examples from temperate marine fishes. *Can. J. Fish. Aquat. Sci.* **50**: 2019-2028.
- Amsler, C.D., Reed, D.C., and M. Neushul. 1992. The microclimate inhabited by algal propagules. *British Phycological Journal* **27**: 253-270.
- Carr, M.H. and D.C. Reed. 1992. Harvest refuges and their potential for enhancing reef fisheries in southern California. Pp. 63-68 in: *Perspectives on the Marine Environment*, P.M. Grifman and S.E. Yoder, Eds. Sea Grant Program, University of California, Los Angeles.
- Neushel, M., Amsler, C.D., Reed, D.C., and R.J. Lewis. 1992. The introduction of marine plants for aquacultural purposes. Pp. 103-138 in: *Movement and dispersal of biotic agents into aquatic ecosystems*, A. Rosenfield, ed. Maryland Sea Grant College, College Park, MD.
- Reed, D.C., Amsler, C.D., and A.W. Ebeling. 1992. Dispersal in kelps: factors affecting spore swimming and competency. *Ecology* **73**: 1577-1585.
- Reed, D.C., Neushul, M., and A.W. Ebeling. 1991. The role of density on gametophyte growth and reproduction in the kelps *Macrocystis pyrifera* and *Pterygophora californica*. *J. Phycol.* **27**: 361-366.
- Eardley, D.D., Sutton, C.W., Hempel, W.M., Reed, D.C., and A.W. Ebeling. 1990. Monoclonal antibodies specific for sulfated polysaccharides on the surface of *Macrocystis pyrifera* (Phaeophyceae). *Journal of Phycology* **26**: 54-62.

Hymansen, Z., Reed, D.C., Foster, M.S., and J. Carter. 1990. The validity of using morphological characteristics as predictors of age in the kelp *Pterygophora californica* (Laminariales, Phaeophyta). *Mar. Ecol. Prog. Ser.* **59**: 295-304.

Annual Report – 2003-2004

DANIEL SCHLENK

Professor, Aquatic Ecotoxicology
Department of Environmental Sciences
University of California
Riverside, CA

- 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
1998-2000 Associate Professor of Pharmacology and Toxicology, 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
1986-1989 Predoctoral Fellow, Oregon State University, Toxicology Program, Corvallis, Oregon
1985-1989 Research Assistant, Oregon State University, Department of Environmental Engineering, Corvallis, Oregon
- Distinctions:** 1986-1989 Postdoctoral Fellow, Oregon State University
1989 George E. Brown Jr. Award (UCMEXUS) Co-PI with J. Garcia-Hernandez
1989-1991 Postdoctoral Fellow, Duke University
1999-2000 University of Mississippi; School of Pharmacy, Faculty Research Award

Selected Publications:

- C. Seruto, Y. Sapozhnikova, D.Schlenk (2005) 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).
- D. Schlenk (2004) Biotransformation of Pesticides in Biochemical and Molecular Biology of Fishes Vol. 6 - Environmental Toxicology - volume (editors T.W. Moon and T.P. Mommsen) Elseiver, New York (submitted)
- E. Sapozhnikova, O. Bawardi, L.Roy, D. Schlenk, D (2004) Pesticides and PCBs in sediments and fish from the Salton Sea, California, USA. *Chemosphere* 55: 797-809.
- L.A. Roy, S. Steinert, S.M. Bay, D. Greenstein, Y. Sapozhnikova, O. Bawardi, I. Leifer and D. Schlenk (2003) Biochemical effects of PAH exposure in hornyhead turbot (*Pleuronichthys verticalis*) exposed to a gradient of PAH contaminated sediments collected from a natural petroleum seep in CA, USA. *Aquatic Toxicology* 65:159-169.

- D. Schlenk (2003) Use of Biochemical Endpoints to determine relationships between contaminants and impaired fish health in a freshwater stream. *Human and Ecological Risk Assessment* 9:59-66.
- Roy, L. A., Armstrong, J. L., Sakamoto, K., Steinert, S., Perkins, E., Lomax, D. P., Johnson, L. L., and D. Schlenk. 2003. The relationships of biochemical endpoints to histopathology, and population metrics in feral flatfish species collected near the municipal outfall of Orange County, CA. *Environmental Toxicology and Chemistry* (in press).
- D. Schlenk, W.H. Benson, S. Steinert, R.Handy and M.Depledge (2003) Biomarkers In: *The Toxicology of Fishes* (R. Di Giulio and D. Hinton editors). Taylor and Francis Publishers, Washington DC (submitted).
- J. Stegeman, S.George, M.James, D. Schlenk, E. Gallagher (2003) Biotransformations In: *The Toxicology of Fishes* (R. Di Giulio and D. Hinton editors). Taylor and Francis Publishers, Washington DC (submitted).
- Huggett, D.B., Brooks, B.W., Peterson, B., Foran, C.M., and D. Schlenk. 2002. Toxicity of Select Beta-Adrenergic Receptor Blocking Pharmaceuticals (b-Blockers) on Aquatic Organisms. *Archives of Environmental Contamination and Toxicology* (in press).
- Schlenk, D., Sapozhnikova, E., Baquirian, J.P., and Z. Mason. 2002. Utilization of biochemical and health endpoints in fish to guide analytical chemistry analyses of sediments. *Environmental Toxicology and Chemistry* (in press).
- Tilton, F., Benson, W.H., and D. Schlenk. 2002. Evaluation of Estrogenic Activity from a Municipal Wastewater Treatment Plant with Predominantly Domestic Input. *Aquatic Toxicology* (in press).
- Todorov, J.R., Elskus, A.A., Schlenk, D., Ferguson, P.L., Brownawell, B.J., and A.E. McElroy. 2002. Estrogenic Responses of Larval Sunshine Bass (*Morone saxatilis* X *M. chrysops*) Exposed to New York City Sewage Effluent. *Marine Environmental Research* (in press).
- Riedel, R., Schlenk, D., Frank, D., and B. Costa-Pierce. 2002. Analyses of organic and inorganic contaminants in Salton Sea fish. *Marine Pollution Bulletin* **44**: 403-411.
- Elalfy, A., Grisle, S., 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.
- Schlenk, D., Huggett, D.B, Block, D.S., Grisle, S., Allgood, J., Bennet, E., Holder, A.W., Hovinga, R.M., and P. Bedient. 2001. Toxicity of Fipronil and its Degradation Products to *Procambarus* sp.: Field and Laboratory Studies. *Archives of Environmental Contamination and Toxicology* **41**: 325-332.
- Tilton, F., Benson, W.H., 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., Kumir, S., Rimoldi, J., 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.

Annual Report – 2003-2004

RUSSELL J. SCHMITT

Department of Ecology, Evolution and Marine Biology and
Coastal Research Center, Marine Science Institute
University of California
Santa Barbara, CA

Project: *Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell us?*

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-present 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:

- Bernardi, G., Holbrook, S.J., Schmitt, R.J., Crane, N.L., and E. DeMartini. 2002. Species boundaries, populations and colour morphs in the coral reef three-spot damselfish (*Dascyllus trimaculatus*) species complex. *P Roy Soc Lond B Bio* **269**(1491): 599-605.
- Bolker, B.M., St Mary, C.M., Osenberg, C.W., Schmitt, R.J., and S.J. Holbrook. 2002. Management at a different scale: Marine ornamentals and local processes. *B Mar Sci* **70**(2): 733-748.
- Brooks, A.J., Schmitt, R.J., and S.J. Holbrook. 2002. Declines in regional fish populations: have species responded similarly to environmental change? *Mar Freshwater Res* **53**(2): 189-198.
- Holbrook, S.J. and R.J. Schmitt. 2002. Competition for shelter space causes density-dependent predation mortality in damselfishes. *Ecology* **83**(10): 2855-2868.
- Holbrook, S.J., Brooks, A.J., and R.J. Schmitt. 2002. Predictability of fish assemblages on coral patch reefs. *Mar Freshwater Res* **53**(2): 181-188.
- Holbrook, S.J., Brooks, A.J., and R.J. Schmitt. 2002. Variation in structural attributes of patch-forming corals and in patterns of abundance of associated fishes. *Mar Freshwater Res* **53**(7): 1045-1053.

- Osenberg, C.W., St Mary, C.M., Schmitt, R.J., Holbrook, S.J., Chesson, P., and B. Byrne. 2002. Rethinking ecological inference: density dependence in reef fishes. *Ecol Lett* **5**(6): 715-721.
- Schmitt, R.J. and S.J. Holbrook. 2002. Correlates of spatial variation in settlement of two tropical damselfishes. *Mar Freshwater Res* **53**(2): 329-337.
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Annual Report – 2003-2004

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Coastal Marine Institute

DONALD SINIFF

Department of Ecology, Evolution and Behavior
University of Minnesota
St. Paul, MN

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

Sato, K., Mitani, Y., Cameron, M.F., Siniff, D.B., Watanabe, Y., and Y. Naito. 2002. Deep foraging dives in relation to the energy depletion of Weddell seal (*Leptonychotes weddellii*) mothers during lactation. *Polar Biol* **25**(9): 696-702.

Gelatt, T.S., Davis, C.S., Siniff, D.B., and C. Strobeck. 2001. Molecular evidence for twinning in Weddell seals (*Leptonychotes weddellii*). *J Mammal* **82**(2): 491-499.

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

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

Watt, J., Siniff, D.B., and J.A. Estes. 2000. Inter-decadal patterns of population and dietary change in sea otters at Amchitka Island, Alaska. *Oecologia* **124**(2): 289-298.

Gelatt, T.S., Arendt, T., Murphy, M.S., and D.B. Siniff. 1999. Baseline levels of selected minerals and fat-soluble vitamins in weddell seals (*Leptonychotes weddellii*) from Erebus Bay, McMurdo Sound, Antarctica. *Mar Pollut Bull* **38**(12): 1251-1258.

Bowen, D. and D. Siniff. 1999. Distribution, population biology, and feeding ecology of marine mammals. *In Biology of Marine Mammals*. J.E. Reynolds and S.A. Rommel, eds. *Smithsonian Press*. pp. 423-484.

Gelatt, T. and D. Siniff. 1999. Line transect survey of crabeater seals in the Amundsen Bellingshausen Seas, 1994. *Wildl. Soc. Bulletin* **27**(2): 330-336.

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

Ralls, K., Hatfield, B., and D. Siniff. 1995. Foraging patterns of California sea otters as indicated by telemetry. *Canadian Journal of Zoology* **73**: 523-531.

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- Siniff, D.B. and K. Ralls. 1991. Reproduction, survival and tag loss in California sea otters. *Marine Mammal Science* **7**(3):211-229.

Coastal Marine Institute

ERIC R.A.N. SMITH

Department of Political Science and Environmental Studies
University of California
Santa Barbara, CA

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

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

Positions: 2003-Present Professor of Political Science, University of California, Santa Barbara
1996-1997 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, Eric R.A.N. 2004. "Public Reaction to Energy, Overview" In Cutler J. Cleveland (ed.), *The Encyclopedia of Energy*, v. 5: 169-79. San Diego: Academic Press/Elsevier Science.
- Smith, Eric R.A.N. 2004. Review of Deborah Lynn Guber, *The Grassroots of a Green Revolution: Polling America on the Environment*. *Political Science Quarterly*, vol. 118, pp. 696-97.
- Smith, Eric R.A.N. 2004. "How Much Knowledge Does Democracy Require?" *Phi Kappa Phi Forum*, vol. 84, pp. 16-19.
- Smith, Eric R.A.N. 2003. *Santa Barbara South Coast Community Indicators 2003* (with Bill Watkins, Amal Bendimerad, and Juliet Carlisle). Santa Barbara, CA: UCSB Institutional Advancement.
- Smith, Eric R.A.N. 2003. The Role of Knowledge in the Public's Trust in Science about Offshore Oil and Gas Development. MMS OCS Study 2002-0051. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-30761. 69 pages.
- Smith, Eric R.A.N. 2002. *Recent Trends in Public Opinion toward Offshore Oil Development*. Report to the Minerals Management Service, U.S. Department of the Interior, December, 2002.
- Smith, E.R.A.N. 2002. *Energy, the Environment, and Public Opinion*. Boulder, CO: Roman & Littlefield.
- Smith, E.R.A.N. and R.L. Fox. 2001. The Electoral Fortunes of Women Candidates for Congress. *Political Research Quarterly* **54**: 205-21.
- Smith, E.R.A.N., Squire, P., Lindsay, J.M., and C.R. Covington. 2001. *Dynamics of Democracy*, 3rd edition. St. Paul, MN: Atomic Dog.
- Smith, E.R.A.N. 2000. Democratic Values vs. Environmentalism? In: *The Culture Wars by Other Means* Richard Ellis and Fred Thompson. University of British Columbia, Centre for Business and Government.
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Annual Report – 2003-2004

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- Smith, ERAN. 1997. Book Review: What Americans know about politics and why it matters, by M.X.D. Carpini, S. Keeter. *Political Science Quarterly* **112**: 314-315.
- Smith, E.R.A.N. 1996. Book Review: Public opinion in America - moods, cycles and swings, by J.A. Stimson. *Critical Review* **10**: 95-105.
- Smith, E.R.A.N. 1996. Book Review: The changing American mind - how and why American public opinion changed between 1960 and 1988, by W.G. Mayer. *Critical Review* **10**: 95-105.
- Smith, E.R.A.N. 1996. Book Review: The rational public - fifty years of trends in American policy preferences, by B. Page and R. Shapiro. *Critical Review* **10**: 95-105.
- 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., Epperlein, T., 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., Smith, E.R.A.N., Lindsay, J. and C. Covington. 1995. *Dynamics of Democracy*. Brown-Benchmark, Madison, Wisconsin. 596p.
- Smith, E.R.A.N. 1992. Changes in the Public's political sophistication. In: *Controversies in Voting Behavior, 3rd edition*, R.G. Niemi and H.F. Weisberg, eds. Congressional Quarterly Press, Washington, D.C. (reprinted from *The Unchanging American Voter*).
- Smith, E.R.A.N., Herrera, R., and C.L. Herrera. 1992. Public opinion and congressional representation. *Public Opinion Quarterly* **56**: 185-205.
- Smith, E.R.A.N. and P. Squire. 1990. The effects of prestige names in question wording. *Public Opinion Quarterly* **54**: 97-116.
- Smith, E.R.A.N., Herrera, R., and C.L. Herrera. 1990. The measurement characteristics of congressional roll call indexes. *Legislative Studies Quarterly* **15**: 283-295.
- Smith, E.R.A.N. 1989. *The Unchanging American Voter*. The University of California Press, Berkeley, CA.
- Smith, E.R.A.N. and P. Squire. 1988. The effect of partisan information on voters in non-partisan election. *J. Politics* **50**: 169-79.
- Smith, E.R.A.N. and P. Squire. 1987. Direct election of the president and the power of the states. *Western Political Quarterly* **40**: 29-44.

Coastal Marine Institute

Smith, E.R.A.N. and P. Squire. 1987. State and National Politics in the Intermountain West. In: *The Politics of Realignment: Partisan Change in the Intermountain West*. Peter Galderisi *et al.*, eds. Westview Press, Boulder, CO.

Smith, E.R.A.N. and P. Squire. 1984. Repeat challengers in congressional elections. *American Politics Quarterly* **12**: 51-70.

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.

DAVID L. VALENTINE
Department of Geological Sciences
University of California
Santa Barbara, CA

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 of Geology (Sediment Geochemistry with a Coastal Ocean Emphasis)
2000-2002	NSF Postdoctoral Fellow in Microbial Biology, Scripps Institution of Oceanography, UC San Diego
2000	Postdoctoral Researcher, Department of Earth System Science, UC Irvine

Research Interests:

General research interests include the geomicrobiology, geochemistry, and anaerobic microbial ecology of anoxic marine sediments. Specific research interests include methane hydrates (psychrophilic methanogenesis, anaerobic methane oxidation, water column methanotrophy, biomarkers, and microbe-hydrate interactions), organic carbon cycling in anoxic sediments (improved analytical analyses, methane production/consumption, organic acid cycling, decomposition of aromatics), hydrogen biogeochemistry (interspecies hydrogen transfer), and anaerobic microbial ecology (relation of community structure to metabolic function, metabolic biomarkers, syntrophy, bioenergetics).

Selected Publications:

- Adams, C. and Valentine, D.L. Bioenergetics of secondary fermentations involving glycolate, butyrate, and alanine. (*in preparation*)
- Chong, S., Liu, Y., Cummins, M., Valentine, D. L., Reysenbach, A. L., and D. R. Boone, *Methanogenium marinum* sp. nov., a H₂-Using Methanogen from Skan Bay, Alaska, and Kinetics of H₂ Utilization (*submitted to Antonie von Leewanhoeck*).
- Valentine, D. L., Chidthaisong, A., Rice, A., Reeburgh, W. S. and S. C. Tyler Carbon and hydrogen isotope fractionation by moderately thermophilic methanogens. (*submitted to Geochimica et Cosmochimica Acta*)
- Valentine, D. L. 2002. Biogeochemistry and microbial ecology of anaerobic methane oxidation: a review. *Antonie von Leewanhoeck*. (*in press*)
- Chidthaisong, A., Chin, K-J., Valentine, D. L., and S. C. Tyler. 2002. A comparison of isotope fractionation of carbon and hydrogen from paddy field rice roots and soil bacterial enrichments during CO₂/H₂ methanogenesis. *Geochimica et Cosmochimica Acta* **66**: 983-995.
- Valentine, D. L., Blanton, D. C., Reeburgh, W. S., and M. Kastner. 2001. Water column methane oxidation adjacent to an area of active hydrate dissociation, Eel River Basin. *Geochimica et Cosmochimica Acta* **65**:2633-2640.
- Valentine, D. L. 2001. Thermodynamic ecology of hydrogen based syntrophy, in Symbiosis: Mechanisms and Model Systems, J. Seckbach ed., Kluwer Academic Publishers, Dordrecht.

- Valentine, D. L., Blanton, D. C., and W. S. Reeburgh. 2000. Hydrogen production by methanogens under low hydrogen concentrations. *Archives of Microbiology* **174**:415-421.
- Valentine, D. L., and W. S. Reeburgh. 2000. New perspectives on anaerobic methane oxidation. *Environmental Microbiology* **2**:477-484.
- Valentine, D. L., and D. R. Boone. 2000. Diversity of methanogens, in Enigmatic Microorganisms and Life in Extreme Environments, Vol II, Diversity of Microorganisms, J. Seckbach ed., Kluwer Academic Publishers, Dordrecht p. 289-302.
- Valentine, D. L. 2000. Biogeochemistry of Hydrogen and Methane in Anoxic Environments: Thermodynamic and Isotopic Studies. Ph.D. Dissertation in Earth System Science, University of California, Irvine, 173pp.
- Valentine, D. L., Reeburgh, W. S., and D. C. Blanton. 2000. A culture apparatus for maintaining H₂ at sub-nanomolar concentrations. *Journal of Microbiological Methods* **39**, 243-251.
- Valentine, D. L. (2000) Biogeochemistry of Hydrogen and Methane in Anoxic Environments: Thermodynamic and Isotopic Studies. Ph.D. Dissertation in Earth System Science, University of California, Irvine, 173pp.
- Valentine, D. L., and D. R. Boone (2000) Diversity of methanogens, in Enigmatic Microorganisms and Life in Extreme Environments, Vol II, Diversity of Microorganisms (J. Seckbach ed.) Kluwer Academic Publishers, Dordrecht p. 289-302.
- Valentine, D. L., and W. S. Reeburgh (2000) New perspectives on anaerobic methane oxidation. *Environmental Microbiology* **2**:477-484.
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- Chidthaisong, A., Chin, K-J., Valentine, D. L., and S. C. Tyler (2002) A comparison of isotope fractionation of carbon and hydrogen from paddy field rice roots and soil bacterial enrichments during CO₂/H₂ methanogenesis. *Geochimica et Cosmochimica Acta* **66**: 983-995.
- Valentine, D. L. (2002) Biogeochemistry and microbial ecology of anaerobic methane oxidation: a review. *Antonie van Leeuwenhoek* **81**: 271-282.
- Chong, S. C., Y. Liu, M. Cummins, D. L. Valentine, and D. R. Boone (2002) *Methanogenium marinum* sp. nov., a H₂-using methanogen from Skan Bay, Alaska, and kinetics of H₂ utilization. *Antonie van Leeuwenhoek* **81**: 263-270.
- Leifer, I., Clark, J., B. Luyendyk, and D. Valentine (2003) Subsurface Hydrocarbon Migration and its Impacts Eos, transactions of the American Geophysical Union (News Item, reviewed)
- Valentine, D. L., Chidthaisong, A., Rice, A., Reeburgh, W. S. and S. C. Tyler (2004) Carbon and hydrogen isotope fractionation by moderately thermophilic methanogens (in Press, *Geochimica et Cosmochimica Acta*).
- Wardlaw G. W. and D. L. Valentine, Evidence for Salt Diffusion from Sediments Contributing to Increasing Salinity in the Salton Sea, California. *Hydrobiologia* (in press).

Annual Report – 2003-2004

Raymond C. Valentine and David L. Valentine *Omega-3* fatty acids in cellular membranes: A unified concept. *Progress in Lipid Research* (in press).

Valentine DL, AL Sessions, SC Tyler, and A Chidthaisong Hydrogen isotope fractionation during H₂/CO₂ acetogenesis: hydrogenase efficiency and the origin of lipid-bound hydrogen. *Geobiology* (in press).

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

Coastal Marine Institute

LIBE WASHBURN

Department of Geography &
Institute for Computational Earth Systems Science (ICESS)
University of California
Santa Barbara, CA

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: 1993-Present 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:

- Gaylord, B., Reed, D.C., Raimondi, P.T., Washburn, L., and S.R. McLean. 2002. A physically based model of macroalgal spore dispersal in the wave and current-dominated nearshore. *Ecology* **83**(5): 1239-1251.
- Nishimoto, M.M. and L. Washburn. 2002. Patterns of coastal eddy circulation and abundance of pelagic juvenile fish in the Santa Barbara Channel, California, USA. *Mar Ecol-Prog Ser* **241**: 183-199.
- Powell, L.A., Calvert, D.J., Barry, I.M., and L. Washburn. 2002. Post-fledging survival and dispersal of Peregrine Falcons during a restoration project. *J Raptor Res* **36**(3): 176-182.
- Boles, J.R., Clark, J.F., Leifer, I., and L. Washburn. 2001. Temporal variation in natural methane seep rate due to tides, Coal Oil Point area, California. *J Geophys Res-Oceans* **106**(C11): 27077-27086.
- Washburn, L., Johnson, C., Gotschalk, C.C., and E.T. Eglund. 2001. A gas-capture buoy for measuring bubbling gas flux in oceans and lakes. *J Atmos Ocean Tech* **18**(8): 1411-1420.
- Clark, J.F., Washburn, L., Hornafius, J.S., and B.P. Luyendyk. 2000. Dissolved hydrocarbon flux from natural marine seeps to the southern California Bight. *J Geophys Res-Oceans* **105**(C5): 11509-11522.
- Quigley, D.C., Hornafius, J.S., Luyendyk, B.P., Francis, R.D., Clark, J., and L. Washburn. 1999. Decrease in natural marine hydrocarbon seepage near Coal Oil Point, California, associated with offshore oil production. *Geology* **27**(11): 1047-1050.
- Washburn, L., Stone, S., and S. MacIntyre. 1999. Dispersion of produced water in a coastal environment and its biological implications. *J Cont Shelf Res* **19**(1): 57-78.

Annual Report – 2003-2004

- Ohlmann, J.C., Siegel, D.A., and L. Washburn. 1998. Radiant heating of the western equatorial Pacific during TOGA-COARE. *J. Geophys. Res.* **103**: 5379-5395.
- Washburn, L., Emery, B.M., Jones, B.H., and D.G. Orender. 1998. Eddy stirring and phytoplankton patchiness in the subarctic North Atlantic in late summer. *Deep-Sea Res Pt I* **45**(9): 1411-1439.
- Jones, B.H., Washburn, L., Bay, S., and K. Schiff. 1997. Stormwater runoff into Santa Monica Bay: Identification, impact, and dispersion, Conf. Proc., California and the World Ocean '97, 24-27 March 1997, San Diego, CA.
- Pinkel, R., Merrifield, M., McPhaden, M., Picault, J., Rutledge, S., Siegel, D., and L. Washburn. 1997. Solitary waves in the western Equatorial Pacific Ocean. *Geophys. Res. Lett.* **24**: 1603-1606.
- Washburn, L. and B.H. Jones. 1996. Field Observations and Modeling of Dispersion Processes around Ocean Outfalls, Oceans 96 MTS/IEEE, Conf. Proc., (published on CD-ROM) 23-26 September, Fort Lauderdale, FL.
- Washburn, L., Duda, T., and D. Jacobs. 1996. Interpreting conductivity microstructure: estimation of the temperature variance dissipation rate in the presence of salinity gradients. *J. Atmospheric and Oceanic Tech.* **13**: 1166-1188.
- Siegel, D.A., Ohlmann, J.C., Washburn, L., Bidigare, R.R., Nosse, C.T., and Y. Zhou. 1995. Solar radiation, phytoplankton pigments and the radiant heating of the equatorial Pacific Warm Pool. *J. Geophys. Res.* **100**: 4885-4891.
- Wu, Y., Washburn, L., and B.H. Jones. 1994. Buoyant plume dispersion in a coastal environment: observations of plume structure and dynamics. *J. Cont Shelf Res* **14**: 1001-1023.
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Selected Publications:

Fuiman, L.A., Davis, R.W., and T.M. Williams. 2002. Behavior of midwater fishes under the Antarctic ice: observations by a predator. *Mar. Biol.* **140**(4): 815-822.

Kanatous, S.B., Davis, R.W., Watson, R., *et al.* 2002. Aerobic capacities in the skeletal muscles of Weddell seals: key to longer dive durations? *J. Exp. Biol.* **205**(23): 3601-3608.

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Selected Publications:

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Annual Report – 2003-2004

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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.