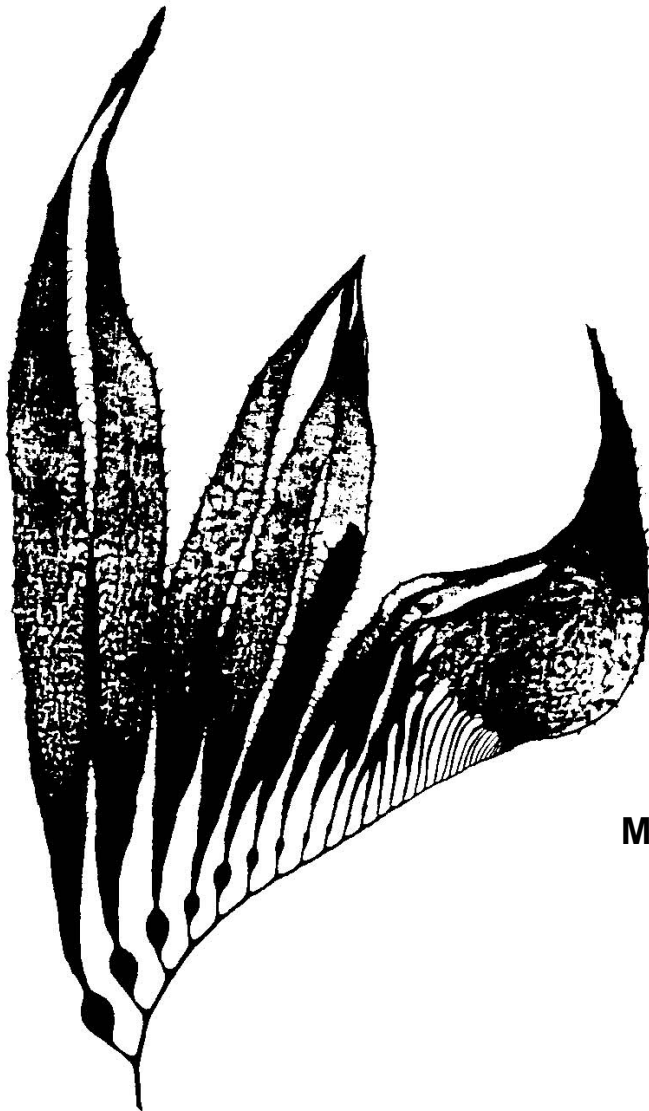


**COASTAL MARINE INSTITUTE
PROGRAM YEAR 7
QUARTERLY REPORT 3**

for the period

January 1, 2001 – March 31, 2001



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

April 25, 2001

**COASTAL MARINE INSTITUTE
PROGRAM YEAR 7
QUARTERLY REPORT 3**

for the period

January 1, 2001 – March 31, 2001

A Cooperative Program

between the

University of California

and the

Minerals Management Service

Russell J. Schmitt
Program Manager

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

April 25, 2001

Program Manager's Report

for the period January 1, 2001 – March 31, 2001

This constitutes the quarterly report for the second quarter for Program Year 7 of the Coastal Marine Institute, a cooperative research agreement between the Minerals Management Service, the state of California and the University of California. As of this quarter, 14 projects currently are being conducted under the aegis of the Coastal Marine Institute.

Actions Pending MMS Approval:

- Task 12387: *Ecological Consequences of Alternative Abandonment Strategies for POCS Offshore Facilities and Implications for Policy Development*, desperately requires approval of a no-cost extension;
- Task 10596: CMI Management requires agency approval of a no-cost extension;
- Task 14181: *Population Trends and Trophic Dynamics in Pacific OCS Ecosystems: What Can Monitoring Data Tell Us?*, requires approval of a transfer of funds for foreign travel;
- Task 15118: *An Experimental Evaluation of Methods of Surfgrass (*Phyllospadix torreyi*) Restoration Using Early Life History Stages*, requires agency approval of a no-cost extension;
- Task 17609: *Advancing Marine Biotechnology: Use of OCS Oil Platforms as Sustainable Sources of Marine Natural Products*, requires agency approval for transfer of funds from salaries and indirect costs into graduate student fees and health insurance. Agency approval is required because of the change in indirect costs.

Major Programmatic Progress and Actions during the Quarter:

- Full proposals have been received for 9 new projects. The proposals have been sent to MMS personnel and peer-reviewers for review;
- The Final Report for Task 13096: *Utilization of Sandy Beaches by Shorebirds: Relationships to Population Characteristics of Macrofauna Prey Species and Beach Morphodynamics*, has been completed. It will be submitted to MMS as soon as the manuscript containing the data has been submitted for publication;
- Task 13094: *Application of Coastal Ocean Dynamics Radars for Observation of Near-Surface Currents off the South-Central California Coast*, has been completed and the draft final study report has been submitted to MMS for review.
- Task 15116: *Wave Prediction in the Santa Barbara Channel*, has been completed and the draft final study report has been submitted to MMS for review;
- Task 15117: *Assessing Toxic Effects on Population Dynamics Using Individual-Based Energy Budget Models*, has been completed and the draft final study report has been submitted to MMS for review.

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

We continued to focus our efforts on writing the final report and associated publications this past quarter. The primary tasks conducted this past quarter were:

- Preparing text, tables and figures for the final report and publications.
- Further analyses of fish abundance and size distributions among depths and habitats (platforms vs. natural reefs).

Problems Encountered: We still have not received the no-cost extension requested from MMS several months ago and this has constrained the amount of time our technicians can devote to data analysis for the past two quarters. Little work can be continued on this project until this is sorted out.

MMS Action Required: Please follow-up on the status of this no-cost extension request.

Future plans: Further analysis and preparation of final report and publications when the no-cost extension allows us to re-hire the technical assistance necessary for this effort.

Estimated Percentage of Budget Expended:

Project Year 1	100%
Project Year 2	100%
Project Year 3	70%

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

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

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.

To date we have analyzed 8 separate datasets collected in three different ecological systems; subtidal, rocky reef, kelp bed, and open ocean pelagic. Trends in population abundances show consistent declines in all three systems over the last 10-15 years. Most interesting, within each system examined, trends within several simple food webs (subtidal, rocky reef: kelp bass, surfperches, epifaunal invertebrates, and foliose algae; kelp bed: sheephead, sea urchins, and understory algae; open ocean, pelagic: piscivorous seabirds, zooplanktivorous, epipelagic fishes, and zooplankton) show approximately the same degree of decline within each component trophic level. 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.

Our most recent efforts have centered around attempts to explore the generality of these results using a much larger dataset on marine fishes. We are currently analyzing this dataset to explore concordances in response among species occupying similar trophic levels or possessing similar life histories with a goal of identifying which suites of species may make the most sensitive indicators of environmental change.

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

We have completed the work-up of all the 1999 samples collected at our 11 permanent survey sites off Santa Cruz Island. These data currently are being entered into our database and are being error checked. An examination of these most recent data suggests that the long-term declines in fish and invertebrate density as well as total algal cover observed over the last 10 years are continuing.

We are currently in the process of working-up samples collected during our 2000 surveys. All algal samples collected have been identified and weighed. Invertebrate resource samples have been rough sorted and we are now in the process of identifying the epi-faunal meso-invertebrates collected to the lowest taxon possible.

Publications and Presentations:

Brooks will present the results from our most recent work at the 6th Indo-Pacific Fish Conference to be held in May, 2001. As part of this presentation, a companion paper will be submitted to the Journal of Freshwater and Marine Research for publication as part of the conference proceedings.

List of all personal associated with the project this quarter

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

Post-graduate researchers: Keith Seydel

Undergraduate researchers: Andrea DeMent, Pam Porteous, Jada-Simone White, Heather Bracken, Glenda Lee, Patrick Sachs

Estimated Percentage of Budget Expended:

Project Year 1 100%

Project Year 2 76%

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

Summary:

The project is continuing as planned and, although progress has been slow, there have been no major barriers to its success. There is nothing new to report since last time, so the details below remain the same as the previous report.

Below are the three main questions proposed by the project and progress to date.

Question 1: What are the spatial and temporal patterns in the structure of the monitored communities at all 25 monitored sites?

These patterns have now been documented.

Question 2: Should there be any modification to the sampling regime employed at the various sites?

The detailed and complex statistical analyses continue. Addressing this question awaits the outcome of all analyses, which are still in progress.

Question 3: Can the collected data be used to predict the structure of communities at previously unsampled sites?

We are planning to address this question with preliminary sampling this spring.

Major Accomplishments:

No major accomplishments in this quarter. Statistical analysis continue as planned.

Problems Encountered:

With the change in personnel, there have minor delays in progress.

Future plans:

1. Continue statistical analyses.
2. Design and preliminary sampling of field component of project to address Question 3.

MMS Action Required:

No assistance is needed at this time.

Task 15118: *An Experimental Evaluation of Methods of Surfgrass (Phyllospadix torreyi) Restoration Using Early Life History Stages*

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

Major Accomplishments, January 31, 2001 - March 31, 2001

During this quarter of research we continued sampling our experiments that are testing the efficacy of various methods of surfgrass restoration. These experiments are being conducted in both intertidal and subtidal habitats and involve monitoring the survivorship and growth of naturally recruited seedlings, laboratory-reared seedlings outplanted to the field, and apical meristems and rhizome clumps that were collected from natural populations and transplanted to experimental sites. Factors that are being explicitly tested in these experiments include: (1) the effects of seedling density (three levels), algal cover (two levels) and outplant technique (three levels) on seedling survivorship and growth in both intertidal and subtidal habitats (2) the effect of transplant size on survivorship and expansion rate of transplanted surfgrass and (3) the effect of clump size on the recovery rate of the bare patches created by collecting clumps of surfgrass for transplanting. We are also continuing to follow the survivorship and growth of three cohorts of seedlings at our intertidal site at More Mesa. We anticipate completing all field work by June 2001.

In addition to our field work we have spent a considerable amount of time analyzing data that will form the basis for several manuscripts that we are preparing.

Future Plans: Work will proceed as scheduled.

MMS Action Required: Approval of no-cost extension.

Estimated Percentage of Budget Expended:

Project Year 1	100%
Project Year 2	100%
Project Year 3	32%

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

Progress to Date

During the reporting period, the shallow shell mounds (Hilda, Hazel, 30-32 m) were sampled by band transect to determine the densities and population structures of mobile benthic invertebrates. Muscle tissue from selected captured organisms was frozen for determination of RNA/DNA ratios. Plastic mesh cages filled with mussel shells were deployed on shallow shell mounds to test whether commercially important crabs recruit to these sites. Development of methods for estimating short-term growth rate using tissue RNA/DNA ratio continued.

Six species of benthic invertebrates, *Parastichopus parvimensis*, *Asterina miniata*, *Cypraea spadicea*, *Kelletia kelletii*, *Parastichopus californicus*, and *Pisaster giganteus*, were collected on shallow shell mounds, and sizes were measured. The most abundant species, *P. parvimensis* and *A. miniata*, were present at densities of 0.7 animals m⁻² and 0.8 animals m⁻², respectively. *C. spadicea* was present at a density of 0.05 animals m⁻².

Upcoming work

Frozen tissue samples from trap and mound samples of invertebrates and fishes will be assayed for RNA/DNA ratios. Recruitment cages will be periodically checked for crab recruits. Sampling of shallow shell mounds by transect will continue. Crab trap deployment will resume in August.

Problems Encountered: None

MMS Action Required: None

Estimated Percentage of Budget Expended:

Project Year 1 67%

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

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

Major Accomplishments (January 1 - March 31, 2000):

During this quarter, the bulk of our efforts revolved around the planning and partial execution of the Spring 2001 sampling, as well as miscellaneous tasks relating to the project as a whole. Early in the quarter (January 17-19), a monitoring workshop was held at the new Kenneth Norris Reserve in Cambria. While the main purpose of this workshop was a review of the Channel Islands Park Service's monitoring program, the protocols of the entire MARINE group were discussed. Among the issues discussed were the upcoming comprehensive surveys, the newly established motile invertebrate sampling protocols, and there was a demonstration on the use of Visor Handspring computers with barcode adapters to collect intertidal data. No significant changes will be made to our protocols as a result of this workshop, but we will be making small changes such that all groups are collecting comparable data. Noteworthy changes are:

1. We should replace our variable focus lens with a fixed focus lens for improved optics and error reduction when taking the site overview photographs.
2. All motile invertebrates except littorines should be counted within the plots rather than limiting counts to certain key species. For example, all species of chitons should be counted rather than just *Lepitochitona*.
3. Better, more repeatable still photo survey protocols should be developed.
4. Where possible, numbers of plots should be uniform across sites. For example, an extra surfgrass transect should be added at Arroyo Hondo to bring the total transects sampled from two to three.
5. Periodic comprehensive surveys are a valuable complement to our regular, fixed-plot design.

These changes have been implemented beginning with the recent Spring 2001 sampling season, currently underway (Table 1). So far, all sampling has gone smoothly without any major problems. This season marked the second season of motile invertebrate data collection within the photoplot quadrats. Mobile invertebrate data were taken within *Chthamalus*, Mussel, *Endocladia*, and *Pelvetia* photoplots. In addition, data were taken within the *Balanus* plots at White's Point. No mobile invertebrate data were collected within *Pollicipes*, or Anemone plots. Subsampling occurred where necessary, with a clear accounting of which plots were subsampled and what fraction of the plot was sampled. The remaining slides from the Fall 2000 sampling season were also scored this quarter and the rest of the associated data management and report writing was completed. The rest of the images from the Fall 2000 sampling were scanned into

the computer for archiving, and copies of the resulting CD's have been distributed. Also this quarter, the methods used in the previous "one-time" comprehensive surveys have been employed in another unrelated project surveying rocky intertidal resources along the Malibu coast, furthering the amount of the comparable intertidal data collected along the California coast.

Table 1. Spring 2001 Sampling Schedule

Date	Location	Personnel	Comments
March 7	Paradise Cove	Steven Lee, Sean Bergquist, Dave Erickson	UCLA personnel only
March 8	Carpinteria	S. Lee, S. Bergquist, Jim Castle Sean Morton, George Johnson, Charlene Burge	UCLA personnel, plus SB County and Ventura College volunteers
March 8	Mussel Shoals	S. Lee, S. Bergquist, J. Castle, C. Burge	UCLA personnel, plus Ventura College volunteers
March 9	Mussel Shoals	S. Lee, S. Bergquist, D. Erickson	UCLA personnel only
March 21	Old Stairs	S. Lee, S. Bergquist	UCLA personnel only
March 22	White's Point	S. Lee, S. Bergquist, Po Fung	UCLA personnel only
March 23	Old Stairs	S. Lee, S. Bergquist	UCLA personnel only
Planned continuation of Spring Sampling			
April 2	Coal Oil Point	S. Lee, S. Bergquist	UCLA personnel only
April 4	Alegria	S. Lee, S. Bergquist, G. Johnson	UCLA personnel, plus SB County help
April 5	Arroyo Hondo	S. Lee, S. Bergquist, G. Johnson	UCLA personnel, plus SB County help
April 6	White's Point	S. Lee, S. Bergquist	UCLA personnel only Planned revisit for barnacle plates
April 6	Point Fermin	S. Lee, S. Bergquist, Susanne Lawrenz-Miller	UCLA personnel, plus Cabrillo Marine Aquarium

Future Plans:

Throughout the present quarter, we will continue with our completion of sampling and wrap-up of the Spring 2001 sampling season, including photographic processing, slide scoring, and data management. We will also continue the process of scanning and archiving the current photoplot and photo survey slides for LA, Ventura, and southern Santa Barbara Counties. In addition, planning and coordination between the UCLA group and the UCSC intertidal "swat team" is currently underway regarding the comprehensive surveys that will be made at many of our monitoring sites in southern Santa Barbara, Ventura, and Los Angeles counties. Multiple low tide dates were set aside for these comprehensive surveys, but were instead used for the more northern sites, and only now is this group able to sample the southern sites. Our personnel will accompany this group during the upcoming comprehensive surveys at our southern sites during the coming quarter. Also during this upcoming quarter, a new still photo survey protocol

will be developed for our sites that will reduce future confusion on the day of sampling. Planning and execution of the Summer 2001 barnacle recruitment sampling will also occur in the present quarter.

Problems Encountered:

Heavy swell hindered some of our sampling attempts but eventually all of the data were collected. Some confusion arose during the sorting and labeling of our still photo survey pan images. The lack of a written protocol for the location of these photographic reference points led to some ambiguity in the exact replication of these images. Field notes were taken during this last sampling period, and a new still photo protocol is being developed.

MMS Action Required:

We are awaiting the purchase of new Visor palm computers with barcode readers for use in intertidal data collection. Additionally, we are anticipating the purchase of a fixed focus 35mm lens for our Nikon camera.

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

During the beginning of this quarter, photographic slides were scored for percent cover of species within photoplots and data collected during the previous quarter were entered into spreadsheets. The second part of the quarter was spent sampling all 10 study sites in San Luis Obispo (SLO) and Northern Santa Barbara Counties (SBC). Sampling occurred during March 5-11 and on March 19th. All sampling was successfully completed, despite the large swells and stormy conditions that occurred during the March 5-11 sampling period. Black abalone numbers continued to decline at Purisima Pt. No evidence of withering syndrome was detected at Piedras Blancas, the closest site upcoast from Purisima where abalone are monitored.

In addition to the regular sampling done for the shoreline monitoring project, newly structured "comprehensive surveys" were completed at most sites. The goal of these comprehensive surveys is to characterize more completely the flora and fauna existing at each site using a repeatable sampling method. Sites will be sampled using the comprehensive method on a less frequent basis than the normal monitoring (approximately every 3-5 years), with the hope that long term changes in the distribution and abundance of species not targeted by the monitoring work can be detected.

Future Plans:

In the next quarter comprehensive surveys will be completed at the SLO and SBC sites. An additional abalone monitoring site will be set-up at Rancho Marino, the UC reserve located between Purisima Pt. (the most northern site to be struck by withering syndrome), and Piedras Blancas (the closest abalone site upcoast from Purisima Pt.). In addition, percent cover data from the photographic slides taken during this quarter will be entered along with field data into computer files.

Problems Encountered: No problems were encountered.

MMS Action Required: None

Estimated Percentage of Budget Expended:

The new CMI funds have just arrived at UCSC. Other funds were used to support the shoreline project during the period when the CMI money was awarded but not yet on campus. Additional county funding is 50% expended, but is awaiting a no-cost extension.

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

Principal Investigators:

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

Major Accomplishments, January 1 - March 31, 2001:

After receiving funds and acquiring all required permits, capture activities of study animals were initiated in mid March in the northern study area (i.e. between Cambria and Pt. Piedras Blancas). A total of 13 study animals, 2 males and 11 females, have been captured at this time, with plans to capture 5 more within the next 2 weeks (weather permitting). Of the animals captured so far, 10 have received VHF radio implants and 6 have received TDR implants. Monitoring of these animals by radio telemetry is ongoing by fieldworkers based at Piedras Blancas field station; currently all but one of the study animals is located and observed (either visually or by radio signal) 4 to 5 times weekly. One adult male is currently unaccounted for by the ground-based observers, but it is expected that this animal will be located by plane during aerial searches. Data collection on movement patterns, activity budgets and foraging behavior/diet is progressing well, and all data are entered immediately into the wild sea otter database (WSOD).

Aerial surveys of the southern study area (south of Pt. Conception) in late 2000 and early 2001 indicated few sea otters had yet arrived, precluding the initiation of captures at this location. Another aerial survey just completed detected a total of 62 otters south of Pt. Conception, thus captures should soon be possible in this region.

The spring range-wide sea otter survey is scheduled for mid May. Beach walks for sea otter carcasses are ongoing: all collected carcasses are subject to detailed necropsies.

Problems Encountered:

No problems were encountered during this quarter

MMS Action Required:

No MMS action required.

Future plans:

Work will proceed as proposed.

Estimated Percentage of Budget Expended:

Project Year 1	40%
----------------	-----

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

The first major goal of our project is to define the genetic boundaries of populations. During this quarter we finished collecting samples along the Santa Barbara County coastline. Thus, we now have collected 49 samples (7 individuals from each of 7 sites) from each of three replicate areas for a total of 147 samples. The sites where we collected within an area were arranged so that distances among them range from approximately 0.5 to 25 km. We have also now isolated DNA from 98 of these samples. From 49 samples, we have already conducted AFLP analyses and all of the methods are working as planned.

Problems Encountered:

No problems were encountered during this quarter

Future plans:

Work will proceed as proposed.

Estimated Percentage of Budget Expended:

Project Year 1 18%

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

In this period, we circulated a draft public opinion questionnaire for comment among some public opinion researchers.

We also revised the design of the newspaper content analysis project and began to collect data from the *Los Angeles Times*. The goal of this analysis is to discover how newspapers cover the oil and gas industry and how that coverage has changed over time. The results of the analysis will be used along with public opinion survey data to help model changes in the public's attitudes toward the industry over time.

Problems Encountered: None

MMS Action Required: None

Future Plans: After obtaining more feedback on the questionnaire, we intend to submit the questionnaire for OMB approval. That approval is required in order to use the questionnaire in a survey.

Estimated Percentage of Budget Expended:

Project Year 1 1%

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

In the quarter ending 31 March 2001 we accomplished an important goal of our new MMS project, namely, the installation of a radio modem at the Point Conception HF radar station. The remote modem was installed in mid-March with the help of Mr. Chad Whelan of the Naval Postgraduate School in Monterey, CA. So far the connection has been reliable with good signal-to-noise and reliable transmission of data packets. The distance to Point Conception is about 50 km, somewhat longer than the nominal transmission range. By placing the receive and transmit antennas as high as possible (on a hill at Pt. Conception and on a 6-story building at UCSB), we were able to achieve a good link. We now can download data from Pt. Conception in near real time; a goal for the new quarter will be to update our data handling procedures to put surface current data on the internet from all three sites (Pt. Conception, Refugio, and Coal Oil Point).

We also made other progress related to this project during this quarter. Proposals were submitted to the Marine Council of the University of California to provide a fellowship for Mr. Edwin Beckenbach (a graduate student working on this project) and to acquire a new HF radar system. Both of these proposals leverage support from MMS on this project. The first cruise of the Santa Barbara Long Term Ecological Research (LTER) Project was just successfully completed. Data from this cruise will be of great value in interpreting our HF radar observations.

Action requested from MMS: We request that MMS continue supporting our monthly helicopter flights to Pt. Conception to maintain our HF radar site there. These have been efficiently arranged by Miriam Rose of the MMS office in Camarillo and are a great benefit to our project.

Estimated Percentage of Budget Expended:

Project Year 1 66%

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

COMMUNITY AND POPULATION ECOLOGY:

During this quarter we experimented with methods to attach sponges to artificial substrates in the laboratory. Developing successful methods of attachment will allow us to compare sponge growth rates among platforms in the field and to identify locations of optimal growth. Sponges were collected from Platforms Houchin, Hogan and Holly in January. One species, *Hymeniacidon sp.*, readily attaches to plates in the laboratory. Congeners of this species are believed to contain promising natural products. We collected additional samples of this sponge species in March at Platform Holly for use in our upcoming pilot study on sponge growth, and to provide voucher specimens from various depths for future product testing. Samples of this and other species of sponges were provided to Dr. Jacobs.

During this quarter, we collaborated with Dr. Jacob's laboratory to develop an inventory database system for maintaining voucher specimens of platform organisms. In March, we participated in a hand-on demonstration session provided by visiting researcher, Dr. Shirley Pomponi, a sponge specialist with Harbor Branch Oceanographic Institute. Dr. Pomponi provided training on methods for collecting, maintaining and identifying sponges. She also reviewed methods for preparing voucher samples for identification, as well as for future product testing. Sponge samples from both our January and March collections were entered into the database, with voucher samples preserved and frozen. A subset of preserved specimens has been sent to Dr. Pomponi for additional identification.

We measured our caged mussels at each platform and photographed the settlement plates for analysis. Preliminary results indicate that the growth rate of mussels (*Mytilus galloprovincialis*) did not vary significantly among platforms during the winter period (3.5 months). However, the settlement and growth of barnacles (*Megabalanus californicus*) did vary among platforms over this period. We constructed and field-tested a quadrat and underwater camera apparatus for use in our photographic surveys of species composition and abundance. We are currently making adjustments to the apparatus.

Future plans: In April, we will initiate a pilot study to measure the growth rate of sponges at Platforms Hogan and Houchin. We will also deploy another group of mussel cages/settlement plates to measure the growth and settlement of these organisms across platforms during the spring and summer. In addition, we will finalize our photo quadrat apparatus and initiate photographic surveys of the platforms. Over the next quarter, we will continue to collect sponge specimens with potentially promising natural products. In particular, we will begin collecting additional samples of *Hymeniacidon sp.* from various depths at each platform.

PHARMACOLOGY:

Poor weather has prevented studies of populations at the platforms of species of specific interest to the Jacobs & Wilson groups. However, 2 collections yielded sponges that are vouchered and ready to be sent out for identification.

Graduate student Lory Santiago has instituted the voucher system for collections. She will be responsible for storing and freezing samples. Lory will also maintain all records and has developed the computer-based UCSB database to allow access to all participants.

Hitachi has finished the upgrade of our 2 HPLC systems and all students have completed the necessary training course. The instruments are working well. Lory Santiago and Laura Mydlarz have completed the protocols to be used allowing preparation of crude organic HPLC extracts for the *Tetrahymena* studies and the microtubule studies. We need one additional upgrade for one Hitachi unit to be outfitted with a diode array detector necessary for the extraction work.

An undergraduate work study student is now trained on growing *Tetrahymena* cells and measuring phagosome formation. She will continue on during the summer months. We will train a second student on certain steps in preparing extracts.

Shirley Pomponi from HBOI in Florida visited us and has demonstrated the intricacies in identifying sponges. She has offered to assist us in developing important aspects of our program.

Nava Dyan, Chief Scientist for Lipo Chemicals Inc., spent 2 days at UCSB reviewing aspects of our program. Lipo Chemicals may soon be an important source of matching funds.

Hamta Madari will be added to the grant beginning in the spring quarter. The algae she is studying is important to the Wilson group. We filed a patent application(provisional) on April 13th. After discussion with a Texas marine lab that also studies this species and a literature search, we found the algae has been reported present on the south east side of platform 73 off the coast of Louisiana. Cliff Ross and I plan to visit this site this summer for a collection. LSU has had no direct contact with us as yet.

GlaxoSmithKline has donated a TLC radio-isotope scanner. This will be an important component of the project. It arrived from Philadelphia yesterday.

POPULATION GENETICS AND NATAL SOURCES:

Tracking the dispersal of marine larvae from their birth site is a daunting challenge because of their small size and potential for long distance dispersal. The sustainability of populations on oil platforms and their contributions to natural populations depend on the source of larvae that settle on the rigs and the fate of larvae that are released from adults on the rigs. We have developed new approaches to resolving this dispersal problem using hard body parts (made of calcium carbonate) in fish and invertebrate larvae. Marine fish and many invertebrates have calcium carbonate "ear bones" that grow in size daily. By analyzing the rings of new material, we can characterize the chemical composition of the water when the material was produced. We have now developed procedures for analyses of extremely small amounts of calcium carbonate using an ICP mass spec that allow sampling resolution of a few days. Resolving the pathways of larval

dispersal requires identifying unique chemical signatures that characterize particular locations. We are investigating whether platforms in different regions of the Santa Barbara Channel can be uniquely identified by the surrounding water chemistry. In the past six months we have developed and field tested new trace metal collectors that can be deployed at locations to characterize their chemical signature.

The trace metal collectors are diffusive gradients in thin films, or DGTs, that contain a layer of Chelex resin, which bind trace metal ions from the surrounding waters. The constant accumulation of elements in situ by DGTs and subsequent analysis using ICP-MS allow for a quantifiable estimate of the concentration of trace metals in the surrounding water. The extreme sensitivity of DGTs in the measurement of analytes (pM from Zang 1995) will enable a unique elemental characterization of a given water mass. If distinct elemental differences between water masses surrounding oil platforms exist they should be detectable using DGTs. DGTs integrate elemental concentrations through the duration of deployment, an attribute that avoids the inherent difficulty of characterizing a water mass from a water sample taken at one point in time. We expect that a DGT can successfully accumulate trace metal ions for up to three months in coastal waters before reaching a saturation capacity (Zang 1995), and we are testing this expectation with laboratory and field trials. We are currently deploying DGTs at several platforms along with collectors that attract larval fish and invertebrates. The primary settlement season for most species is spring and summer, so we will be comparing chemical signatures among rigs based upon DGTs and larval statoliths and otoliths to see if resolution of natal sources is feasible.

Problems Encountered: We had hoped to be able to collaborate with LSU and visit some Gulf platforms. So far, there have been difficulties scheduling this work.

Estimated Percentage of Budget Expended:

Project Year 1 25%

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

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

Major Accomplishments, January 31, 2001 - March 31, 2001

During the past quarter, we hired one new student intern, Mike Williams, who is working with Dr. Jim Lima to support the MMS archeology program, and is organizing and archiving archeological information into an existing database, and creating narratives and website information on archeological resources from the region. Kevin Buchanan, continues to work with Michael McCrary at MMS, USGS-BRD personnel and NPS personnel entering data from aerial surveys and monitoring of seabirds in the Santa Barbara Channel. Mr. Jason Chau is also supporting the MMS marine archeology program and is mentored by Dr. Jim Lima of MMS. Luke Hamlin is assisting Ms. Joan Barminski of MMS with a regional database for use in site-specific geological and engineering evaluation of producing offshore fields in the Santa Maria Basin, Santa Barbara Channel and offshore Long Beach. We advertised one new internship this quarter to help with geology at the MMS office and hope to fill this position in early April. We are working with Jim Lima and others to arrange additional internship opportunities for MMS/CMI projects during Spring and Summer 2001.

No Information Transfer Seminars were presented by CMI/SCEI PI's this past quarter at the request of MMS. We will work with Fred Piltz and others to develop a seminar schedule in the future.

Future plans:

New interns will be hired as needs are identified.

Estimated Percentage of Budget Expended:

Project Year 1: 13%

Task 17611: *Simulation of a Subsurface Oil Spill by a Hydrocarbon Seep (SSOS-HYS)*

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

Major Accomplishments, January 31, 2001 - March 31, 2001

Overview

During the first quarter, significant progress towards the project goals have been made. These include bubble visualization, video surveying of the seep area. Specifically, the bubble measurement system was constructed and field tested. Diver collected water samples were analyzed for dissolved gas, and oil, while bubble-gas samples were collected and analyzed for major and trace gas content. During this period, a bubble-mediated gas model was tested on some of the bubble data. Further details on each of these aspects are provided below.

Bubble Visualization System

As part of this research, a Bubble Measurement System (BMS) has been designed and built. A schematic is shown in Fig. 1, while images of the BMS during a pool test are shown in Fig. 2. Lights, screen and camera are all mounted on an adjustable rail. Bubble blockers are used to prevent the bubble density from being too high in the field of view, to ensure that bubbles are all at a known (i.e., calibratable) distance, and to ensure that the view is not obscured by blurry bubbles too close to the camera. Illumination is by backlighting through a diffuser screen. Currently, system modifications will allow it to operate in high current areas.

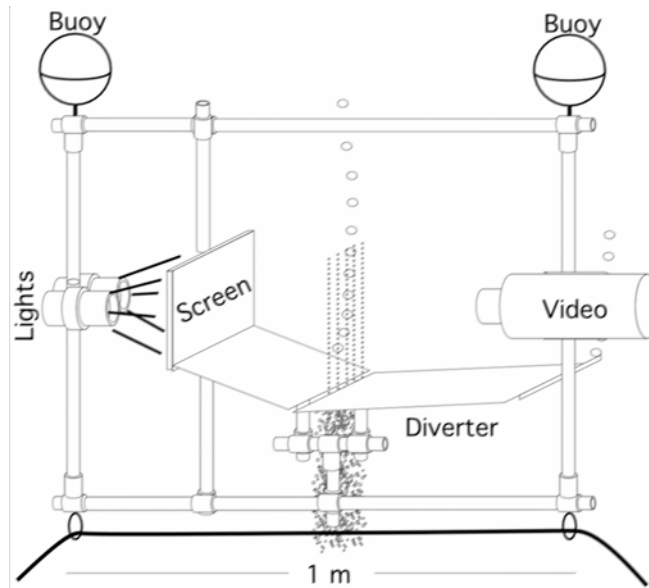


Fig. 1. Schematic of Bubble Measurement System.

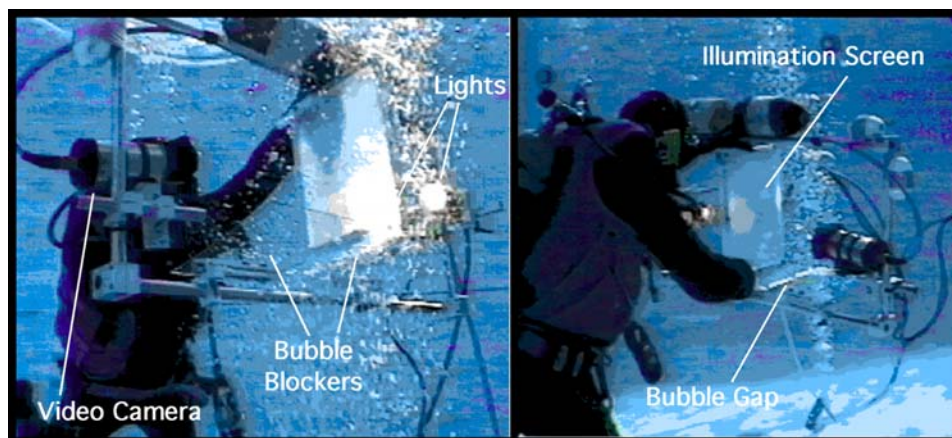


Fig. 2. Pool test of the seep Bubble Measurement System.

Near surface images from Shane seep - 34°24.37' N, 119° 53.41' W, (see Fig. 3a) were digitized and analyzed to determine the size distribution, Φ (Fig. 3b), defined as the number of bubbles per size increment (1 μm) in the entire measurement field. Φ shows a relatively broad peak centered at 2500 μm . Minimum resolution for this optical setting was circa 1500 μm . A power law was fit to Φ for $r > 3000 \mu\text{m}$, where r is bubble radius, and showed a steep decrease with $\Phi \sim r^{-3.1}$. Total seep gas in this image is $\sim 7 \text{ cm}^3$.

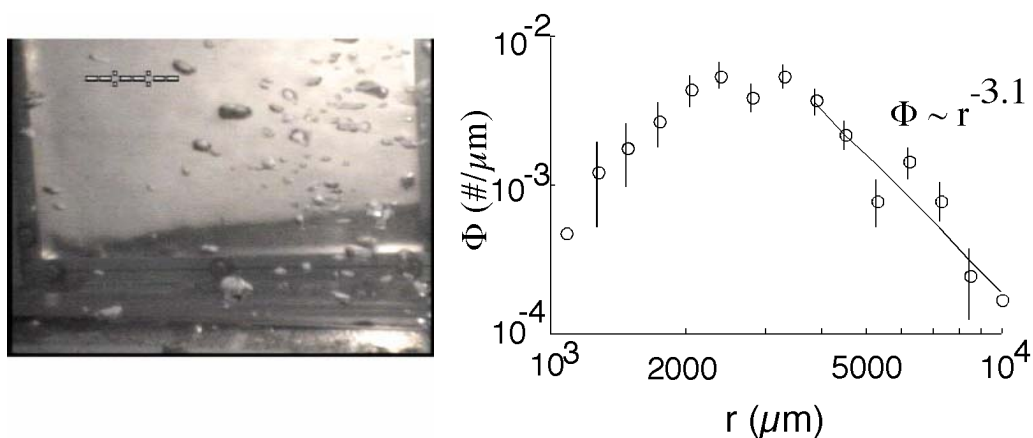


Fig. 3. Image of bubbles from Shane seep (34°24.37' N, 119° 53.41' W) (a) and bubble size distribution, Φ , as a function of radius, r .(b).

Dissolved methane and higher alkanes

Samples of the bubble gas and water were also collected at Shane seep and the Seep Tent seep and analyzed. The aqueous methane, CH_4 , concentrations near the surface in the bubble plumes were substantially greater ($>10^8$ times) than atmospheric equilibrium values. At the sea floor, bubbles were $\sim 90\%$ CH_4 and 10% higher hydrocarbons while at the surface of deeper seeps (65 m) they are about 60% CH_4 , 30% air, and 10% higher hydrocarbons. The decrease in CH_4 at a shallow seep (20 m) was much less; the surface composition was about 70% CH_4 , 15% air, and 15% higher hydrocarbons. For alkanes heavier than CH_4 , the ratio of the surface to sea floor mole fraction showed a linear enhancement (see Fig. 4) with increasing alkane number. CH_4 behaved differently because the water column was saturated with CH_4 .

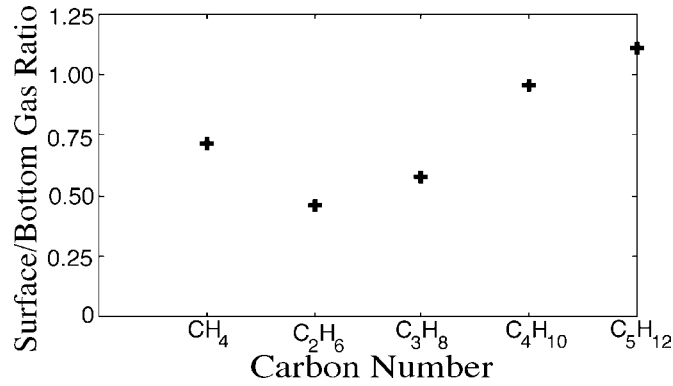


Fig. 4. Alkane ratio from sea floor to sea surface for Seep Tent seep (34° 53.35' N, 119° 23.05' W) bubble gas.

Dissolved oils

Preliminary investigations have shown that spectrofluorometry can be used to investigate oil dissolution from the bubble plume. Water samples were obtained in a horizontal transect under the seep surface expression at a depth of 1 m for fluorometric and gas chromatographic (GC) analysis. The features of the surface expression of the seep are shown in Fig. 5a. The current was towards the north, while the transect line was cross current (east to west). Within this surface expression, there were three different regions, the central upwelling area where most bubbles surfaced, an outwelling region where flow from the central region dominated, and an outer region where oil slicks were visible. Transitions between these regions are marked on Fig. 5a. There were two strong bubble plumes in the central region, presumably one for each of the large sea floor vents - located in mud volcanoes. A sea floor map of the major Shane Seep features is shown in Fig. 5b.

Preliminary spectrofluorometry results are shown in Fig. 6. Excitation was at 337 nm, emission was integrated over 350 - 600 nm, and values are normalized to quinine sulfate. Spectra showed clear oil signatures. Using GC analysis of collected oil from the sediment, these values will be ground truthed to provide dissolved oil components. The transect (shown in Fig. 5a) was cross current, and the surface slick features corresponding to Fig. 5a are indicated on Fig. 6a. The 0 m coordinate is centered in one of the bubble plumes. Between the two bubble plumes was a surface convergence zone (+2 m) that showed a local fluorescence maxima. The highest fluorescence was located under the visible surface slick (-10 m), while the lowest was in the center (+3 m). This trend was also observed at 15 m (Fig 6b), and is consistent with “pulling” by the strong current of dissolved oil out of the bubble plume.

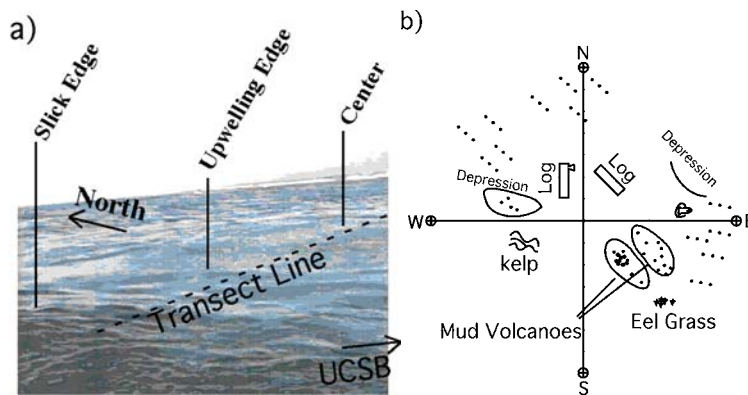


Fig. 5. Shane Seep surface expression showing features and sampling transect (a), and sea floor map at 20 m depth (b). Squares in (b) are 1 m by 1 m and dots represent seafloor vents.

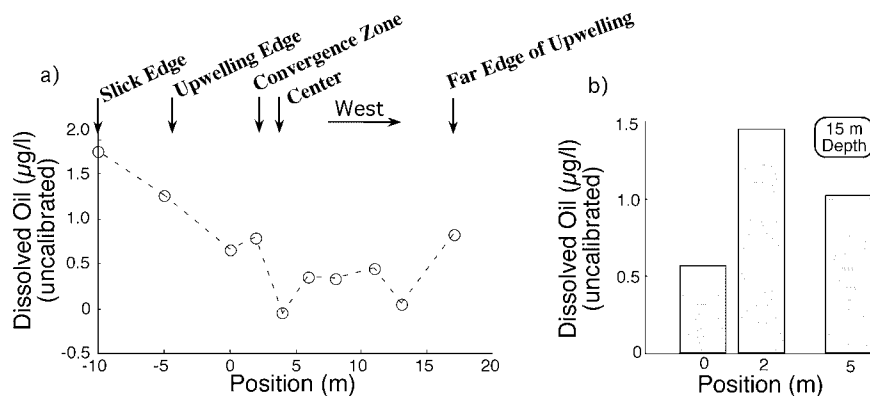


Fig. 6. Plot of excitation-emission fluorescence, normalized to quinine sulfate with background subtracted, for 1-m depth (a) and 15-m depth (b) for Shane seep.

Numerical Modeling

A bubble-mediated air-sea gas exchange model that has been used for modeling breaking-wave bubble plume gas transfer (Leifer, 1995) and sensitivity studies of seep gas (Leifer and Patro, 2001) was modified to incorporate trace gases. The model was then used to investigate several aspects of marine seepage, specifically, bubble survivability to the surface, and methane transport to the atmosphere. While these two are interrelated, the influx of air into the bubbles can allow bubbles to survive to the surface with little methane, but significant

An example model output is shown in shown in Fig. 7, for an upwelling flow of 30 cm/s, 15°C, and dissolved CH₄, O₂, N₂, equivalent to 0.9, 0.10, and 0.34 Atm, respectively (as determined by Henry's law). Bubbles were varying surfactant coverage, i.e., small bubbles are simulated dirty, while large bubbles are simulated clean, with a transition at 500 µm. The environmental conditions were assumed to be constant throughout the water column, current investigations and further model studies will determine the validity and appropriateness of this simplifying assumption.

The model shows the surface to bottom ratio of each of the trace gases for each different bubble size, i.e. what was shown in Fig. 4. Because the kinetic properties of each of the alkanes is different, the transport efficiency varies with bubble size. Thus while larger bubbles do not produce a significant variation in ratio with alkane number, bubbles smaller than 2000 µm do. In this simulation, bubble smaller than 300 µm dissolved (see right hand y-axis). The conclusion from this simulation was that most of the gas transfer needed to be due to bubbles in the initial 1000 – 3000 µm size range, in agreement with the observed surface bubble distribution shown earlier. However, this simulation also shows bubbles 400 µm surviving to the surface, and although bubbles in this size range were (qualitatively) observed in some of the seep plumes at the seabed in the survey video, the surface distribution showed no bubbles of this size range.

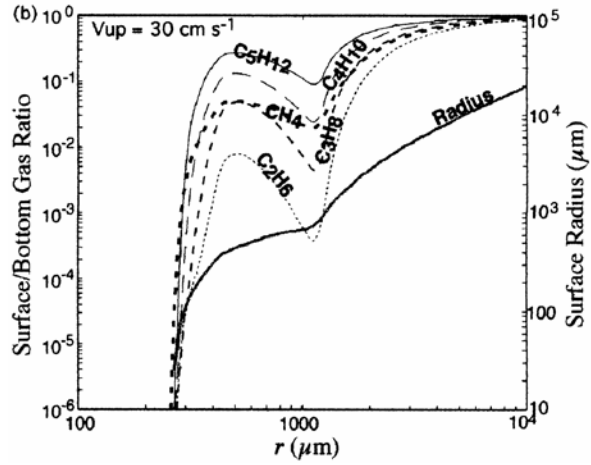


Fig. 7 Sensitivity study showing the predicted ratio of bubble alkane molar content at surface versus seabed as a function of bubble radius, r for an upwelling flow, V_{up} , of 30 cm/s . Also shown is the surface radius on the right vertical axis. Alkane and surface radius labeled on plot.

References

- Leifer I., and R. Patro, 2001. The bubble mechanism for transport of methane from the shallow sea bed to the surface : A review and sensitivity study. *Cont. Shelf Res. accepted*.
- Leifer, I. S., 1995, "A validation study of bubble mediated air-sea gas transfer modelling", Ph.d. Thesis.