1984-85 ANNUAL REPORT

USC SEA GRANT

UNIVERSITY OF SOUTHERN CALIFORNIA
Institute for Marine and Coastal Studies
University Park, Los Angeles, CA 90089

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UNIVERSITY OF SOUTHERN CALIFORNIA
SEA GRANT INSTITUTIONAL PROGRAM

Research, Advisory Services & Education
for
"THE URBAN OCEAN"

UNIVERSITY OF SOUTHERN CALIFORNIA
Institute for Marine and Coastal Studies
University Park, Los Angeles, CA 90089

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INTRODUCTION

Introduction

This report describes the achievements of the University of Southern California's fifteenth year of participation in the National Sea Grant College Program. The Sea Grant program, funded by the National Oceanic and Atmospheric Administration, supports marine research, education and advisory services at universities and institutions in 30 coastal and Great Lakes states.

Sea Grant research is primarily applied research, and USC, like every Sea Grant program, is committed to working with representatives of the public and industry to solve marine and coastal problems of regional importance.

Although Sea Grant programs have similar framework and overall goals, there are individual differences in character. Located as it is in Los Angeles--the second most populous city in the nation--USC Sea Grant supports research that will help to wisely develop resources and solve problems associated with the rapid expansion of population and industry at the edge of the Pacific.

Los Angeles is a city involved with the sea. The Los Angeles-Long Beach port complex is the second largest in the nation. Ocean sports are an important pastime and an important industry in Southern California, because of the generally temperate climate. Nationally-renowned marine industries and facilities add to the picture: Todd Shipyards, the Long Beach Naval Shipyard, Marineland, the Queen Mary, and the Star-Kist and Pan Pacific canneries. Several major outfalls conduct urban waste into the ocean. Southern California has long been and probably will continue to be one of the nation's most important locations for recovering offshore oil.

Few Sea Grant programs so closely confront the opportunities and constraints of the metropolitan environment as does USC Sea Grant. Social and economic aspects of marine resource development have taken on greater emphasis here. It is hoped that USC's efforts in these areas may provide direction for other growing, urban-coastal regions of the nation and world.

"The Urban Ocean" theme of USC Sea Grant is mirrored in the research projects undertaken in

1984-85. There is an analysis of public policies affecting coastal population growth; a study of growth trends of smaller West Coast seaports; and a field study of oceanographic conditions influencing the dispersion of effluent from an ocean sewage outfall. Related to offshore development are two projects--a geological investigation of features on Point Arguello's upper slope, and an engineering analysis of corrosion fatigue in weld metal. Two projects are less explicitly "urban" but are important to marine interests of this region, in this case the shellfish industry. The first is a study of the nutritional importance of dissolved organic material for larval mollusks, and the second is research documenting the validity of the fly bioassay as a test for paralytic shellfish poisoning.

Projects proposed for Sea Grant support run an extensive course of review before funding is awarded. A technical advisory panel makes recommendations to the program managers; academic peer reviewers comment on the professional quality of the work; a panel of state agency representatives comments on the worth of the projects to the state; and a team of scholars and administrators appointed by the federal government reviews the entire program. Members of the IMCS Technical Advisory Panel and the California Resources Agency Sea Grant Advisory Panel are listed at the end of this report.

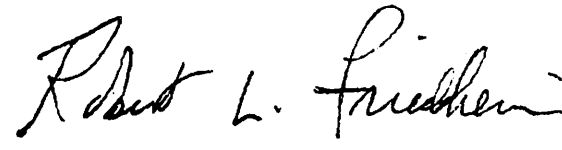
Sea Grant programs are required to match the federal grant with half again as much funding from private, state or local sources. We are pleased to acknowledge the receipt, for 1984-85, of $370,140 in cash or in kind from more than 10 different sources.

USC has continued to place students in Sea Grant internships; in 1985 Jeanne Grasso and Jill Zucker, both graduate students in the Master of Marine Affairs Program, were selected for the Washington, D.C.-area internship program. Grasso worked with the House Merchant Marine and Fisheries Subcommittee on Fisheries and Wildlife, while Zucker joined the staff of NOAA's Office of Oceanic and Atmospheric Research.

The internship program has proven its value, both to the students who gain first-hand experience in the workings of the federal government and to the government offices and legislative committees which benefit from the students' marine expertise.

Such productive interaction and communication also characterize other USC Sea Grant endeavors, such as the 1985 workshop on non-maritime activities of coastal ports and harbors, sponsored jointly by USC Sea Grant's Marine Advisory Program, Louisiana Sea Grant, LSU Ports and Waterways Institute and LSU's Center for Wetland Resources. The workshop is described in the marine advisory section of this report.

It is through such workshops, conferences and informal meetings that Sea Grant-generated information reaches and becomes useful to government representatives, industry officials and citizens. An additional means of communication is through publication of project results, as in the list of USC Sea Grant publications for 1984-85, following the research reports in this document. These will reach an even broader, worldwide audience, increasing the possibilities for stimulating discussion and informed decision-making in relation to use of the oceans.



Robert L. Friedheim
Director
USC Sea Grant Program

Stuart A. Ross
Assistant Director
USC Sea Grant Program

BUDGET SUMMARY

Budget Summary

	Sea Grant Funds	State/Local Match
Program Management		
Administration and Management (M-1)	129,750	38,830
Program Development (M-2)	30,061	6,573
Communications and Publications (M-3)	69,539	15,734
Advisory Services and Education		
Advisory Services and Education (AE-1)	179,333	102,634
Sea Grant Congressional Fellowship (AE-3, 4)	60,000	---
Graduate Student Trainee Program (E/M-1)	45,000	11,250
Living Marine Resources		
Nutritional Implications of Dissolved Organic Material in Seawater for Culturing Oysters (*Crassostrea gigas*) (R/RD-27)	33,234	25,060
Non-Living Marine Resources		
Origin and Distribution of Enigmatic Upper Slope Depressions on the Arguello Slope, California (R/RD-26)	31,099	47,491
Environmental Quality		
Physical and Chemical Oceanographic Variability Near the Los Angeles County White's Point Outfall (R/EQ-40)	39,461	48,601

	Sea Grant Funds	State/Local Match
Environmental Quality, cont'd.		
Problems of Paralytic Shellfish Poisoning (R/EQ-31)	34,691	43,614
Seaports and Marine Transportation		
Small Seaports: An Examination of Selected Attributes and Analysis of Trends (R/CM-30)	15,916	3,652
Coastal Engineering		
Corrosion Fatigue of Weldments in Offshore Structures (R/CE-8)	27,291	11,463
Coastal Planning		
Population Policies in California's Coastal Zone (R/CM-29)	14,625	14,238
TOTAL	$710,000	$370,140

ADMINISTRATION AND MANAGEMENT

Administration and Management

Robert L. Friedheim
Director, USC Sea Grant Program; Associate Director, Marine Policy, Institute for Marine and Coastal Studies; Professor, International Relations, University of Southern California

Stuart A. Ross
Assistant Director, USC Sea Grant Program; Director, Marine Advisory Services, USC Sea Grant Program

The Sea Grant management office has overall responsibility for coordination and direction of research, educational and marine advisory programs of the USC Sea Grant Institutional Program. A number of accomplishments in the area of management, or having program-wide significance, were made in 1984-85:

Cooperation Friedheim and Ross have continued to work with state and local organizations in exploring, defining and meeting marine resource management needs. In 1984, they participated in the development of new guidelines for the state's Sea Grant advisory program, and subsequent USC proposals reflect the new guidelines. The administrators took part in discussions between the Los Angeles County Department of Beaches and Harbors and the principal investigators on R/CM-34, concerning shallow-water diving accidents.

Interaction The USC Sea Grant Program's productive relationships with other organizations are evident throughout this annual report. They resulted in the contribution of substantial matching funds by other universities, industry and government. For the third year in a row, one or more of USC's Master of Marine Affairs students was selected to work in Congress or NOAA as a Sea Grant Intern. The director was named chairman of the university's Marine Programs Executive Committee by the Dean of Natural Sciences and Mathematics. USC co-sponsored, with another Sea Grant program, a national conference on seaport management, and cooperation was renewed with the School of Education.

Management efficiency With the delegation of more of the financial and computer work to the administrative assistant, the director and assistant director have gained time for more substantive tasks. Additional computer facilities and staff training on computers have increased flexibility and control in report preparation, and have improved Sea Grant network communication and monitoring of our finances.

Program Development

Robert L. Friedheim
Director, Sea Grant Program

Stuart A. Ross
Assistant Director, Sea Grant Program

Each year Sea Grant sets aside limited funds for discretionary allocation to research projects other than those that pass through the annual review cycle. The purpose of the program development fund is to allow USC Sea Grant management sufficient flexibility to respond appropriately to circumstances that are not easily accommodated under the annual review cycle.

Projects to meet emergencies, projects that are interesting but not yet fully developed, projects that must begin early or end late, and other discretionary situations can be covered by the program development funds if they promise sufficient contribution to the Sea Grant program. The National Sea Grant office approves all sizeable allocations before execution.

In 1984-85, program development funds were used to support these projects:

1. The third national workshop on seaport management, "Non-Maritime Activities in Coastal Ports and Harbors." Held May 16-17, 1985, in Baton Rouge, LA, this USC conference was cosponsored with the Louisiana Sea Grant College Program, LSU Ports and Waterways Institute and the LSU Center for Wetland Resources. The conference was attended by port managers and commissioners, port researchers, Sea Grant marine advisors and public officials responsible for managing port-related activities. The proceedings of the workshop will be published in 1986.

2. When two Sea Grant investigators needed a water cooling system installed in the Fish Harbor laboratory, Sea Grant agreed to fund its installation.

3. A consultant gave two in-house computer training sessions for Sea Grant staff, and two ram-disks were purchased for office computers.

4. A contribution was made to a Pacific Area Sea Grant College Program conference on sharks.

5. A principal investigator who had proposed unsuccessfully in 1985 received funds for further research on coastal erosion.

6. Funds for interview trips to Washington, D.C., were provided for two USC students who were finalists for Sea Grant Internships.

ADVISORY SERVICES AND EDUCATION

Advisory Services and Education

Stuart A. Ross
Assistant Director, USC Sea Grant
Director, Marine Advisory Services

James A. Fawcett
Seaport Management Specialist

Gilbert E. Lee
Marine Education Specialist

The Marine Advisory Services program assists in integrating Sea Grant research with the community at large. The program endeavors to ensure that groups that use the ocean directly have access to the best available information, while also stimulating awareness of the ocean in groups not now using the resource.

The program seeks to identify and match community needs and university-based information sources. Advisory Services has identified three problem areas related to the urban ocean that need attention and in which we are capable of making useful advances. These are marine recreation, seaports and shipping, and education. A previous major emphasis, coastal planning, has been discontinued. The specialist in coastal planning, James Fawcett, was both qualified and willing to undertake the responsibilities in the area of seaport management and shipping.

The Marine Advisory Services offices are located on campus in the Sea Grant headquarters and off campus at USC's Fish Harbor Laboratory at Los Angeles Harbor.

Marine Recreation

Marine recreation has long been one of the principal attractions of Southern California. Boating, swimming, tidepooling, diving, surfing and fishing all are important here. More than 100,000 boats in Los Angeles County are registered with the state, and the National Coalition for Marine Conservation has estimated the value of marine sportfishing in Southern California to be $953 million.

With such great potential for use of the area's marine resources, Marine Advisory Services works to ensure such use is safe, proper and economical.

Marine Advisory Services has cooperated with the National Weather Service and a volunteer radio operator to establish the area's first Mariner's Reporting Program (MAREP). The operator, a volunteer in Avalon on Catalina Island, records weather observations by mariners in the San Pedro Channel and relays them to the National Weather Service Forecasting Office in Los Angeles.

Sea Grant assists in coordination of MAREP and prepares publicity; a press release resulted in stories in the Los Angeles Times, the Southern California Yachting News, the San Pedro News Pilot, and the USC Transcript. One of the news stories led to a distribution of 200 fliers about MAREP by the Southern California District Coast Guard's auxiliary at its annual convention.

Since 1972, USC Sea Grant has sponsored a series of weekend marine weather broadcasts on KNX-AM, the CBS network station in Los Angeles. Five reporters broadcast 21 live reports each weekend, during daylight hours, providing over 1100 reports each year. The reports cover wind and wave conditions, small craft advisories, and other information for the area from Santa Barbara to San Diego and out 60 miles. KNX radio donates commercial air time for the broadcasts. In addition to the benefits rendered recreational boaters, the radio series has been one of the program's principal sources of visibility.

Boaters and other marine users can phone the Los Angeles office of the National Weather Service and hear a taped message about the local marine weather, available every day of the year, around the clock, updated every three hours. This service is sponsored by Marine Advisory Services, which replaced the old phone answering machine with a newer one in 1984. The system has received 74,600 calls in the past year--on average, more than 200 calls a day.

"Weather to Go Boating," a booklet on marine weather, boat handling, visual distress signals, and other information, is in its fifth reprinting (paid for by the Marina Foundation) and third edition. More than 1900 copies were distributed last year.

A pocket guide to Los Angeles County beaches has been developed and will feature international symbols to indicate facilities at the various recreational sites. This free publication is aimed at the many ethnic and cultural groups found in the Southern California area. A small number will be printed in 1986; funding will be sought for a larger press run.

Seaports and Shipping

Seaports and shipping are essential pathways for the exchange of imports and exports and are important sources of employment, commercial development and revenues in local areas. In Southern California, the combined Los Angeles and Long Beach harbors make up the largest port complex on the West Coast and the second largest in the nation.

Seaport management, which is just now developing as a profession, must address the redevelopment of older waterfront areas, conflicts between commercial development and public access, maintenance of environmental quality, and other challenges. The problems experienced by California ports are common to ports across the country. Marine Advisory Services efforts are directed at investigation of specific problems and supplementing and facilitating communication among port managers.

The program's major activity during 1984-85 was its third national research conference on seaport management, "Non-Maritime Activities in Coastal Ports and Harbors." Held May 16-17, 1985, in Baton Rouge, LA, the conference was cosponsored with the Louisiana Sea Grant College Program, LSU Ports and Waterways Institute and the LSU Center for Wetland Resources.

The conference addressed the problems of smaller, non-maritime ports which, though not engaged in international trade, can have considerable economic impact in a region. Eight topics of discussion were:

- --Offshore support industry
- --Industrial vs. non-industrial uses
- --Self-generated revenues for non-maritime activities
- --Economic role of small, non-maritime ports
- --Community support and public participation
- --Sources of capital for non-maritime activities
- --Fishing vs. recreation and other use conflicts
- --State-local coordination and planning for non-maritime activities

Attendance at the conference was limited to 75 invited participants representing ports, port users, government and academia. While the major purpose was to develop an agenda for research, the conference appeared to contribute in other ways; the academics learned more about practical port management; the port practitioners learned about management approaches they otherwise might not have considered; and these exchanges of information were reinforced by new personal contacts.

Proceedings of the meeting, including recommendations for further research, were edited by conference organizer James Fawcett and LSU's Michael Liffmann. The publication will be available in early 1986.

Research agendas developed in two previous port conferences--one on large, general purpose ports (Los Angeles, 1983) and one on management of smaller maritime ports (Sacramento, 1984)--are now available (see Publications section).

Lectures on current Marine Advisory activities in port management and shipping were given by USC's James Fawcett and LSU's Michael Liffmann during the 1985 Sea Grant Week conference. The sessions were rated the second most useful of those offered, by attending Marine Advisory personnel.

As part of the Council of Sea Grant Directors' initiative on major research issues within Sea Grant, USC Sea Grant was chosen to write the paper on port management and marine transportation. Researched and written by James Fawcett and Stuart Ross, the paper describes current major problems and opportunities of seaport management and marine transportation and summarizes the port-related Sea Grant program activities around the nation. Despite the relatively small size of the national effort, Sea Grant has already had an important impact on the manner in which observers and practitioners think of ports.

Marine Advisory personnel held consultations with local and national maritime officials. Locally, consultations have been held with Robert Kleist, Executive Vice-President of Evergreen Lines; Lee Zitko, Director of Public Relations for the Port of Los Angeles; Sid Robinson, Planning Director of the Port of Los Angeles; Paul Brown, Finance Director of the Port of Long Beach; and Penny Van Dyke, Maritime Consultant. In the national Sea Grant network,

contacts have included Michael Liffmann of the Louisiana Sea Grant College Program, Tom Dowd of the Washington Sea Grant College Program, Dale Baker of the Minnesota Sea Grant College Program, Fred Smith and Gib Carter of the Oregon Sea Grant College Program, and Sea Grant port researchers including Bruce Marti from the University of Rhode Island and Willard Price from the University of the Pacific.

In addition, Sea Grant has given assistance to port managers and government agencies: On December 10, 1985, Stuart Ross testified at a state legislative hearing, concerning a bill to ensure the future availability of space within ports for maritime operations. James Fawcett worked with Fred Smith, Oregon Sea Grant College Program, interviewing port managers regarding the courses and subjects most needed in a Sea Grant-sponsored curriculum development project targeted at West Coast and Pacific Rim port managers.

Marine Education

To better inform Los Angeles-area citizens of ocean resources and of the need for wise development and conservation, the Marine Advisory Services puts a part of its effort into education projects. These are directed mainly at the elementary and secondary schools.

Effective October 1985, the program was headed by a new member of the staff, Gilbert (Gib) E. Lee, in a 60% time position. Lee has 36 years of experience with the Los Angeles Unified School District, serving as teacher, administrator and science specialist. During that time, he participated in some of the applications of USC's materials in the schools.

To reach public school children, the education staff completed a set of six curriculum guides for grades K-6, titled "Wet and Wild." As a result of an agreement with the Evaluation, Dissemination and Assessment Center at California State University, Los Angeles, the guides are now in the publication process; three of the units have been printed, a fourth is at the printer and the remaining two are scheduled for 1986 printing.

In other accomplishments, the education staff has completed, in English and Spanish, two "Marine Studies Idea books." Supplemental materials for children, in Braille and large letters, and teacher training materials, have been prepared.

An on-going effort to introduce the publications to Los Angeles-area schools involves both sending publication lists to school officials and visiting teachers, librarians and administrators to acquaint them with the material.

Graduate Student Trainee Program

James A. Fawcett, Trainee Coordinator

For the past 10 years, the USC Sea Grant Graduate Student Trainee Program has offered students the opportunity to apply classroom knowledge to actual research projects. Students work under the direction of faculty members on Sea Grant-funded research projects and further develop research skills learned in the classroom while working alongside principal investigators.

The program accomplishes several objectives:

1. It provides qualified students with the opportunity to work under the direction of experienced faculty members.

2. It provides students with the opportunity to do marine research that contributes to a master's thesis or doctoral dissertation.

3. It provides Sea Grant principal investigators with qualified students who will substantially contribute to the success of projects.

4. It provides students with experience in their chosen fields to help prepare them for leadership roles in marine research.

The seven Sea Grant trainees chosen for 1984-85 represented a rather wide spectrum of academic disciplines, all with interests in the marine environment. Three trainees--Alexander Andrasi, William Jaeckle, and Mohammed Yazdandoust--are doctoral students in biology. Their research encompassed such questions as the effects of dissolved organic material on the nutrition of nonfeeding invertebrate larvae, and the problems of paralytic shellfish poisoning.

In the Department of Materials Science, Dr. Vedantham Raman, a post-doctoral investigator, worked on a project that investigated the micro-structural, mechanical and environmental factors controlling the rate of fatigue in steel exposed to marine atmosphere.

In another project from the natural sciences, Suzanne Reynolds, a doctoral student in geology, has explored the genesis of enigmatic depressions off the coast of Southern California, making an assessment of the geologic stability of these areas for bottom-resting structures.

In the social sciences, Kathleen West, a doctoral candidate in the School of Urban and Regional Planning, has been looking at the viability of smaller seaports given the rapid changes in maritime shipping technology that have drastically affected the competitive position of smaller ports during the past 20 years. Jael Mongeau, a doctoral student in sociology, examined policy decisions influencing population change and distribution in the coastal areas of California.

Following a long-standing tradition of the USC Sea Grant Program, monthly research seminar luncheons were held to allow the trainees to present their research progress to their trainee colleagues and Sea Grant principal investigators, as well as interested faculty and students. The opportunity provided by these luncheons to share methodology and substance of the research has been of great value to the trainees in refining their research processes and has been useful to the other participants in appreciating the diversity of issues subsumed under the rubric "marine."

At the conclusion of the academic year, Dr. Raman finished his studies and found employment with IBM at the Watson Research Center in New York. Of the remaining six trainees, each is continuing his or her research toward the dissertation. We expect that two of them will complete their studies during the 1985-86 academic year.

LIVING MARINE RESOURCES

Importance of Dissolved Organic Material in Seawater in the Nutrition of Larval Mollusks

The oyster industry on the U.S. West Coast depends on hatcheries for new seed because the Pacific oyster, Crassostrea gigas, does not generally reproduce successfully in these waters. To improve the survival rates of oyster and other mollusk larvae reared artificially, information is needed on (1) their nutritional requirements and (2) how hatchery-induced changes in the chemistry of seawater can affect the survival of larvae. Both questions are addressed in this project.

Most of the organic carbon in seawater is present in the form of dissolved organic material (DOM); carbon in particulate form is present at only one-tenth the concentration of DOM. The major objective of this study is to determine whether larvae can use DOM directly as a source of nutrition.

In his second year of research on this question, USC biology professor Donal T. Manahan has measured uptake rates by mollusk larvae of 16 amino acids, which are representative of DOM found in seawater. Manahan used bacteria-free cultures of oyster larvae in the study. This approach precludes any possibility that bacterial uptake is involved in the DOM removal. Using high-performance liquid chromatography (HPLC), which permits measurement of net flux of multiple substrates into organisms, Manahan found oyster larvae take up 16 amino acids. The neutral non-polar amino acids valine, leucine, isoleucine, methionine and phenylalanine were removed more rapidly than acidic or basic amino acids (Fig. 1).

Manahan has been assisted by USC Ph.D. candidate and Sea Grant trainee William B. Jaeckle. A commercial abalone grower's interest prompted the researchers to study larvae of the red abalone (Haliotis rufescens), as well as Pacific oyster larvae. Jaeckle's studies showed that abalone larvae have a pattern of amino acid uptake similar to that determined for oyster larvae.

Both oyster larvae and abalone larvae were found to release the amino acid taurine into seawater, whether or not amino acids were present in the seawater. This taurine loss also occurs in oyster larvae reared under typical (not bacteria-free) conditions in a commercial hatchery.

Manahan found that bacteria-free oyster larvae are capable of de novo synthesis of the four amino acids methionine, phenylalanine, isoleucine and leucine. This finding is contrary to the widely-held view that these compounds must be supplied in the diet (Fig. 2).

Another unexpected finding of Jaeckle's research was that abalone larvae gain significant weight in the 5-day period between egg release (day 0) and day-2 larvae. Biomass of the organisms increased 600 percent in this period (Fig. 3). This increase occurred despite the fact that the larvae lack a digestive system.

Manahan has also investigated the release of organic materials by algae commonly used as food sources in larval culture. The alga Isochrysis galbana released several of the amino acids (Fig. 4) that can be absorbed by larvae.

Thus, amino acids dissolved in seawater do constitute a potential source of nutrition for mollusk larvae. The importance of these substances to overall larval metabolism and energetics now needs to be assessed. This, and the animals' changing amino acid requirements during development, are the subject of research continuing in Manahan's laboratory in 1986.

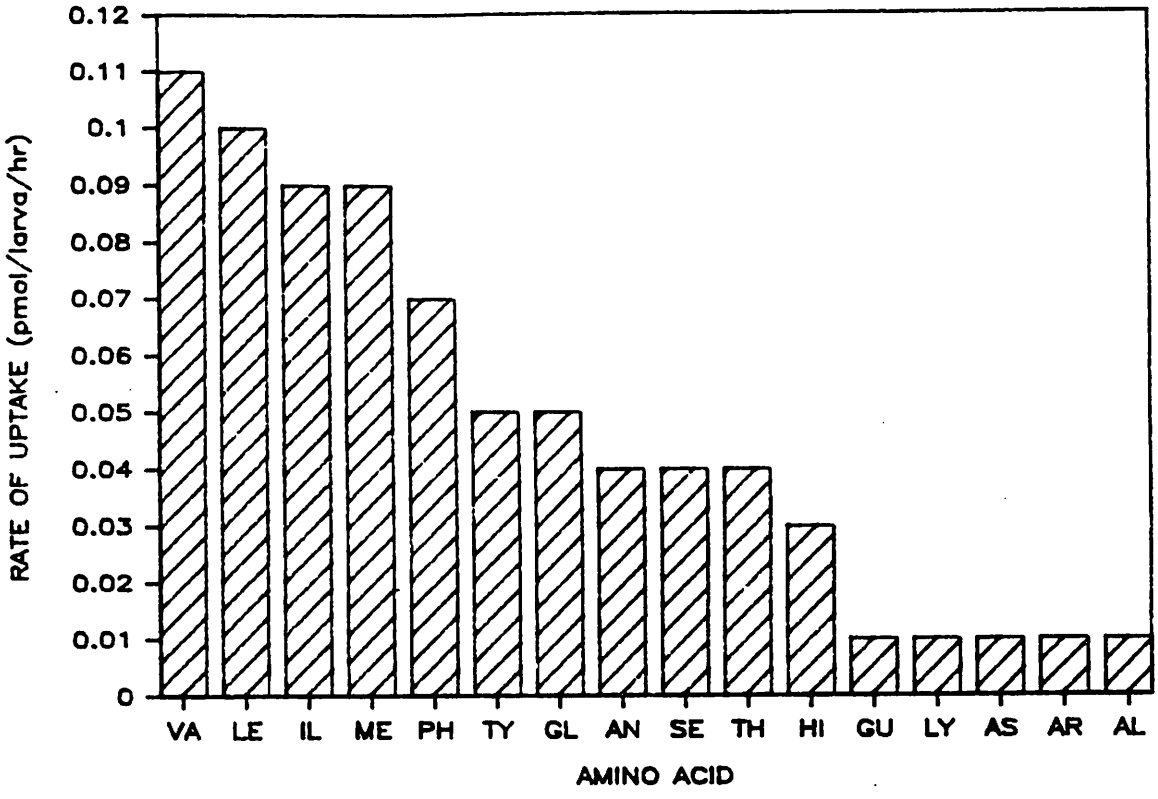


Figure 1. Uptake of amino acids by bacteria-free oyster larvae (Crassostrea gigas). Each amino acid was initially present at 250 nM. Newly-formed D-veligers were used in this experiment at a density of 2586/ml.

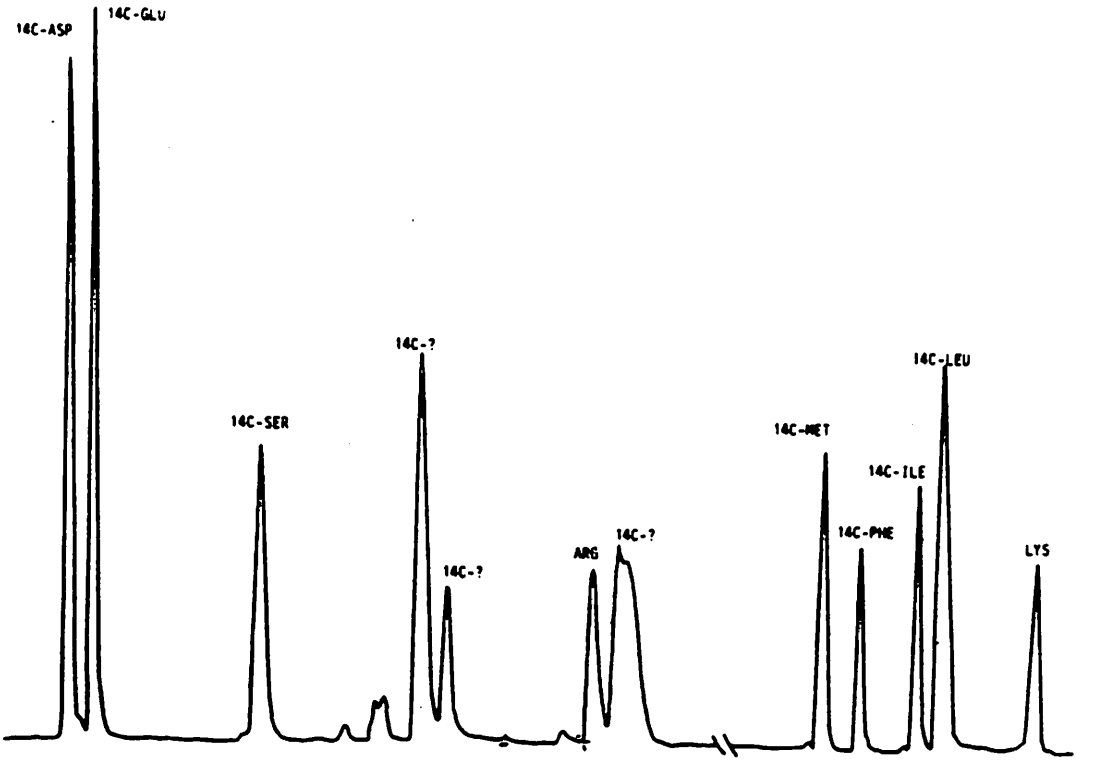


Figure 2. HPLC chromatogram of the amino acids measured in a protein hydrolysate of oyster D-veliger larvae (Crassostrea gigas). Amino acids that have been identified are labeled, and those found to contain radioactivity are labeled "14C-". Bacteria-free larvae were exposed to a 1 uM solution of 14C-glucose for 6 hours. The larvae were then removed, washed free of excess isotope, and the larval protein was hydrolyzed in 6 M HCl at 120 deg C for 2 hours. The sample was passed through a 0.2 micron filter, and the amino acids determined by HPLC. Fractions were collected for determination of isotope.

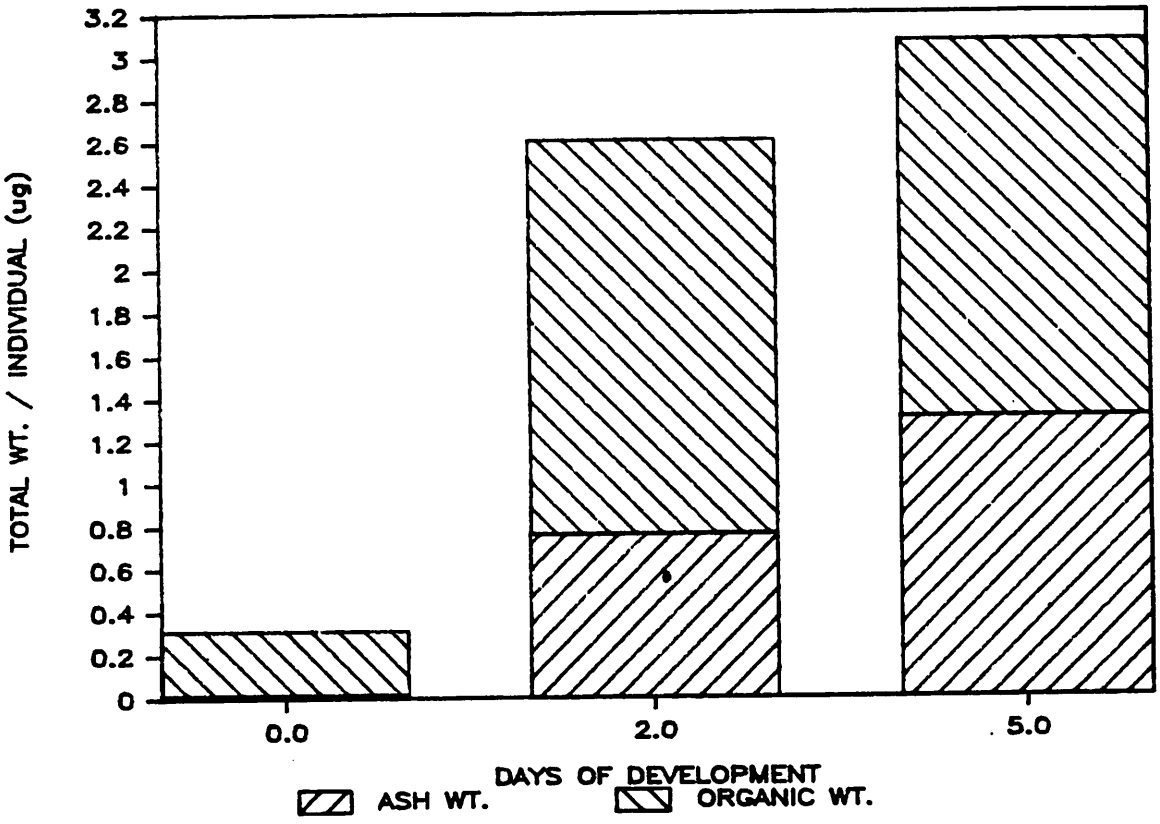


Figure 3. Total dry weight and ash/organic weight of abalone larvae (Haliotis rufescens) cultured (1/ml) for 5 days at 21 deg C. Samples of eggs or larvae were counted, washed in ammonium formate to remove salts, freeze-dried, and weighed to 0.1 ug on a Cahn 29 microbalance. The sample was then placed in a muffle furnace at 400 deg C for 16 hours to remove all organic material. The remaining material (ash) was re-weighed and subtracted from the original total dry weight to determine the organic dry weight of an individual.

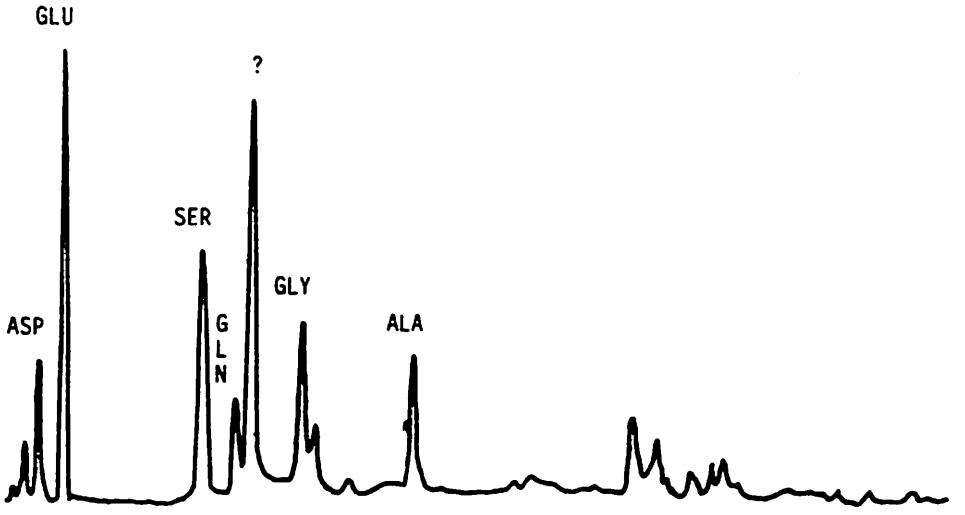


Figure 4. HPLC chromatograms of the amino acids found in a sample of seawater in which the alga Isochrysis galbana had been cultured.

NON-LIVING MARINE RESOURCES

Origin of Arguello Slope's Enigmatic Depressions

Companies searching for offshore deposits of oil and gas must consider potential hydrographic or geologic hazards that could increase the risk or expense of exploration and production. Such considerations led to this study of a series of shallow, channel-like depressions formed in the 200- to 500-meter depth region of the upper continental slope off Point Arguello, California, near an area of potential oil development.

Donn Gorsline, a USC marine geologist; Robert Douglas, USC marine geologist and director of the Center for Earth Sciences; and Sea Grant trainee Suzanne Reynolds, Ph.D. candidate in geology, studied the features, which had been discovered during environmental assessment of the area. Their goal was to determine how the depressions may have been formed and whether the processes involved could pose hazards to offshore oil development.

Sidescan sonar was used to map bottom topography during a five-day cruise in August 1984, covering a larger geographic area than that of the environmental assessment study (Fig. 1). In addition, high-resolution seismic data and 10 box cores were collected to provide information on structure and composition of sub-surface material.

From the data, Reynolds has described the features as downslope-trending "depressions 100 to 200 meters wide, with an average negative relief of 20 meters." The depressions are spaced regularly about half a kilometer to one kilometer apart (Fig. 2). In the larger area that she surveyed, Reynolds found more of the depressions, which appeared to be similar to, though less well developed than, the ones noted originally.

The bulk densities of sediments taken in box cores was high for typical borderland surface sediments, suggesting that this material previously had been buried at greater depth. Because the features contained neither an arc-shaped slump scar upslope nor deposits of eroded material downslope that would typify downslope slumping, this possible cause of the depressions was deemed unlikely.

Rather, the researchers hypothesize that erosion by currents is responsible. The area is marked by sand ripples, and divers working in the area have documented both strong- and moderate-strength currents. Also, the presence of hummocks of older, erosion-resistant material within the depressions suggests that younger material lying on top may have been removed.

The regular spacing of the features offers a clue to the source of the currents producing them, according to Reynolds and Gorsline. They note that beaches may have periodic features caused by rip currents, which are strong and of short duration. They speculate that similar subsurface currents, produced as a result of internal waves rather than surface waves, may be responsible for the features.

They point out that the importance of currents as shapers of continental slope morphology has received little attention in the scientific literature.

Finally, because of the strong evidence that continuing current activity shaped these features and could affect structures built in the area, Gorsline, Douglas and Reynolds suggest that current measurements need to be made in this location before any development work is done.

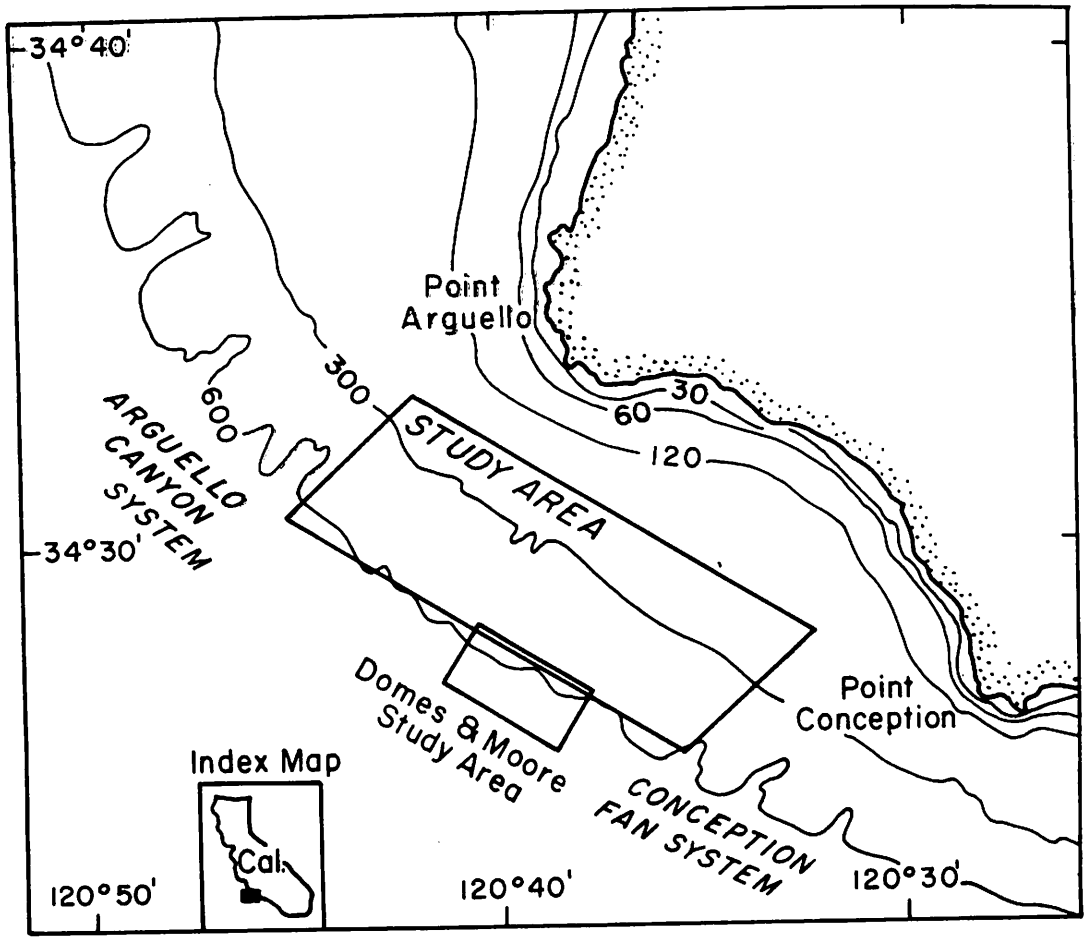


Figure 1. Map of the Point Arguello-Conception area showing location of Dames and Moore study area and present study area. Depth in feet.

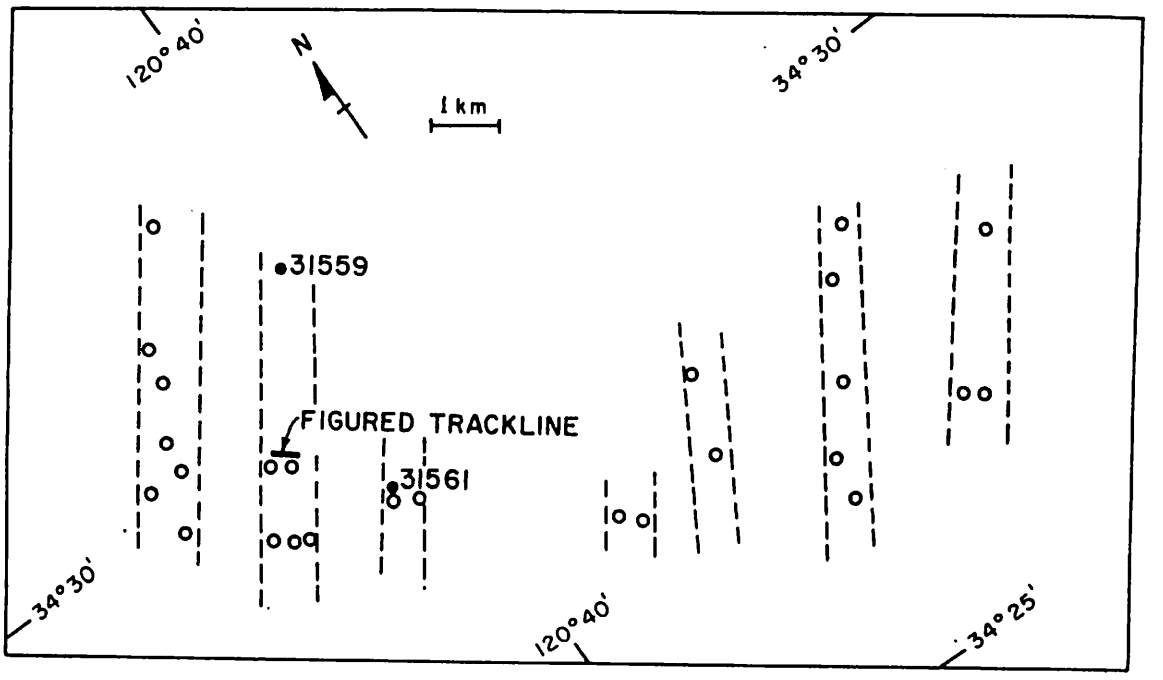


Figure 2. Map of features seen in sidescan data. Circles represent hummock fields and the dashed lines indicate the extent of the depressions. The locations of figured sidescan data and box cores are also shown.

ENVIRONMENTAL QUALITY

Oceanographic Variability Near an Ocean Sewage Outfall

Information about local oceanographic conditions may be important to the operation of sewage treatment plants that discharge effluent into the ocean. At the Los Angeles County treatment plant with ocean outfalls at White's Point on the Palos Verdes peninsula, plant operators need information that will help them determine appropriate levels of chlorination--levels that will result in sufficiently low counts of coliform bacteria at the water surface above the outfall and at nearby beaches. Seasonal and shorter-term variations in ocean conditions can alter the speed and direction of effluent dispersion and also can affect bacterial survival rates, making it difficult to predict chlorination needs.

To characterize ocean variability near the sewage outfalls, an observational program was initiated in early 1985 by USC biologist Burton Jones and USC physical oceanographers Alan Bratkovich and Tommy Dickey. Associate investigators for the project are USC biologists Gary Kleppel and Rudolfo Iturriaga. Assisting with the field program was USC graduate student John Alexander Steele, now a Sea Grant trainee.

A goal of the field studies was to sample the environment on time and spatial scales likely to affect dispersion of effluent from the White's Point outfalls. The study area is shown in Fig. 1.

Field work included intensive hydrographic sampling to measure inorganic nutrients, temperature, salinity, light transmission, plant pigments, and bacterial abundance and growth rate over two weeks in January 1985. In addition, for the four months from January to May, measurements of temperature and current velocity components were taken by current meters on a single mooring two kilometers upcoast from the outfalls. Near surface currents were traced with surface drifters, and wind data were obtained from local meteorological stations.

For a synoptic view of temperatures in the region, the researchers obtained satellite infrared images yielding sea surface temperatures for 51 days distributed over the four-month field season.

Analysis of the late January-early February wind and current data revealed weak correlation between the along-shore windspeed and current components for lower frequency fluctuations (longer than a day) (Fig. 2). The higher frequency current variations appeared to be related to tidal, diurnal heating/cooling, and sea breeze effects.

The researchers found little correlation between fluctuations in currents and temperature. Although currents were not usually persistent, there was some indication of persistence and predictability for temperature over relatively long time periods (about 100 hours).

The surface drifters provided evidence of significant current variability within eight-hour observation periods. Data from the surface drifters will be further analyzed in the second and third years of the project. The rate of separation of pairs of drifters will be used to assess dispersion tendencies of water parcels in this region.

The moored current meter measurements will be used to synthesize pseudo-trajectories and current statistics showing the time it should take fluid parcels to travel certain distances from the outfall. Further analysis of the pseudo-trajectories and the implications of such water movement for outfall effluent dispersion will be completed during 1986-87.

The satellite infrared images yielded several observations about temperature structure of the region over the four months:

--Wintertime sea surface temperature structure between the Palos Verdes peninsula and Santa Catalina Island is weak and highly variable.

--Winter occurrences of upwelling off Palos Verdes can be local and isolated but are more often associated with upwelling along the entire coast.

--Spring upwelling is more frequent and pronounced; there is a pattern of downcoast advection of cooler water displacing warmer water from near shore and creating strong thermal gradients.

Preliminary analysis of the hydrographic data showed that, in winter, inorganic nutrient distributions were related to temperature stratification of the water column; in general, these decreased linearly as temperature increased. However, high ammonium concentrations, low salinity and density, reduced light transmission, and higher levels of phosphate, bacteria and bacterial productivity characterized the water affected by the effluent. Some of the relationships among hydrographic parameters and their variations in relation to the effluent, including a "bottom-hugging" distribution of high-ammonium, lower-salinity water, are evident in Fig. 3.

A useful result is that ammonium appears to be a good indicator of bacterial abundance and productivity (Fig. 4).

The downcoast displacement of both ammonium and bacteria during the January hydrographic sampling agrees with the estimates of downcoast advection derived from current meter measurements.

Day-to-day variability was evident both in the characteristics and spatial distribution of effluent waters. Also, the researchers saw distinct variation in spatial distribution of effluent characteristics within the sampling region on a single day.

Besides local Sea Grant funding, the project was supported by the Los Angeles County Sanitation District. Project investigators meet regularly with Sanitation District officials to discuss progress and results of the work.

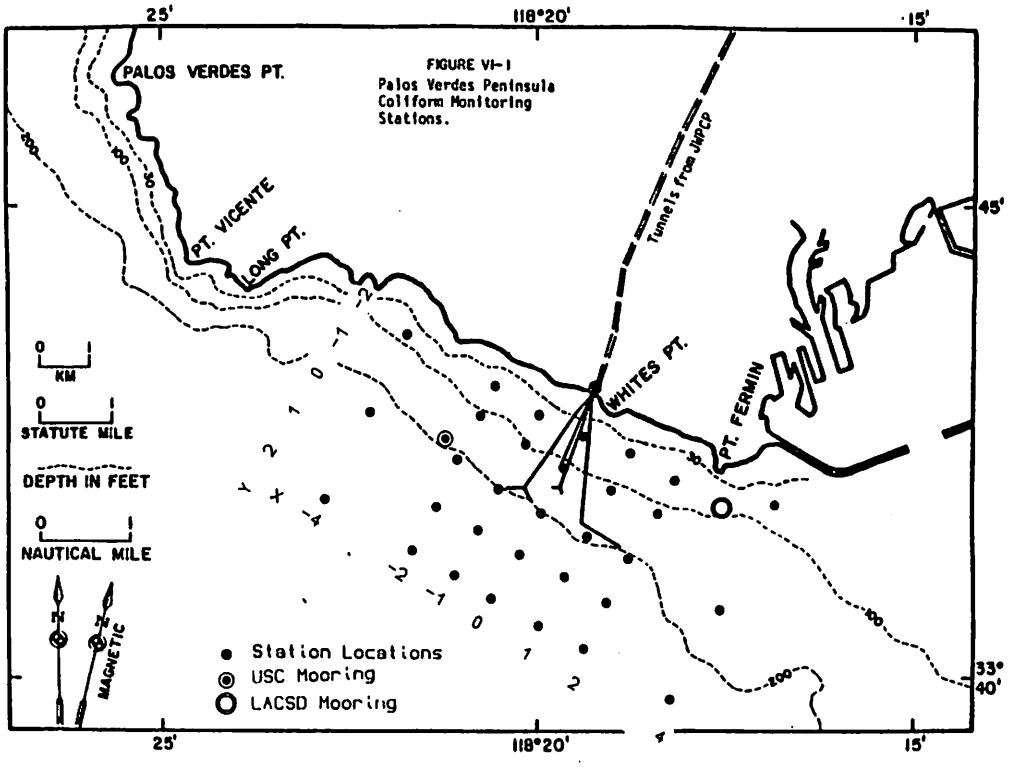


Figure 1. Map of the study region showing the location of the Los Angeles County Sanitation District's outfalls, the station grid used for hydrographic sampling, and the location of the USC current meter mooring.

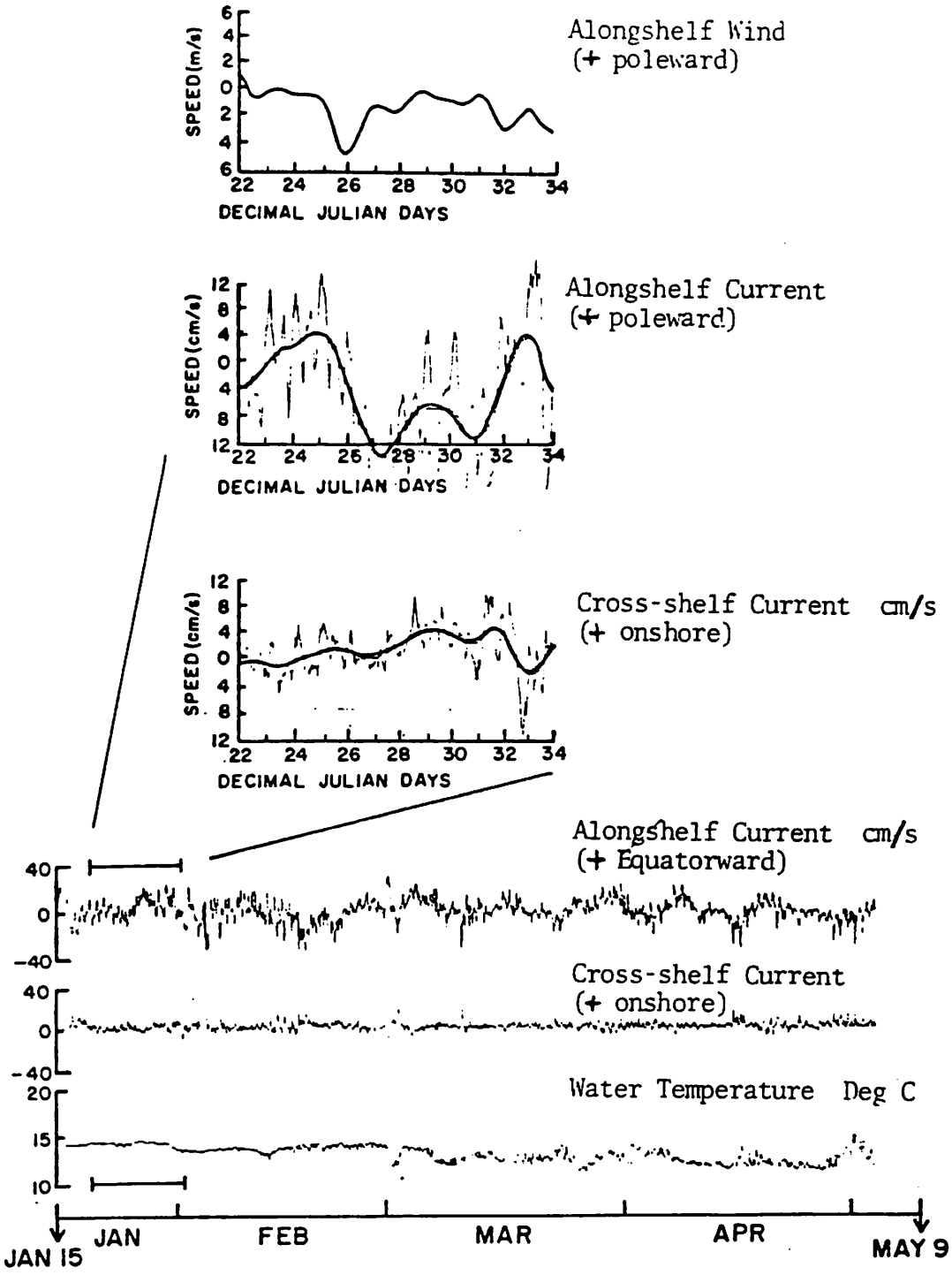


Figure 2. Time series of the alongshelf wind component, alongshelf current component and cross-shelf current component for the period spanning January 22 to February 4, 1985. Wind data are from the Point Vicente weather station. The current data from the instrument deployed at 12 meters depth on the USC mooring are shown in the top frames. The time series of alongshelf current, cross-shelf current and ocean temperature for the entire mooring deployment period sp ıning January 14 to May 9, 1985, are shown in the lower frames.

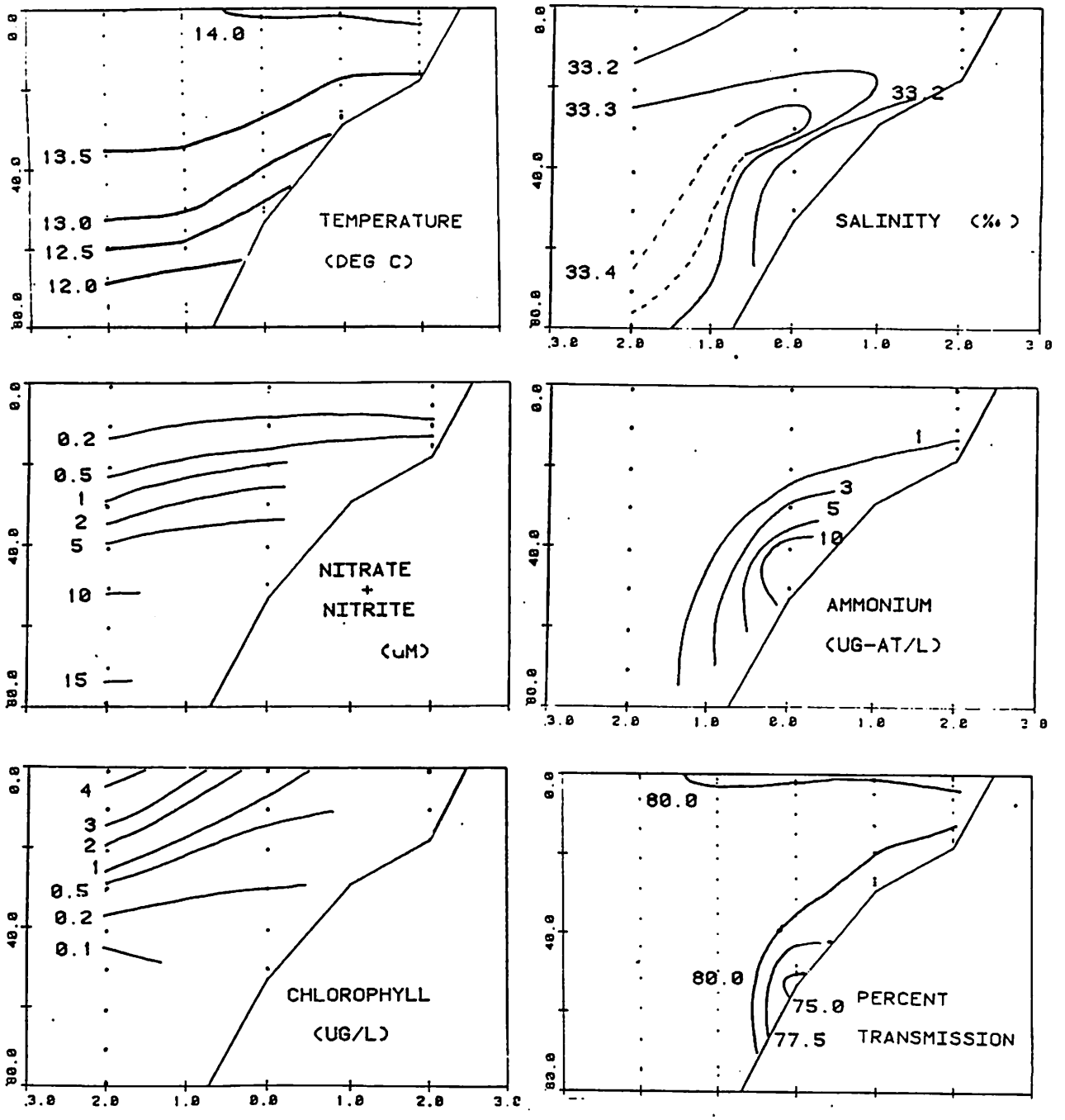


Figure 3. The cross-shelf hydrography section at grid location x=-2 (see Figure 1) on January 28, 1985. Temperature and percent light transmission are from the in situ profile; salinity, nitrate, ammonium and chlorophyll a are from the pump profile.

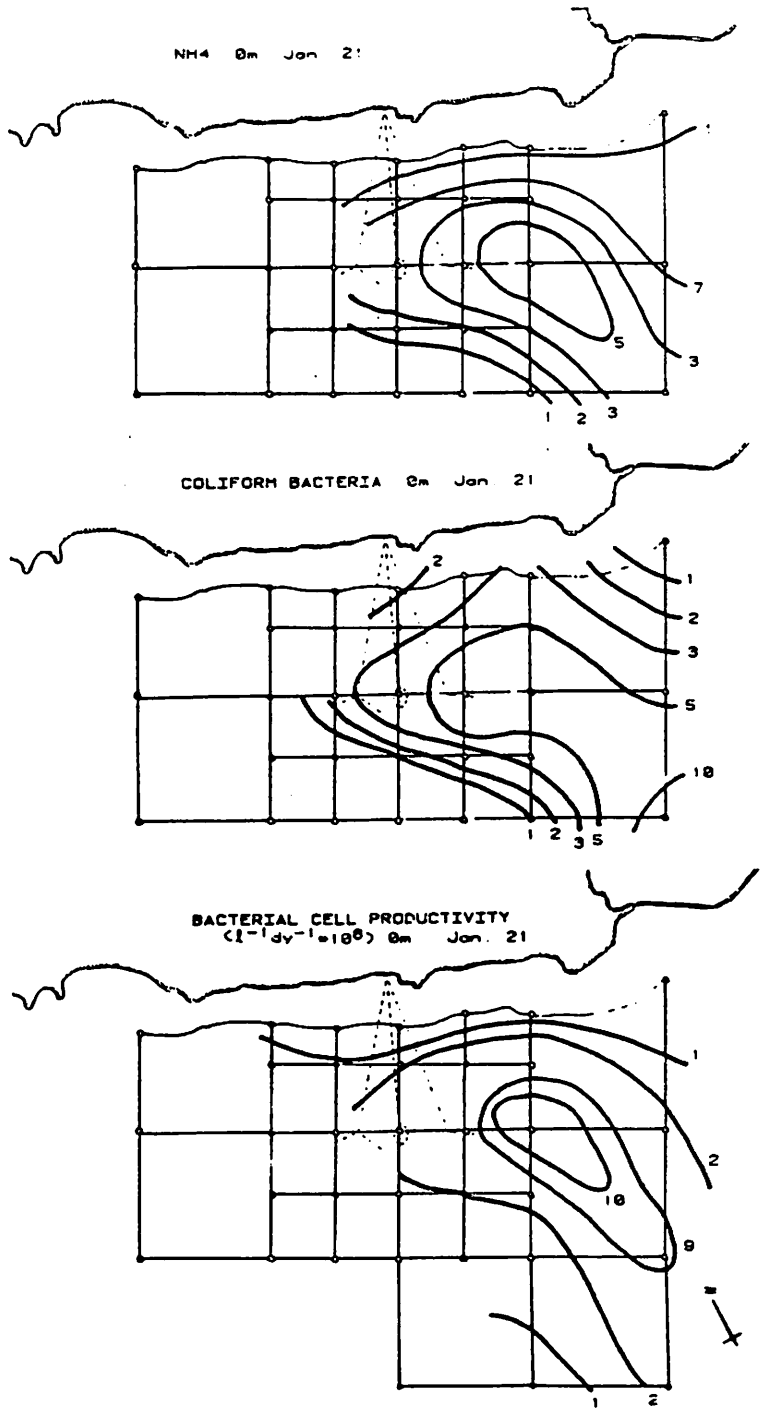


Figure 4. The surface map of ammonium, E. coli abundance and bacterial cell productivity (no. $l^{-1}\,d^{-1} \times 10^{-6}$) from January 21, 1985. This surface map is constructed from the surface samples at the individual stations.

The Fly Bioassay for Shellfish Toxins

Incidents of paralytic shellfish poisoning in humans are the result of consumption of toxin-loaded shellfish. Molluscan shellfish can ingest the marine organisms that produce the toxins without themselves being affected by the toxin. Paralytic shellfish poisoning (PSP) has become not only a national but international problems because blooms of the toxic organisms, called dinoflagellates, occur worldwide.

Because of the hazard to human life, regular monitoring of the PSP levels in commercially harvested shellfish is mandated by state health departments in the U.S., and sales of shellfish are banned when certain threshold levels of toxin are exceeded. Commercially sold shellfish, therefore, do not pose a health hazard from PSP. The deaths that occur are primarily among recreational shellfish collectors, who may ignore the quarantines posted along the shoreline during times when toxicity is suspected. The shellfish industry suffers from the publicity surrounding such fatal events, however, and it incurs the cost of extensive monitoring programs. Recurrences of PSP have sparked a resurgence of interest in this potential hazard in recent years, and new scientific techniques are being used to study the problem.

There is no known antidote to the poison, and there is little likelihood that the toxin-producing organisms can be controlled. Solutions to the problem, therefore, lie in making the monitoring programs less expensive, easier and more credible.

The only bioassay for shellfish toxins that is currently recognized by the U.S. Food and Drug Administration is the Mouse Mean Death Time test. There are a number of disadvantages in using the mouse for monitoring PSP: (1) the difficulties in maintaining a mouse colony precludes using the method in the field; (2) the necessity of shipping samples to a regional testing laboratory leads to critical delays in harvesting decisions; (3) the cost of maintaining mouse colonies is rising dramatically; (4) the use of mammals as experimental animals is receiving increasing criticism by the public; and, perhaps most important, (5) the so-called "salt effect" may

cause the mouse method to seriously underestimate toxin concentrations at low levels.

Sea Grant investigators have developed a new, inexpensive and sensitive test for PSP toxins, using the common housefly, Musca domestica. Use of the fly counters all the disadvantages of using the mouse. USC biologists Bernard Abbott, Alvin Siger and Maria Ross have demonstrated the reliability of the method by performing detailed tests on toxic and non-toxic field samples, and comparing the results with the mouse bioassay and high- pressure liquid chromatography. The overall project goal is to complete the testing of paralytic shellfish toxins using the fly as test organism and to establish this bioassay as sufficiently reliable and sensitive to be legally acceptable.

Two Sea Grant trainees, Alexander Andrasi and Mohammed Yazdandoust, have won awards from the Sea Grant Association for their dissertation research on particular aspects of this problem. Additional support has come from the National Marine Fisheries Service and the National Fisheries Institute.

For the bioassay, individual flies are immobilized by exposure to cold, injected with 1.5 µl of the test shellfish extract, and placed in separate small petri dishes. At 10 minutes after injection, the flies are scored for motor ability. A simple dichotomous scale is used. If the fly moves freely about the plate or can right itself when turned on its back, its score is 0; if not, the score is 1. A fly can be injected or scored within 30 seconds. The procedure is divided into alternating 10 minute segments -- the first for the injection of 20 flies, and the second for scoring -- allowing an assay rate of one fly per minute.

For a sample shellfish extract of unknown toxin content, a coarse series of 10-fold dilutions is prepared, and each dilution is injected into a small number of flies (usually five) to determine the approximate toxicity. On the basis of the results of this series, a dilution is prepared at a level that affects roughly half the flies and is then injected into a larger number (10 to 20) to estimate more accurately the "ED50," the dosage that affects 50 percent of the flies. Comparison with a known standard toxin then yields the toxin content. Experiments with samples of known toxin content have confirmed that the distribution of errors agrees with theoretical expectations. The

degree of error can be controlled because it is inversely related to the square root of the number of flies.

The reliability of the fly bioassay has been demonstrated by repeated assays by several individuals (Table 1). Various injection volumes, fly sample sizes, fly ages, and species of flies have been tried. It has been determined that the age of the fly makes little difference to the results. The following parameters provide reliable results and have become standard procedure in the USC laboratory: injection volume, 1.5 µl; diluent, 1.8 N HCl, pH 3.3; number of flies, 20; age of flies, under two weeks; species, common housefly (Musca domestica).

The toxin used as the standard of comparison is saxitoxin. Its ED50 concentration using the protocol above, was shown to be 0.490 ug/ml for an injection volume of 1 µl, and 0.253 µg/ml for an injection volume of 1.5 µl. The dose-response curve for saxitoxin is shown in Figure 1.

In 1982 and 1984, the USC laboratory participated in the toxic clam study used by the Northeast Technical Services Unit (NETSU), of the Food and Drug Administration, as part of its quality assurance program. Homogenized shellfish samples were provided by NETSU to participating laboratories. Extracts for the fly analysis were prepared in replicate samples by the official method endorsed by the Association of Official Analytical Chemists (AOAC).

The results of the 1984 study are shown in Figure 1 and Table II. Table II includes a summary of the results from laboratories using the mouse bioassay and from one laboratory that used the high-pressure liquid chromatography (HPLC) method. Several aspects of the results require comment. First, the fly bioassay indicated substantially higher toxin levels than did the mouse method (the same result was obtained in the 1982 study). This discrepancy can be explained by the pronounced "salt effect" that obscures the toxin levels in the mouse bioassay but not in the fly bioassay. Second, in both years, the range of results reported by the laboratories using the mouse bioassay varied by nearly a factor of three. This variation is difficult to understand in an officially approved and apparently clear method. Third, the laboratory using HPLC reported toxicity

levels lower than those indicated by the fly method. Since the HPLC analyses are calibrated by the mouse bioassay, it is possible that they may need re-evaluation, in light of these results.

A homogenate supplied by the NETSU and identified by the mouse bioassay as non-toxic was shown by the fly bioassay to contain a low level of toxin. The ease with which the fly bioassay can detect such low levels of toxicity, which are below the threshold for the mouse method, indicates that the fly method can be used to monitor the very early phases of accumulation of PSP by shellfish. In a similar study, mussel (Mytilus edulis) extract that had been identified as non-toxic by the mouse bioassay was shown by the fly bioassay to contain a low level of toxin.

The USC researchers are making an effort to move from the studies with the certified standard saxitoxin to the extracts derived from various species of bivalve mollusks. The chemistry and relative toxicities of various analogues of saxitoxin are also of scientific interest. Recently the USC investigators have begun to study the response of the fly to analogues of saxitoxin. Neosaxitoxin has been found to be, on a molar basis, about 7 percent more toxic than saxitoxin (Figure 2). Several other analogues appear to be more toxic than expected, but these conclusions are obscured by the likely conversion of these compounds to more toxic relatives.

These studies indicate that the fly bioassay is an excellent alternative to the mouse bioassay, because: (1) the standard AOAC extraction method is used and no special training is needed; (2) the fly responds to all of the toxic compounds, so no further chemical manipulation of the extract is necessary; (3) the assay can be done in the field at harvesting sites; (4) only a small amount of shellfish meat (about 10 grams) is needed; (5) the shellfish industry will be able to monitor its own shellfish beds and be able to harvest before dangerous levels of accumulation are reached, thereby avoiding major losses; (6) the PSP concentration is not underestimated at any level, as is possible with the mouse bioassay; (7) the assay provides information on the total biotoxicity of the melange of the naturally occurring toxins.

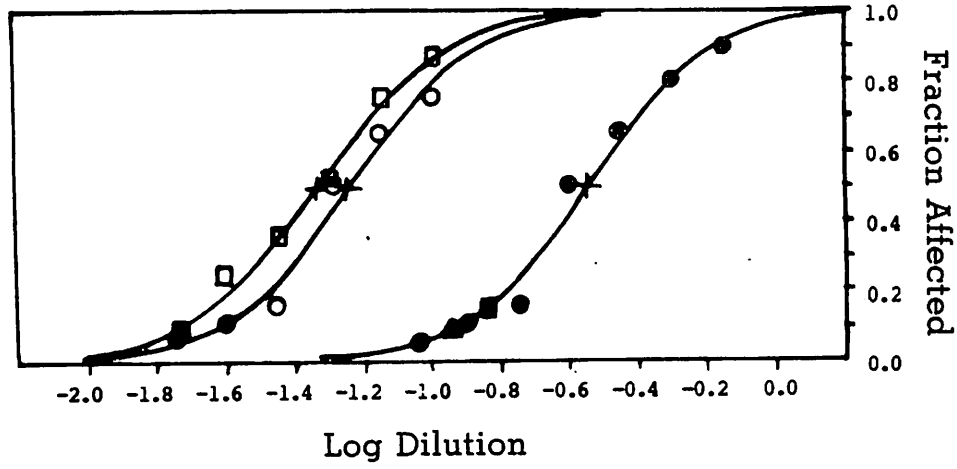


Fig. 1. Fly Bioassay Dose-Response Curve. NETSU STX standard (1 ug/mL) ; Toxic homogenates A1 ○ , A2 □ , B1 ■ , B2 ▲ ; dose volume 1.5 uL/injection; diluent 0.18N HCl pH 3.3; animal species Musca domestica; ED50 (50% effective dose 0.285 ug/mL or 428 picograms/fly. Results are from the 1984 study.

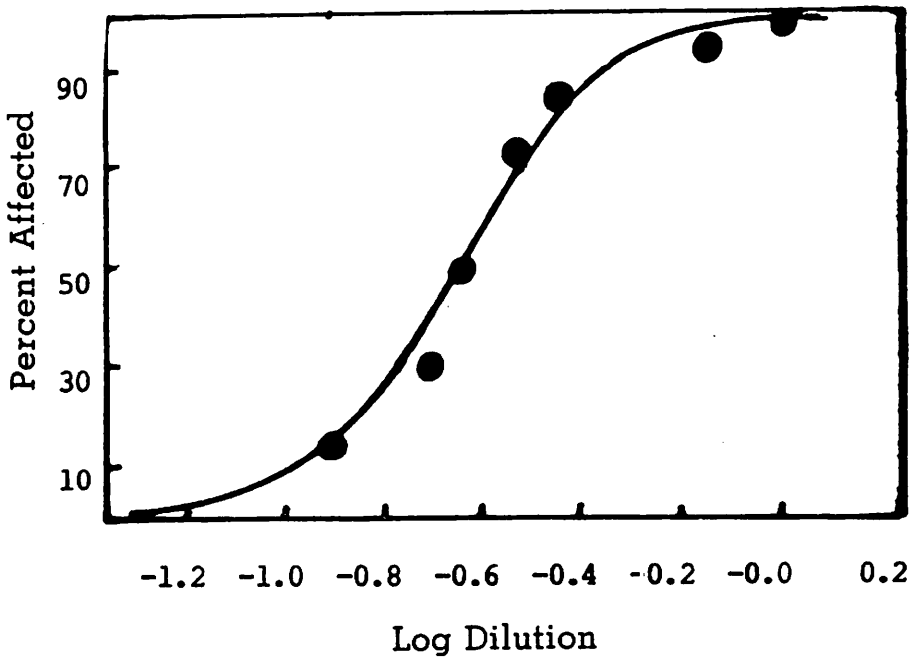


Fig. 2 Fly Bioassay Dose-Response Curve for Neosaxitoxin standard (1 ug/mL. Animal used: the house fly, Musca domestica; injection volume 1.5 ul; diluent 0.03M Acetate pH 3.3; ED50 (50% effective dose) 0.227 ug/mL or 340 picograms/fly.

Table I. FLY BIOASSAY RELIABILITY STUDY

Individuals	ED50 (µg/mL)	ED50 (pg/fly)	Flies inj. /dil.	Fly age (days)
A	0.285	428	20	1-14
B	0.250	375	40	1-14
C	0.243	366	30	1-5
D	0.237	356	30	10-15
E	0.252	378	20	1-20
ED50 mean	0.253 $\pm$ 0.019 µg/mL		381 $\pm$ 27.85 pg/fly	

Calibration study with FDA certified Saxitoxin (STX) standard; dose volume per fly 1.5 µL; diluent 0.18N HCL pH 3.3; scoring time 10 minutes after injection.

Table II. NETSU* 1984 TOXIC CLAM SPLIT SAMPLE
PSP BIOASSAY

		Toxin Concentration (µg/100g tissue)				
Assay Method	N (sample A)	A1	A2	B1	B2	N(B)
"Mouse Bioassay" Laboratories	16	658 ±201	662 ±195	<36 ±<7	<37 ±<7	15
USC Fly Bioassay	1	983	1220	23	30	1
FDA HPLC**	1	798		<36	<36	1

*NETSU - Northeast Technical Services Unit, FDA. NETSU in-house estimate 660 µg/100g meat.
** HPLC - High Pressure Liquid Chromatography for estimating PSP in shellfish extracts. Chromatographed analogues are oxidized and detected by their fluorescence.

The average of the 16 participating laboratories performing the bioassay was derived from a range of values as follows:

Sample	Range
A1	362-1072
A2	375-1142
B1	<28-<58
B2	<28-<58

The threshold level regarded as dangerous is 80 ug per 100 grams of tissue.

A1 and A2 are replicate extractions from the same sample. B1 and B2 are also replicate extractions from the same sample.

SEAPORTS AND MARINE TRANSPORTATION

Smaller West Coast Seaports: Recent Trends Examined

In the period from 1967 through 1982, when larger West Coast seaports were handling increasing tonnages of cargo each year, growth at many of the smaller West Coast ports (those handling less than 10 million tons of cargo yearly) appeared to have halted or actually to be declining.

Willard T. Price, professor in the School of Business and Public Administration at the University of the Pacific in Stockton, CA, has initiated a study of the smaller ports. His objective is to determine whether changes in growth are occurring at the smaller ports, whether such changes have affected the financial health of the ports, and whether the port managers have developed new strategies to cope with the changes. Sea Grant trainee Kathleen West, a Ph.D. candidate in USC's School of Urban and Regional Planning, has participated in the project, collecting and examining cargo and revenue data.

The researchers chose for study 13 smaller West Coast ports:

In California: San Diego, Port Hueneme, Redwood City, San Francisco, Richmond, Stockton, Sacramento, Humboldt

In Oregon: Coos Bay, Astoria

In Washington: Vancouver, Kalama, Longview

Price and West collected three types of data:

* Cargo data—including total cargo, non-petroleum cargo and market share--were obtained from U.S. Army Corps of Engineers waterborne commerce reports for 1977-1983.

* Financial information was requested from the ports regarding gross revenue and maritime revenues; total debt, annual new debt, debt service and net worth; annual total expenditures and capital expenditures; net revenues/surplus and general tax subsidy. Using these data, Price computed a simple annual performance index to measure the extent of fiscal stress of the ports.

* Managers of 12 of the ports (excluding Vancouver, WA) were interviewed regarding their use of the following strategies: Marketing old and new cargoes/services; shifting to new land uses and services; using the private sector in port development and operation; divestiture of facilities and land; and other management strategies or policies to ensure financial viability.

Price and West observe that while the smaller ports continue to handle such basic cargo as dry bulk and neo bulk, they are not taking part in the West Coast's growth in volume (Fig. 1). Waterfront space and maritime facilities show substantial underutilization, and some divestiture of facilities and land has occurred. Smaller ports, therefore, could theoretically attract cargo from more crowded larger ports, but there is no evidence that this has happened.

Preliminary examination of the financial data reveals that many smaller ports experienced increased fiscal stress during the period 1982-84, but were coping with this stress and surviving in the non-growth environment. Price notes that the ports have been making the necessary policy choices to maintain their financial viability, including expenditure control and revenue generation. Some depletion of assets and net worth has occurred; however, revenues for most smaller ports stayed even or increased, partially aided by inflation of service fees.

Nearly all the smaller ports surveyed for the period 1977-85 had experienced net losses in some recent years, yet none seemed to be experiencing continued, long-term losses. The ports used (or sold) assets to compensate for the losses and had reduced expenses and debt costs. The vast majority of ports had reduced their long term debt and controlled the associated annual debt service costs.

Some managers reported retrenchment of services while others had added activities. Two ports, San Diego and San Francisco, had added non-maritime use of space as a means of subsidizing continuing maritime uses.

No port in the survey had experienced any significant decline in its net worth. Price observes that, in effect, these smaller ports have remained as viable public enterprises. Washington and Oregon ports continue to receive general tax subsidies, but these subsidies have not increased substantially as the ports felt fiscal stress.

Price expects to write one or more research papers based on further analysis of the data. He will address the hypotheses posed initially, draw conclusions concerning the health of the ports, and develop additional research priorities for smaller maritime ports, both on the West Coast and nationwide.

Abbreviations for Ports, Figure 1, listed south to north:

STATE	SMALLER PORTS	LARGER PORTS
California	San Diego--SD	Long Beach--LB
	Port Hueneme--PH	Los Angeles--LA
	Redwood City--RC	Oakland--OL
	San Francisco--SF	
	Richmond--RM	
	Stockton--ST	
	Sacramento--SC	
	Humboldt--HB	
Oregon	Coos Bay--CB	Portland--PL
	Astoria--AS	
Washington	Vancouver--VC	Tacoma--TC
	Kalama--KM	Seattle--SE
	Longview--LV	
	Olympia--OP	
	Everett--EV	
	Port Angeles--PA	
	Port Townsend--PT	
	Anacortes--AC	
	Bellingham--BH	

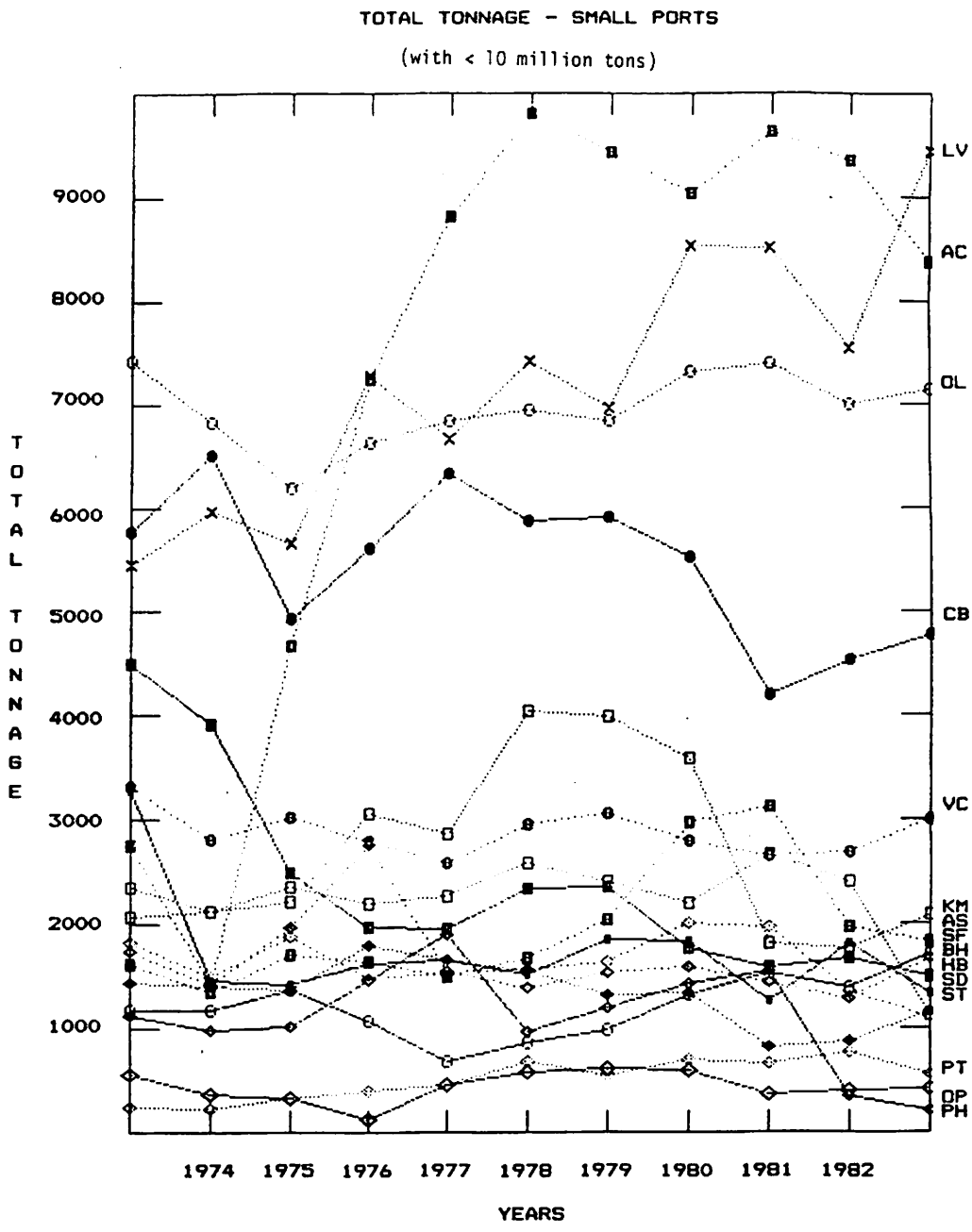


Figure 1. Total Tonnage, West Coast Smaller Ports

COASTAL ENGINEERING

Corrosion Fatigue of Weldments in Offshore Structures

Corrosion fatigue is a problem for steel structures subjected to the cyclic stresses of the marine environment. Offshore drilling platforms, deep sea pipes, and submarine hulls all contain welded joints which, although protected by cathodic polarization, nevertheless may suffer corrosion fatigue crack growth, and welded nodes may even fail.

To increase our understanding of corrosion fatigue, Judith A. Todd, professor in USC's Departments of Materials Science and Mechanical Engineering, has conducted a study of the propagation of corrosion fatigue cracks subjected to stresses at low frequency.

How corrosion fatigue cracks begin, and what roles are played by metal dissolution, corrosion debris, cathodic hydrogen and weld residual stresses, are not well understood for the marine environment. There is particular need for studies of long-term crack propagation in the slow- to mid-growth regime, according to Todd.

Determining what mechanisms control the rates of crack propagation in weldments--units composed of pieces welded together--should enable Todd to model the process. Her long range goal is to develop weldments with refined microstructures and lower residual stresses which would perform significantly better in the ocean than weldments currently in use.

In this second year of research, Todd, working with post-doctoral scholar Vedantham Raman of USC's Department of Materials Science, tested crack propagation rates of base plates and weld metals at two frequencies, 20 Hertz (cycles per second) and 2 Hz, in air. The researchers also examined the microstructures of the base plates and welds, and the corrosion deposits formed on them, using optical and transmission electron microscopy.

The material studied was ASTM A710, a type of high-strength, low-alloy (HSLA) steel. Submerged arc welds, with and without powder additions, were prepared. Microscopy showed that the base plate contained a heavily dislocated ferrite with precipitates on the dislocation lines. The welds were

found to have narrower heat affected zones (HAZ) and more refined HAZ microstructure, as the powder content was increased. The HAZ contained bainitic (containing packets of ferrite laths) microstructures and the weld metal was also bainitic.

Initial crack propagation tests were conducted in air at 20 Hz frequency and a stress ratio of $R = K_{min}/K_{max} = 0.1$. Crack lengths were monitored optically. By subjecting the base plate to decreasing loads, and plotting crack growth rates per cycle as a function of stress intensity range, the threshold stress intensity range was determined to be approximately 7 Ksi $in^{1/2}$ (Ksi = 1000 pounds per square inch), a value which compares favorably with similar strength HSLA steels, indicating satisfactory test procedure (Fig. 1).

Todd and Raman repeated the tests at 2 Hz, a frequency which T. Gooch of the Welding Institute in England advised them would have greater effect on near-threshold crack propagation rates. At this frequency, the threshold stress intensity range for the base plate drops to approximately 6 Ksi $in^{1/2}$, and for the weld metal drops to approximately 5 Ksi $in^{1/2}$; i.e., the crack growth rates are higher in weld metal than in base plate (Fig. 2). However, the difference in threshold K_o is not large.

Rather than rely on optical monitoring for the 2 Hz tests, the researchers used a d.c. potential drop system which measured the resistance change of the test sample as the crack extended.

Fracture surfaces of the base plate and weld metal, tested in air at 2 Hz, were compared. The base plate had a greater amount of oxide than did the welded sample.

Todd is now applying the near-threshold corrosion fatigue tests to base plate and weld metal in seawater, and she will conduct similar tests on cathodically-polarized steel.

In addition to USC Sea Grant support, the National Association of Corrosion Engineers (NACE), recognizing the importance of this research area, awarded Todd's program one of its two National Seed Grant awards for 1983-84. Other contributions were $30,000 for an electronic console from Rockwell International and an IBM PC-XT from USC's Project Socrates.

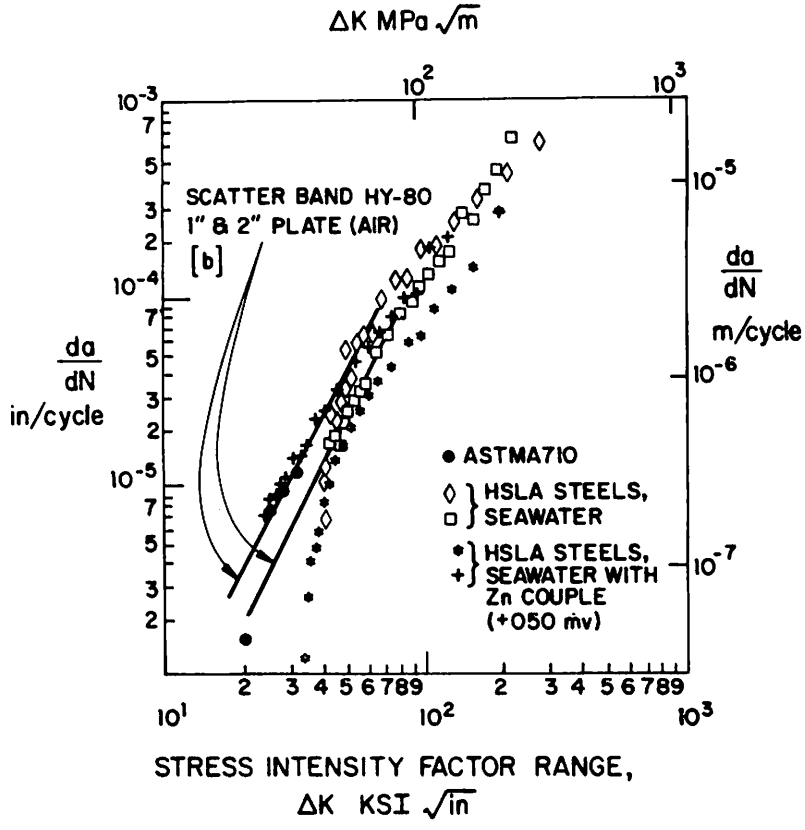


Figure 1. Comparison of crack growth rate data for ASTM A710 with other similar-strength commercial steels.

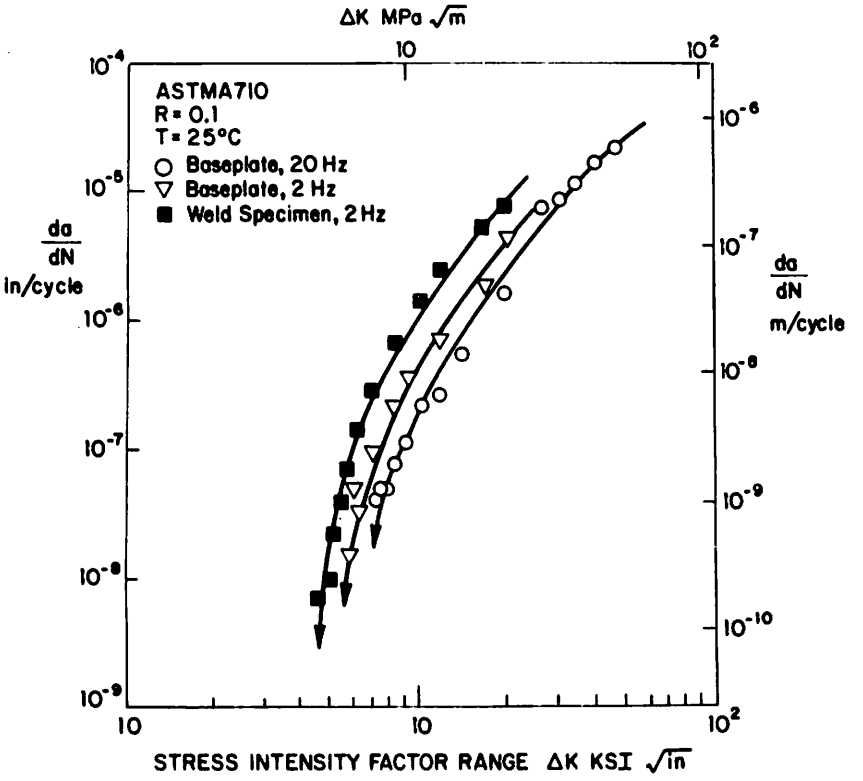


Figure 2. Comparison of near-threshold fatigue crack propagation data for ASTM base plate at 20 Hz and 2 Hz with weld metal tested in air at 2 Hz, R = 0.1.

COASTAL PLANNING

Policies Affecting Growth of California's Coastal Population

The population of California's coastal and inland waterway counties continues to grow, and with the growth come changes in land use, environmental quality and natural resource availability. A variety of public policies are available which can be used to direct and control population growth, but there is a need for an evaluation of their effectiveness before they can be coordinated.

Sociologist Maurice Van Arsdol, director of USC's Population Research Laboratory, has undertaken an analysis of the impact of different policies on population growth in California's coastal areas. Working with Van Arsdol are Margo Koss, a 1983-84 Sea Grant trainee, and 1984-85 Sea Grant trainee Jael Mongeau, both doctoral candidates in sociology.

The researchers identified nine general types of policies related to population change: 1) zoning and land use regulation of private land; 2) public ownership of land; 3) infrastructure planning and investment; 4) housing policies; 5) taxation policies; 6) environmental and social regulation; 7) explicit population growth promotion/limitation; 8) population projections; and 9) economic development.

To evaluate the effects and importance of these policies, Van Arsdol and his associates interviewed 20 representatives of county and city planning departments, regional associations of governments, and other government authorities. Their "snowball" sampling of experts started with persons suggested by Sea Grant staff and was extended to individuals suggested in the initial interviews.

Those interviewed were asked to:

1. Identify policies intended to promote coastal growth and those intended to limit it, and note the most effective ones;

2. Evaluate the use of population projections in the formulation of coastal population policy;

3. Evaluate the effects of such projections on population growth and distribution;

4. Identify land use policies affecting population;

5. Evaluate how population changes are taken into account in formulating coastal housing policies;

6. Evaluate effects of transportation policies, economic development policies, and environmental quality policies on population change in coastal areas; and

7. Consider whether population growth and distribution should be taken into account incoastal policies.

Preliminary analysis of the interview data has enabled Van Arsdol, Koss and Mongeau to make a number of observations about policies affecting population growth in coastal areas:

* Population growth policies are often not established until areas are densely settled, then preservationists tend to work to control growth. Citizen involvement in formulating coastal policies varies greatly with coastal area.

* Representatives of concerned agencies tend to focus on environmental problems rather than on population issues which affect the environment. Planners state that they do not formulate or implement population policies. However, some organizations use population projections relating to facilities and infrastructure development. For example, population projections are used to determine future housing needs for elderly, low income, or other population segments.

* A few respondents, but not the majority, regard population forecasts as having a self-fulfilling effect.

* Land use policies that influence coastal population growth include: fixing rural-urban limits, agricultural zoning, flexible zoning, establishing urban reserves, upscaling residential zoning near industrial parks, green belt preserves, coastal zone plans, downzoning and conditional zoning.

* Transportation policies affect coastal population change by facilitating or inhibiting access to or movement along the coast; however, transportation policies, like policies for other infrastructures, are designed to serve existing or projected populations, not to influence coastal development.

* Proposition 13, which withdrew many public services, affected population composition of new housing developments in both coastal and non-coastal areas. The requirement that some developers purchase infrastructures to serve new housing tends to encourage development of middle- and upper-income housing, rather than low-income housing.

* Environmental quality policies tend to limit growth, because population growth impacts the environment. Limiting growth in some areas deflects it elsewhere to more accommodating areas.

The sociologists will use these and other results of the interviews to refine the inventory of coastal policies and to select policies for use in modelling population changes. Projections of the populations of coastal counties will be made using assumptions that follow from these analyses.

These projections will be useful to policymakers needing information on population effects of alternative policies. Those who could benefit include housing planners and developers, recreation agencies, local governments planning coastal infrastructure development, taxing agencies and businesses concerned with local markets.

APPENDIX

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